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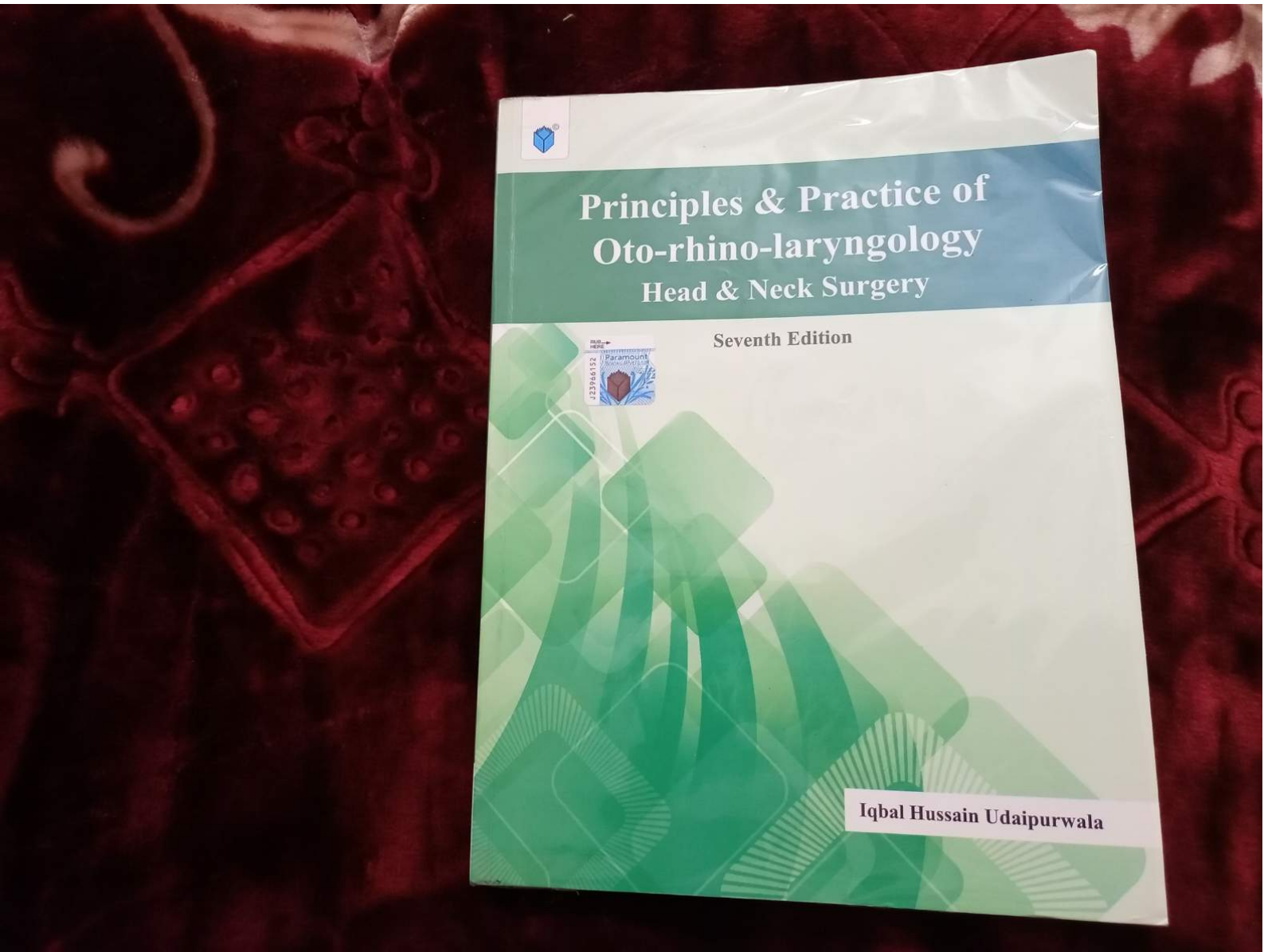
Principles & Practice of
Oto-rhino-laryngology
Head & Neck Surgery
Seventh Edition
Iqbal Hussain Udaipurwala

Principles and Practice of Oto-rhino-laryngology
by
Iqbal Hussain Udaipurwala

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Dedicated to

My parents, family members, colleagues, patients and students.

Preface to the Seventh Edition

It gives me immense pleasure to present seventh edition of this book. A lot of changes have been made in this edition. I am thankful to all who supported me in any form and who encouraged and promoted this book.

There was an immense need for a concise and precise book of ENT diseases for the undergraduates of our region. This stimulated me to write a textbook, which is concise and written in simple and easy language. This book covers the curriculum of ENT diseases, which most universities of our country are following for undergraduate medical studies. It meets the requirement, which a medical graduate ought to know regarding ear, nose and throat. Special emphasis is given to the diseases prevalent in our region. Unnecessary details regarding surgical procedures and rare diseases have been avoided. I hope students will find it very useful in their preparation for examination in ENT. In addition, general physicians and postgraduates will also find it useful for quick reference in their routine ENT practice.

In each chapter, important and particular points are mentioned in a tabulated form for easy revision, in addition to its detail in running text. At the end of each chapter, concise chapter summary and key points are given in the form of highlighted text and a brief description of difficult words used in the chapter. Many changes have been done in this edition, photographs and X-rays have been added and format of few chapters have been changed.

By no means it is perfect and there may be some ambiguity in the text. Your suggestions and criticism are always welcome to improve the standard of this textbook.

Iqbal Hussain Udaipurwala

Acknowledgement

This book could not have been accomplished without the help and assistance of many people. I would like to express my sincerest gratitude to all my teachers and colleagues who gave me valuable guidance and suggestions in writing this textbook.

My special thanks goes to Dr Muhammad Shuja Farrukh, Professor of ENT, Dow University of Health Sciences, Karachi who gave me his utmost support and full-time assistance in proofreading the manuscript several times, as indeed in seeing it in the form of a print. I am thankful to Dr Muhammad Sajid Abbas Jaffri, Professor of Medicine, Bahria University Medical and Dental College for his support in preparing and repeated checking of BCQs. I am very much obliged to the entire staff of Paramount Books (Pvt.) Ltd. for their heartiest support and care during the publication of this book.

I am much grateful to my wife Azra Iqbal Hussain for her enormous support and untiring efforts at every step of this work, without whom it would not have been possible to make this idea into a reality. I am especially thankful to my daughter Dr. Fatima Iqbal Hussain, who proofread the text many times. I am also thankful to my daughters, Saba Iqbal Hussain and Zahra Iqbal Hussain for their help and cooperation.

My final note of thanks is for my alma mater, Dow Medical College, Karachi, which has been the seat of learning for me for nearly four decades.

Iqbal Hussain Udaipurwala

Contents

Lesson Objectives

COURSE: DISEASES OF THE EAR

At the end of this course, the student should be able to:

1. Describe applied anatomy of the ear.
2. Describe applied physiology of hearing and balance.
3. Enlist differential diagnosis of the symptoms related to ear:
   a. Earache.
   b. Deafness.
   c. Discharge.
   d. Vertigo.
   e. Tinnitus.
   f. Itching, swelling and deformity.
4. Identify and interpret each type of audiogram.
5. Identify and interpret each type of tympanogram.
6. Describe the significance of speech audiogram report.
7. Describe the significance of BERA report.
8. Identify and name different congenital malformations of the ear.
9. Identify and describe types and management of different injuries to the ear.
10. Describe types and management of foreign bodies in the ear.
11. Identify and name different types of otitis externa.
12. Describe etiology, pathogenesis, complications and management of otitis externa.
13. Identify and name different types of otitis media.
14. Describe etiology, pathogenesis, complications and management of different types of otitis media.
15. Describe clinical features, complications and management of wax in the ear.
16. Identify and diagnose a case of maggots in the ear.
17. Describe types, clinical features and management of the ear neoplasia.
18. Describe etiology, pathogenesis, clinical features, and management of otosclerosis.
19. Describe etiology, pathogenesis, clinical features, and management of Meniere's disease.
20. Describe types, etiology, pathogenesis, clinical features, and management of labyrinthitis.
21. Diagnose and identify site of lesion in a case of facial paralysis.
22. Describe types, etiology, pathogenesis, clinical features, and management of facial nerve paralysis.
23. Describe causes, clinical features, prevention and management of sensorineural deafness (ototoxicity, noise induced hearing loss and presbycusis).

COURSE: DISEASES OF THE NOSE AND PNS

At the end of this course, the student should be able to:

1. Describe applied anatomy and physiology of the nose and PNS
2. Enlist differential diagnosis of common nasal symptom:
   a. Nasal obstruction, discharge, postnasal dripping.
   b. Sneezing, snoring.
   c. Epistaxis.
   d. Rhinolalia.
   e. Disturbances in sense of smell.
   f. Facial pain, headache.
   g. Nasal deformity, swelling.
3. Identify and diagnose common congenital malformations of the nose.
4. Describe management of common congenital malformations of the nose.
5. Describe causes, types and management of nasal injuries.
6. Enlist causes of epistaxis.
7. Describe management of epistaxis.
8. Describe pathogenesis, clinical features and management of deviated nasal septum (DNS)
9. Identify and diagnose different septal diseases (hematoma, abscess and perforation)
10. Describe pathogenesis, clinical features and management of common septal diseases (hematoma, abscess and perforation)
11. Describe types, clinical features and management of foreign bodies in the nose and rhinolith.
12. Describe etiology, pathogenesis, clinical features, differential diagnosis and management of acute rhinosinusitis.
13. Describe etiology, pathogenesis, clinical features, differential diagnosis and management of chronic rhinosinusitis.
14. Describe pathogenesis, clinical features, differential diagnosis and management of nasal allergy and vasomotor rhinitis.
15. Describe types, pathogenesis, clinical features, differential diagnosis and management of nasal polyp.
16. Describe types, clinical features and management of different neoplasia of the nose and paranasal sinuses.

COURSE: DISEASES OF THE ORAL CAVITY AND PHARYNX

At the end of this course, the student should be able to:

1. Describe applied anatomy and physiology of the oral cavity and pharynx.
2. Enlist differential diagnosis of acute and chronic sore throat.
3. Enlist differential diagnosis of dysphagia.
4. Enlist differential diagnosis of disturbances of taste sensation/salivation.
5. Enlist differential diagnosis of mouth ulcers.
6. Enlist differential diagnosis of patches in the oral cavity and pharynx.
7. Describe types and management of congenital malformations of the oral cavity, lips, palate and pharynx.
8. Describe types, clinical features, differential diagnosis and management of stomatitis and oral ulcers.
9. Describe types, clinical features, differential diagnosis and management of acute and chronic pharyngitis.
10. Describe etiology, clinical features, differential diagnosis and management of acute, recurrent and chronic tonsillitis.
11. Describe etiology, clinical features, differential diagnosis and management of quinsy.
12. Describe etiology, clinical features, differential diagnosis and management of enlarged adenoids.
13. Describe types, clinical features, differential diagnosis and management of premalignant conditions of the oral cavity.
14. Describe types, clinical features, differential diagnosis and management of neoplasia and cysts of oral cavity and pharynx.

COURSE: DISEASES OF THE LARYNX AND TRACHEA

At the end of this course, the student should be able to:

1. Describe applied anatomy and physiology of the larynx and trachea.
2. Enlist differential diagnosis of the laryngeal symptoms:
   a. Hoarseness.
   b. Stridor.
   c. Dyspnea.
3. Describe types and management of congenital malformations of the larynx.
4. Describe types, clinical features, differential diagnosis and management of laryngeal injuries, stenosis and foreign bodies.
5. Describe etiology, pathogenesis, clinical features, differential diagnosis and management of vocal nodules.
6. Describe etiology, pathogenesis, clinical features, differential diagnosis and management of vocal cord paralysis.
7. Describe etiology, types, pathology, clinical features, differential diagnosis and management laryngeal neoplasia.
8. Describe procedure, indications, contraindications and complications of tracheostomy, mini-tracheostomy and percutaneous tracheostomy.
9. Describe procedure, indications, contraindications and complications of laryngoscopy, bronchoscopy and oesophagoscopy.

COURSE: DISEASES OF THE HEAD AND NECK AND GENERAL ENT

At the end of this course, the student should be able to:

1. Describe applied anatomy and physiology of the salivary glands.
2. Identify and diagnose a case of salivary calculus, parotitis, sialadenitis and tumor of the salivary gland.
3. Describe pathophysiology, clinical features, investigations and management of a case of salivary calculus, parotitis, sialadenitis and tumor of different salivary glands.
4. Describe applied anatomy and physiology of the thyroid gland.
5. Identify and diagnose a case of thyroid swelling.
6. Describe pathophysiology, clinical features, investigations and management of a case of multinodular goiter and solitary thyroid nodule.
7. Identify and diagnose a case of swelling or mass in the neck.
8. Describe pathophysiology, clinical features, investigations and management of a case of swelling or mass in the neck.
9. Identify and diagnose a case of deep neck space infection.
10. Describe types, clinical features and management of neck space infections.
11. Describe general principles, techniques, types, clinical uses and safety measures of laser surgery.
12. Identify, read and interpret the findings of plain X-ray mastoid, PNS, nasal bone, nasopharynx, neck, floor of the mouth, orthopantomogram, sialogram, barium swallow, carotid angiography and CT scan of the nose, PNS and head and neck.
13. Identify and enlist uses of different surgical instruments used in ENT practice.

SECTION I

Ear

Contents

auditory canal, one at the junction of the cartilaginous and bony part and the second is about 5 mm from the tympanic membrane in the bony part called *'isthmus'*. This is the narrowest part of the canal.

The blood supply of the external auditory canal comes from the superficial temporal and the posterior auricular arteries. In addition, it also receives supply from the deepest part of the auricular branch of maxillary artery. The veins accompany the arteries. The lymphatic drainage is the same as that of the pinna. The nerve supply is from the auriculotemporal nerve to the anterior half and auricular branch of the vagus nerve to the posterior half.

Tympanic Membrane

The tympanic membrane separates the external auditory canal from the middle ear cavity. Functionally, it is considered to be a part of the middle ear because in association with the ossicles, it works as a unit for impedance matching. The tympanic membrane is divided into two parts, *pars flaccida (Shrapnel's membrane)* and *pars tensa* (Fig. 1.5). It is oval in shape and pearly white in color. From the top, downwards it is 10 mm in length and anteroposteriorly, it is about 8 mm. The center part of tympanic membrane is called 'umbo'. Extending from the umbo, downwards and forwards is a bright triangular area called 'cone of light'.

Tympanic membrane is made up of three layers. An outer *epithelial* layer continuous with the epithelium of the external auditory canal. A middle *fibrous* layer containing inner circular and outer radial fibers. Third and innermost layer is mucosal. The middle fibrous layer is absent in the pars flaccida and so it is thin and lax. The pars tensa is thickened peripherally into a fibrocartilaginous annulus called *annulus tympanicus*, which fits into the grooved tympanic sulcus of the temporal bone. The annulus is deficient superiorly in the pars flaccida and is called *'notch of Rivinus'*. The lower margins of the pars flaccida are thickened and extend from the ends of the notch of Rivinus to the lateral process of malleus forming the anterior and posterior malleolar folds.

The outer surface of the tympanic membrane receives its blood supply from the deep auricular branch of the maxillary artery and the inner surface of the tympanic branch of maxillary artery. The nerve supply of the outer surface of tympanic membrane is similar to that of the meatus. Anterior half is supplied by the auriculotemporal nerve (branch of mandibular division of the trigeminal) and the posterior half by the auricular branch of the vagus nerve. The inner surface (mucous membrane) is supplied by the tympanic branch of glossopharyngeal nerve.

Middle Ear

The middle ear cleft consists of:

1. Eustachian (pharyngotympanic) tube.
2. Middle ear or tympanic cavity.
3. Aditus ad antrum.
4. Mastoid antrum.
5. Mastoid air cells.
6. Compartments and folds of the tympanic cavity.

The whole middle ear cleft is lined by a continuous layer of epithelium. The epithelium is respiratory in type i.e. columnar epithelium, ciliated in parts of the eustachian tube and the anteroinferior part of the tympanic cavity. Elsewhere, the epithelium is flattened or cuboidal in type.

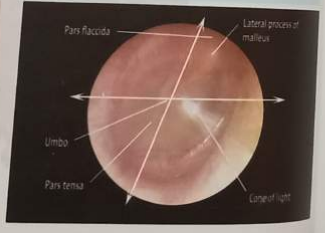
Eustachian Tube

This is about 36 mm in length in an average adult. It is directed upwards, backwards and outwards from its lower opening in the lateral wall of the nasopharynx to its upper opening in the anterior wall of tympanic cavity. The upper one-third is bony and the lower two-thirds is cartilaginous. In the cartilaginous part, the cartilage is confined to the upper and medial areas only, the remainder being formed by a membrane. In infants, the tube is shorter and wider and its course is more horizontal than in adults. The tube is normally closed at rest but is opened on yawning or swallowing by the action of the tensor palati muscle.

The blood supply of the tube is from the ascending pharyngeal, the middle meningeal arteries and from the artery of the pterygoid canal. Veins drain into the pterygoid plexus. The nerve supply is via the nervus intermedius.

Fig. 1.4: Lateral surface of the pinna.

Fig. 1.5: Tympanic membrane of the right side. Pars tensa is divided into four quadrants by two imaginary lines, horizontal along the umbo and vertical along the handle of malleus.



Tympanic Cavity

The tympanic cavity lies between the external and internal ears. It is in the form of a biconcave disc having six sides. It measures about 15 mm from the top downwards, 13 mm from below backwards and very narrow in its transverse diameter, measuring only 2 mm at its narrowest point in the center (Fig. 1.6).

The lateral wall of the tympanic cavity is formed mainly by the tympanic membrane and partly by the bone above, below and behind the membrane. The part of the tympanic cavity extending above the tympanic membrane is called the *attic* or *epitympanum* and the part extending below the level of floor of the external auditory canal is called the *hypotympanum*. The part lying medial to the tympanic membrane is referred to as the *mesotympanum*.

The *medial wall* separates the middle ear from the inner ear. The most obvious feature is the *promontory*, a smooth rounded bony bulge formed by the basal turn of the cochlea. Above and behind the promontory is the oval *window*, closed by the footplate of stapes and the annular ligament. Below and behind the promontory is the *round window* closed in life by the secondary tympanic membrane. The oval window separates the middle ear from the scala vestibuli of the cochlea while the round window separates it from the scala tympani. Just above the oval window is the horizontal part of the facial nerve lying in its bony fallopian canal. The bulge of the horizontal semicircular canal also lies in the medial wall above the facial canal.

The *anterior* wall is formed by a thin plate of bone. In its lower part, it separates the cavity from the internal carotid artery. Above it, lies the tympanic orifice of the eustachian tube. Pro-tympanum is the bony portion of eustachian tube. Superiorly lies the canal for the tensor tympani muscle.

The *posterior wall* is wider than the anterior wall and has an opening in its upper part called the aditus ad antrum which leads posteriorly from the epitympanum (attic) into the mastoid antrum. Below the aditus is the pyramid, a conical projection, through it exits the tendon of the stapedius muscle, which is inserted into the neck of stapes. The facial nerve bends downward to the level of the floor of aditus and lies close to the posterior wall.

The *roof* of the middle ear is formed by a thin plate of bone (tegmen tympani), which separates the cavity from the middle cranial fossa. Posteriorly, it is continuous with the roof of the mastoid antrum (tegmen antri). Its roof is formed partly by the petrous and partly by the squamous of the temporal bone. The petro-squamous suture may be deficient, so provides a preformed pathway for infection of the middle ear to involve middle cranial fossa.

The *floor* is also formed by a thin plate of bone, which separates the cavity from the bulb of internal jugular vein. The tympanic branch of the glossopharyngeal nerve enters the cavity through its floor.

The contents of the middle ear cavity include air, three ossicles, two intratympanic muscles, chorda tympani nerve, tympanic plexus, compartments and folds of the middle ear.

Fig. 1.6: Middle ear cavity showing the three ossicles.

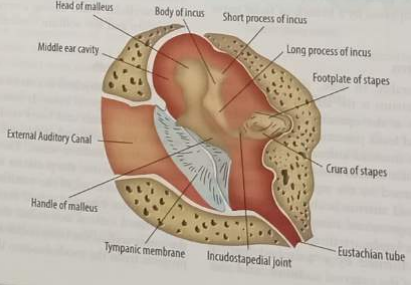
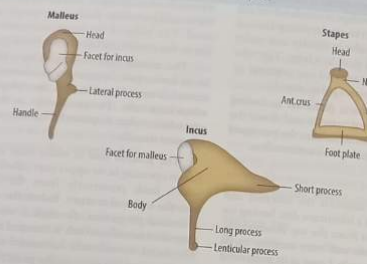


Fig. 1.7: Three separated ossicles: The malleus, incus and stapes.



The three ossicles are malleus, incus and stapes, which transmit sound energy from the tympanic membrane to the oval window (Fig. 1.6 and 1.7). The malleus has a head, neck, handle, anterior and lateral processes. The head is situated in the epitympanum and the handle is firmly attached to the fibrous layer of the tympanic membrane. The incus has a body, a short process and a long process. The body is articulated with the head of malleus and the long process bends medially at its lower end (lenticular process) to articulate with the head of stapes. The stapes has a head, neck, two crura and a footplate. The footplate is held in the oval window by the annular ligament.

The two intratympanic muscles, *tensor tympani* and *stapedius* are mainly striated muscles. Tensor tympani runs above the eustachian tube and after emerging from the bony tunnel, incorporates into the malleus just below the neck. It is supplied by the motor division of the trigeminal nerve through the otic ganglion. The stapedius muscle after emerging from the pyramid incorporates into the neck of the stapes. It is supplied by a branch of facial nerve (nerve to stapedius).

Mastoid Air Cell System

These vary considerably in size, distribution and number. The mastoid antrum is the largest and is always present. *Aditus ad antrum* is the opening in the posterior wall of the middle ear and leads posteriorly to the mastoid antrum. The roof of the mastoid antrum (tegmen antri) separates it from the middle cranial fossa. The lateral wall of mastoid antrum is formed by the squamous temporal bone. In adults, the mastoid antrum is about 15 mm deep from the surface. The *suprameatal triangle* or *MacEwin's triangle* is the bony surface landmark in adults for mastoid antrum. This triangle is formed by a 'temporal line', a posterosuperior margin of the external auditory canal and an imaginary line drawn as tangent from posterior margin of external auditory canal. The medial wall of the mastoid antrum is connected with the posterior and horizontal semicircular canals. Posteriorly, it communicates through several openings in the mastoid air cells. In an extensively cellular mastoid, the air cells may occupy the whole mastoid part of the temporal bone, root of zygoma and the petrous part of temporal bone upto its apex.

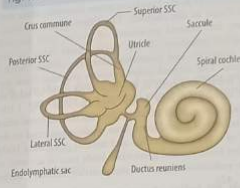
Inner Ear

The inner ear lies in the temporal bone and because of its complexity, it is called the labyrinth. It consists of a *bony labyrinth* and a *membranous labyrinth*. The membranous labyrinth is enclosed within the bony labyrinth. The bony labyrinth contains a fluid between its walls and the membranous labyrinth is called the perilymph. The membranous labyrinth contains fluid called the endolymph. The composition of perilymph is very similar to that of extracellular fluid while the endolymph is similar to that of intracellular fluid, having a very high concentration of potassium and low sodium content.

Bony Labyrinth

The bony labyrinth is a series of cavities in the petrous part of the temporal bone. It consists of a vestibule, bony semicircular canals and bony cochlea. The vestibule is in between the medial wall of the middle ear and the lateral end of the internal auditory canal. There are three semicircular canals, the anterior, the posterior and the lateral. The bony cochlea lies in front of the vestibule. It resembles a snail's shell but has two and a half turns in human beings. Its shape has a central axis called the *modiolus*, which forms the inner wall of the bony cochlea. The bony spiral lamina projects from the modiolus into the canal.

Fig. 1.8: Membranous labyrinth.



Membranous Labyrinth

It is a continuous series of communicating sacs and ducts within the bony cavities (Fig. 1.8). It consists of a saccule, an utricle, membranous semicircular canals and a cochlear duct. The endolymphatic sac, which lies on the posterior surface of the temporal bone is connected to the membranous labyrinth by the endolymphatic duct. The endolymphatic duct passes through the medial wall of the bony labyrinth.

Cochlear Duct

This is also called *membranous cochlea* or *scala media*. It is a blind tube, triangular in section and present within the bony cochlea. Thus the bony cochlea is divided into *scala vestibuli* and *scala tympani* by the scala media (Fig. 1.9). The floor of scala media is formed by the basilar membrane on which lies the *organ of Corti*. The lateral wall of scala media, has a layer of vascular epithelium called the stria vascularis. The roof of scala media is inclined and is formed by the *Reissner's membrane*, which separates the scala media from the scala vestibuli. The narrowest part of the membranous cochlea lies within the vestibule and is connected to the saccule by a fine duct called ductus *Reuniens*.

The organ of Corti is the sense organ of hearing. It consists of a complex arrangement of hair cells and supporting cells. The basilar membrane and the tectorial membrane, which are in contact with the hair cells, are an integral part of the structure. Ascending from the basal coil to the apical coil of scala media the structure of organ Corti changes. A tunnel, composed of two rows of Corti rods forming a triangle with the basilar membrane divides the organ of Corti into inner and outer portions. Fluid called the cortilymph is present in the tunnel of Corti. On the inner side of the organ, there is a single row of hair cells called inner hair cells. On the outer side of the rods, there are three to four rows of outer hair cells. In a human ear there are 12,000 hair cells and 25,000 to 30,000 cell bodies in the spiral ganglion.

Fig. 1.9: Cross section through the cochlea.

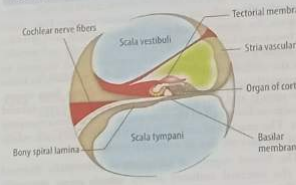
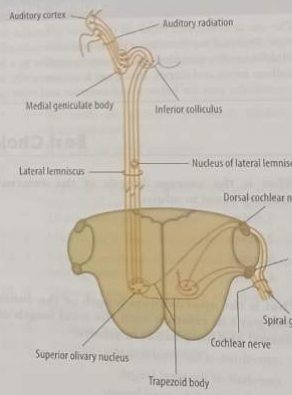


Fig. 1.10: Cochlear nerve nuclei and their central connections.



Semicircular Canals

The three membranous semicircular canals occupy the lumen of the bony canals. The three ducts lie in the three planes of space. Each duct is dilated at one end to form an ampulla, which contains a neuroepithelium called *crista ampullaris*. The three ducts communicate with the utricle through five openings, with the superior and posterior canals having a common opening at their non-ampullary ends. Crista ampullaris contains hair cells having long filaments which project into a mass of gelatinous material called the *cupula*.

Utricle and Saccule

The utricle and saccule communicate with each other indirectly through an endolymphatic duct. This duct occupies the bony aqueduct of the vestibule and divides into two branches which open into the saccule and utricle. The distal portion of the endolymphatic duct expands to form the endolymphatic sac. This sac lies partially in bone and partially under the posterior cranial fossa dura mater. In the utricle and saccule, there is also a patch of specialized neuroepithelium called the macula, which is also a receptor organ. The macula of utricle lies in a horizontal plane while that of the saccule lies in a vertical plane.

The blood supply of labyrinth is principally derived from the internal auditory artery, which arises normally from the anterior inferior cerebellar or sometimes directly from the basilar artery.

Auditory Pathway

The cochlear nerve conducts nerve impulses from organ of Corti in the cochlea. The fibers of the nerve are the central processes of nerve cells in the spiral ganglion. These nerve fibers relay to anterior (ventral) and posterior (dorsal) cochlear in the pons. The second order neurons originate from cochlear nuclei and runs in the trapezoid body to superior olivary nucleus of the opposite side (Fig. The axons now ascend as lateral lemniscus and some in the nucleus of lateral lemniscus while others end nucleus of inferior colliculus and medial geniculate The fibers from medial geniculate body pass as acoustic auditory radiation to end in the primary auditory (area 41, 42).

Chapter Summary and Key Points

The ear is developed from all the three germinal layers. It is divided into three parts called external, middle inner ear. External ear consists of pinna and external auditory canal. Tympanic membrane is considered a part of ear. Middle ear is a six sided slit like cavity similar to a 'matchbox'. Three ossicles are present in the middle ear the malleus incus and stapes. Inner ear is anatomically and functionally divided into two parts. Superior and is the vestibular part for balance and anterior and inferior part is the cochlea for hearing.

Best Choice Questions

Q1. What is the average length of the external auditory canal in adults?
a. 1.5 cms.
b. 2.5 cms.
c. 3.5 cms.
d. 4.0 cms.

Q2. What is the approximate length of the inner bony part in relation with the total length of external auditory canal in adults?
a. one-third of the total length.
b. one-half of the total length.
c. one-fourth of the total length.
d. two-third of the total length.

Q3. The outer part of the external auditory canal is cartilaginous. What is the approximate length of this part in relation with the canal's total length?
a. one-fourth.
b. one-third.
c. one-half.
d. two-third.

Q4. Tensor tympani is an intratympanic muscle. Where is this muscle located in the middle ear?
a. neck of the malleus.
b. short process of the incus.
c. neck of the stapes.
d. tip of the pyramid.

Q5. Histologically, the tympanic membrane in adult is made up of many layers. How many layers are present in the pars tensa?
a. one.
b. two.
c. three.
d. four.

Q6. If you are clinically examining the ear of 22-year-old normal person, the color of the tympanic membrane will appear as?
a. brilliant white.
b. dirty white.
c. pearly white.
d. light gray.

Q7. How many walls are present in the middle ear?
a. three.
b. four.
c. five.
d. six.

Q8. In three dimensional view, the shape of middle ear cavity in a normal adult is very similar to a?
a. cube.
b. matchbox.
c. sphere.
d. pyramid.

Q9. What is the nerve supply called for the outer part of the tympanic membrane?
a. greater auricular and lesser occipital nerves.
b. auriculotemporal and vagus nerves.
c. auriculotemporal and glossopharyngeal nerves.
d. greater auricular and glossopharyngeal nerves.

Q10. You are performing a surgery on the mastoid region in a 28-year-old male patient. What is the average depth from the surface at which you will find the mastoid antrum?
a. 10 mm.
b. 15 mm.
c. 20 mm.
d. 25 mm.

Q11. Which part (s) of the middle ear is least deep?
a. epitympanum.
b. mesotympanum.
c. hypotympanum.
d. both epitympanum and hypotympanum.

Q12. What is the average length of the eustachian tube in adults?
a. 6 mm.
b. 16 mm.
c. 26 mm.
d. 36 mm.

Q13. Which wall of the middle ear cavity is also called 'tegmen tympani'?
a. anterior wall.
b. medial wall.
c. floor.
d. roof.

Q14. The tympanic membrane is developed from which embryonic layers?
a. ectoderm and endoderm.
b. ectoderm and mesoderm.
c. endoderm and mesoderm.
d. ectoderm, mesoderm and endoderm.

Q15. Which of the following structure communicates directly with the middle ear cavity?
a. internal auditory canal.
b. mastoid antrum.
c. sigmoid sinus.
d. scala media.

Answers with Explanations

1. b 2.5 cms or 1 inch.
2. d Outer one third is cartilaginous.
3. b Inner two-third is bony.
4. a It is inserted just below the neck of malleus.
5. c Outer epithelium, middle fibrous and inner mucosal layer.
6. c.
7. d Six walls are anterior, posterior, medial, lateral, floor and roof.
8. b It is like six sided matchbox.
9. b.
10. b Suprameatal or MacEwin's triangle is the surgical superficial landmark for mastoid antrum situated 15 mm deep to the surface.
11. b Middle ear is like a biconcave six sided matchbox.
12. d Upper one-third is bony and lower two-third is cartilaginous.
13. d Tegmen tympani separates the middle ear from middle cranial fossa.
14. d All three germinal layers take part in its formation.
15. b Through aditus ad antrum.

CHAPTER

02 Physiology of Hearing and Balance

- Hearing
  - Conduction of sound
  - Perception of sound
- Balance

HEARING

The ear is primarily concerned with hearing and balance. Regarding hearing, frequency response of the human ear is roughly from 20 to 20,000 Hz, which covers almost eleven octaves. Function of the ear is to convert the sound energy in the atmosphere into nerve impulses, which then transmit these impulses along the auditory nerve. Sound travels from its source to the ears in waves consisting of alternate compressions and rarefactions of molecules of the medium through which it is transmitted. Sound travels at a speed of 344 metres per seconds (approximately 770 m.p.h.) at normal temperature and pressure.

For physiological purpose the ear is divided into two parts:

1. Conducting apparatus: consists of the external ear, tympanic membrane, chain of ossicles, eustachian tube and labyrinthine fluids.
2. Perceiving or sensorineural apparatus: consist, organ of Corti, the auditory nerve and their central connections.

Sound can be transmitted to the inner ear by following three mechanisms:

1. Through the ossicular chain from the vibrating tympanic membrane.
2. By bone conduction where the sound energy is transmitted to the inner ear through the skull bones.
3. Directly across the middle ear. When a large perforation is present in the tympanic membrane, sound energy can strike the round window directly.

Conduction of Sound

Sound energy can travel through any medium e.g. air, fluid and solid but with specific acoustic resistance. A sound energy travelling through air cannot transmit directly into a liquid medium completely. Most of the sound energy is reflected back into the air at the surface of liquid. In the process of hearing, sound energy in the air has to be transmitted into a liquid medium i.e. perilymph and endolymph. So the basic purpose of the conducting apparatus of the ear is to transmit sound energy from the air into liquid labyrinthine fluid. The conducting apparatus serves to match the acoustic resistance of air to that of the labyrinthine fluid, phenomenon called *'impedance matching'*. Vibration of the incompressible endolymph and perilymph in the rigid bony labyrinth is made possible by the movement in opposite phase of the structures seal... the round window and oval window. Thus in oval window if stapes is pushed inwards, secondary tympanic membrane will bulge outward at round window (Fig.2.1).

Sound energy collected by the larger area of tympanic membrane is applied through the ossicles to the smaller area of stapes footplate. In addition the ossicles themselves constitute a lever mechanism, which has a mechanical advantage. By the combined effect of both of these mechanisms, the force exerted by the stapes footplate upon the labyrinthine fluid is increased many folds, about 15 times (Fig. 2.2). In this way conducting apparatus performs the function of impedance matching and transfer of sound energy from the air into the labyrinthine fluid.

Perception of Sound

Vibration of the stapes produces a flow of perilymph and displaces the cochlear partition to and fro between the upper and lower scalae (Fig. 2.2). For high frequency maximum displacement of basilar membrane is confined to the basal turn. Low frequencies cause a longer travelling wave with maximum displacement near the apex of the cochlea. Vibration of the basilar membrane results in sliding or shearing movement between the tectorial membrane and the reticular lamina. The hair of the hair cells are thus displaced relative to their cell bodies. This is probably the final mechanical event proceeding to neuronal stimulation. The movement of hair results in changes in the resting potential of hair cells and this in turn stimulates the nerve endings.

Within the cochlea, the vibration of cochlear fluid is analyzed in such a way that data representing frequency, intensity and phase relationship is transmitted along the auditory nerve.

Fig. 2.1: Movement of the ossicles and perilymph.

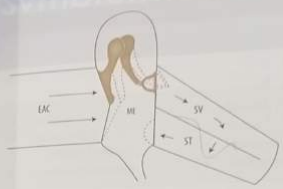
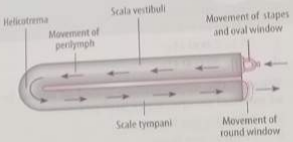


Fig. 2.2 Movement of perilymph at helicotrema and movement of round window.



BALANCE

The balance and equilibrium of the body is maintained by coordination of information from these three sources:

1. Vestibular system.
2. Eyes.
3. Proprioceptive sensations from joints and muscles.

The higher center for coordination and equilibrium is the cerebellum. The receptor organs in the membranous vestibular labyrinth are concerned with the reflex adjustment of posture as well as with subjective sensations.

The three semicircular canals respond to angular acceleration of the head. The horizontal pair responds to rotation about a vertical axis. The posterior and anterior pairs respond to displacement of head about a horizontal axis. Each duct shows sensitivity to rotation in its own plane. Acceleration causes movement of endolymph within the membranous labyrinth and deflection of the cupula on the crista within the expanded ampulla of the canal. There is a constant resting impulse in the fibers supplying the crista. Movement of the endolymph and cupula towards the ampulla causes an increase in the impulse rate and movement away from the ampulla causes a reduction in impulse rate in the fibers.

The utricle responds through gravity to the slightest tilt of head and to linear acceleration. The utricular macula is situated in the horizontal plane. It remains quiescent as long as the head is horizontal and stationary.

The exact function of the saccule is uncertain. The alteration in the position of the head in relation to the direction of gravity may stimulate the saccule. Impulses from the saccule and utricle not only give information about the position of head in space but initiate reflexes which tend to keep the head in upright position. Probably, it also detects very low frequency vibrations.

Chapter Summary and Key Points

There are two important functions of the ear, hearing and balance. In relation to hearing, sound energy present in the atmosphere is converted into nerve impulses, which are transmitted to the central auditory cortex. Tympanic membrane functions with the middle ear to transmit sound energy from the air (gaseous medium) to perilymph (liquid medium). This function is called 'impedance matching'. Cochlea converts this mechanical energy into nerve impulses by 'organ of Corti'. Semicircular canals respond to angular acceleration while utricle responds to linear acceleration and head tilting. The function of saccule is uncertain.

Best Choice Questions

Q1. Which frequency range is audible to a normal person?
a. 10 to 1,000 Hz.
b. 100 to 10,000 Hz.
c. 20 to 2,000 Hz.
d. 20 to 20,000 Hz.

Q2. What is the approximate speed of sound in air at normal temperature and pressure?
a. 7.7 miles per hour.
b. 77 miles per hour.
c. 770 miles per hour.
d. 7700 miles per hour.

Q3. The human ear can be divided into how many parts for physiological purpose of hearing?
a. two parts.
b. three parts.
c. four parts.
d. five parts.

Q4. In which part of the cochlea, there is maximum displacement of basilar membrane when there is a high frequency sound?
a. apex of cochlea.
b. basal turn of the cochlea.
c. middle part of the cochlea.
d. helicotrema of the cochlea.

Q5. Where is the higher center of coordination and equilibrium located?
a. cerebellum.
b. midbrain.
c. parietal lobe.
d. temporal lobe.

Q6. Which body movement causes the maximum stimulation of the horizontal semicircular canal?
a. rotation in horizontal axis.
b. rotation in vertical axis.
c. linear acceleration.
d. vertical acceleration.

Answers

1. d.
2. c.
3. a.
4. b.
5. a.
6. b.

CHAPTER 03

Symptoms of Ear Diseases

- Deafness
- Pain or otalgia
  - Referred otalgia
- Otorrhea or discharge
- Tinnitus
- Vertigo
- Itching or irritation
- Swelling or deformity
- Facial palsy/asymmetry
- Hyperacusis
- Trauma or foreign body
- Bleeding

Common symptoms of ear diseases because of which the patient comes to his physician are:

1. Deafness.
2. Pain or otalgia.
3. Otorrhea or discharge
4. Tinnitus.
5. Vertigo.
6. Itching or irritation.
7. Swelling or deformity.
8. Facial palsy/asymmetry.
9. Hyperacusis and autophony.
10. Trauma or Foreign body.
11. Bleeding.
12. Other symptoms like fever, nausea, vomiting and neurological symptoms.

DEAFNESS

Deafness or hearing impairment is a common symptom of ear disease. It is the decrease in the ability to hear. According to WHO report, 360 million people worldwide have disabling hearing loss and among these 32 million are children. Deafness may vary from a degree so slight as to escape notice of the patient to complete loss of hearing. So, the deafness may be *partial* or *complete*. According to the severity, most commonly used classification of deafness is as follows:

• Normal hearing	up to 25 dB
• Mild deafness	26–40 dB
• Moderate deafness	41–55 dB
• Moderately severe deafness	56–70 dB
• Severe deafness	71–91 dB
• Profound/stone deafness	>91 dB

Following are the distinct types of deafness:

1. Conductive.
2. Sensorineural.
3. Mixed.
4. Non-organic.

Conductive Deafness:

In conductive deafness, there is pathology in the conductive pathway of the sound to the inner ear. The pathology may lie in the external ear or middle ear till the foot plate of the stapes. Typically, in conductive deafness the sound appears quieter but not distorted. The quality of speech is well maintained because the patient hears his own voice clearly. In some cases of conductive deafness especially in otosclerosis, *Paracusis Willisi* is also present. This is a phenomenon where the patient hears better in the noisy environment than the quiet and soundless one. The common causes of conductive deafness include:

1. Impacted wax in the external auditory canal
2. Big foreign body in the external auditory canal
3. Otomycosis.
4. Boil: if large enough.
5. Tumors: e.g. osteoma.
6. Congenital atresia and malformations.
7. Acute and chronic otitis media.
8. Otitis media with effusion.
9. Trauma: ear drum perforation or dislocation of the ossicle.
10. Otosclerosis and tympanosclerosis.
11. Eustachian tube dysfunction due to pathologies of the nasopharynx, like enlarged adenoids and tumors of the nasopharynx.
12. Iatrogenic: e.g. surgical.

Sensorineural Deafness

Any pathology that lies in the sensory end organ i.e. cochlea, its neural connections till the higher center of hearing in temporal lobe will cause sensorineural type of deafness It has two components; sensory deafness and neural deafness. In sensory deafness, the pathology lies in the sensory organ of hearing i.e. cochlea or organ of Corti. In neural deafness, pathology may be present anywhere from the cochlear nerve to the higher centers or auditory cortex.

In sensorineural deafness, sound not only appears quieter but is distorted as well. The most usual distortion occurs in high frequency sound, which diminishes the understanding of consonant sounds resulting in difficulty in understanding speech. Distortion of sound is more pronounced in neural type of deafness than the sensory type of deafness. In severe cases the patient may not hear their own voice, so the speech is also loud and expressionless. The common causes of sensorineural deafness are:

1. Congenital causes:
   a. Genetic: In genetic causes, defective genes are inherited from the parents.
   b. Non-genetic: The genes are not defective and include:
      i. Prenatal causes: during pregnancy, conditions like rubella, use of ototoxic drugs, radiation, viral infections etc.
      ii. Peri-natal causes: e.g. birth hypoxia, prematurity, low birth weight.
      iii. Postnatal causes: Rh factor incompatibility and hypothyroidism.
2. Labyrinthitis.
3. Perilymph or endolymph leakage.
4. Trauma to inner ear or cochlear nerve.
5. Acoustic trauma and blast injuries.
6. Noise Induced Hearing Loss (NIHL).
7. Meniere's disease.
8. Acoustic neuroma.
9. Presbycusis.
10. Ototoxicity.
11. Idiopathic sudden sensorineural hearing loss.
12. Central causes: e.g. CVA, space occupying lesions.
13. Systemic diseases: e.g. diabetes mellitus, hypothyroidism, autoimmune disorders, multiple sclerosis.

Mixed Deafness

Some diseases may cause both conductive and sensorineural deafness called *mixed deafness*, like otosclerosis initially causes conductive deafness by fixation of footplate of stapes but in later stages may lead to sensorineural deafness. In the analogous way, the cholesteatoma initially causes conduction deafness but later may erode the ear and cause sensorineural deafness as well.

Non-organic Deafness

Non-organic deafness, also called functional deafness is not due to pathology in any part or organ related with hearing. This type includes malingering for compensation or medico-legal purpose, psychosis, hysteria or other psychological illnesses.

Diagnosis for the cause of deafness is made by taking detailed history, thorough clinical examination and audiological investigations. History about the deafness must include:

- Duration of hearing loss.
- Onset.
- Severity.
- Progress.
- Continuous, intermittent or fluctuant.
- Unilateral or bilateral.
- Hears better in noisy room or in a quiet room.
- Difficulty in understanding speech.
- Associated symptoms.
- Aggravating and relieving factors.
- Occupational history.
- Exposure to loud sounds.
- Use of ototoxic drugs.
- Trauma to head or ear.

Clinical examination includes complete examination of the ear with voice test and tuning fork tests (see chapter 4). Audiological investigations are described in detail in chapter 5.

PAIN OR OTALGIA

Pain in the ear or *otalgia* may occur either due to complications in the ear or complications somewhere else having the same sensory nerve supply as the ear *(otalgia)*. The complications in the ear may either be in the external ear or the middle ear. Inner ear has no pain fibers so diseases of the inner ear are mostly painless.

The common complications in the external ear are:

1. Acute diffuse otitis externa.
2. Boils.
3. Otomycosis.
4. Bullous myringitis.
5. Herpes zoster oticus.
6. Perichondritis.
7. Trauma or foreign body.
8. Impacted wax.
9. Malignant otitis externa.
10. Neoplasia.

Common complications in the middle ear are:

1. Acute otitis media.
2. Acute chronic otitis media.
3. Chronic otitis media with complications.
4. Mastoiditis and mastoid abscess.
5. Trauma and hemotympanum
6. Otitic barotrauma.
7. Neoplasms.

Referred Otalgia

Many patients who complain about an earache often have disease somewhere else. This is due to a common sensory nerve supply within the ear. The ear is supplied by the branches of the trigeminal, facial, glossopharyngeal, vagus, greater auricular and lesser occipital nerves. The cutaneous nerve supply of the pinna comes from the auriculotemporal (trigeminal), greater auricular (cervical plexus, C2 and C3) and lesser occipital (cervical plexus, C2) nerves. The medial surface of pinna in its lower two-third is supplied by the greater auricular nerve and upper one-third by the lesser occipital nerve. The lateral surface in its lower one-third is supplied by greater auricular and upper two-third by auriculotemporal nerves. The nerve supply to the anterior half of the external auditory canal is from the auriculotemporal nerve while the auricular branch of the vagus nerve supplying the posterior half. The nerve supply of the outer surface of tympanic membrane is like that of the canal. Anterior half is supplied by the auriculotemporal nerve (branch of mandibular division of the trigeminal) and posterior half by the auricular branch of the vagus nerve. The inner surface (mucous membrane) is supplied by the tympanic branch of the glossopharyngeal nerve.

Any painful pathology in the distribution of these nerves may cause referred pain in the ear. Diagnosis of referred otalgia is made by excluding local causes in the ear with no positive finding in the ear and presence of some other pathology in the head and neck region.

Some of the common causes of referred otalgia are:

1. Post tonsillectomy operation.
2. Post adenoidectomy operation.
3. Dental diseases or tooth extraction.
4. Carcinoma of pyriform fossa, base of tongue and tonsil.
5. Nasal and PNS diseases.
6. Acute tonsillitis.
7. Peritonsillar abscess.
8. Ulcers in the mouth and pharynx.
9. Cervical spondylosis or arthritis (C2 and C3 nerves).
10. Salivary gland diseases.
11. Temporomandibular joint dysfunction.

History about the pain must include:

- Duration
- Onset
- Continuous or intermittent: if intermittent then its frequency, timings etc.
- Progression: whether it is increasing or decreasing or constant.
- Severity of the pain and its effect on the normal routine
- Characteristics of pain
- Site and radiation of the pain
- Aggravating and relieving factors
- Associated symptoms.

OTORRHEA OR DISCHARGE

Otorrhea or *discharge* from the ear is one of the most prevalent symptoms of ear disease. Discharge may arise from the external auditory canal or the middle ear cleft. The discharge arising from the external auditory canal does not contain mucous since the external auditory canal does not have mucous secreting glands. Mucoid or mucopurulent discharge always arises from the middle ear cleft. Watery discharge may be cerebrospinal fluid after head injury or ear surgery (CSF otorrhea). Purulent discharge is often associated with the attico-antral or squamous type of chronic otitis media and in patients with large boils after a spontaneous rupture. Blood stained discharge is present in cases of granulation tissues, maggots in the external auditory canal, after a spontaneous rupture of tympanic membrane in acute otitis media, vascular tumors like hemangioma, glomus jugulare and malignant tumors of the ear.

Common causes of ear discharge are:

1. Acute suppurative otitis media.
2. Chronic suppurative otitis media.
3. Acute diffuse otitis externa.
4. Malignant otitis externa.
5. Seborrheic otitis externa.
6. Otomycosis.
7. Boils after rupture.
8. Wax after softening.
9. Carcinoma and other neoplasia.
10. CSF otorrhea.

History of discharge must include:

- Duration.
- Onset.
- Continuous or intermittent.
- Quantity.
- Color.
- Smell.

- Blood stained or not
- Aggravating and relieving factors
- Associated symptoms.

TINNITUS

Tinnitus is the subjective sensation of sound or noises in the ear or head. The term tinnitus is derived from the Latin word *'tinnire'*, which means "to ring". Typically, an individual perceives the sound in the absence of external sound and perception is unrelated to any external source. Tinnitus is common and sometimes the only symptom of ear disease. It is regarded as a sign of irritation of the cochlea or auditory pathways. Nature of the sound varies widely e.g. ringing, buzzing, hissing, hammering etc. Unfortunately, little is known about the causes of tinnitus and very limited therapy is available to eliminate the problem.

Two clinical forms of tinnitus are recognized:

1. Tinnitus with deafness.
2. Tinnitus without deafness.

Tinnitus with Deafness

This form of tinnitus is more common and is usually due to diseases within the ear. In fact, any type of deafness can cause tinnitus. Some of the common causes of tinnitus with deafness are:

1. Presbycusis.
2. Meniere's disease.
3. Ototoxicity.
4. Acoustic trauma or blast injury.
5. Noise induced hearing loss.
6. Acoustic neuroma.
7. Labyrinthitis.
8. Otitis media.
9. Eustachian tube dysfunction.
10. Impacted wax or entry of a foreign body like insect.
11. Glomus tumors.

Tinnitus without deafness:

In few patients, tinnitus may occur without deafness. In majority of these cases, cause is unknown. Some of the common causes of tinnitus without deafness are:

1. Idiopathic: most common.
2. Hypertension or hypotension.
3. Anemia.
4. Hypoglycemia.
5. Vascular: vascular malformation, arterio-venous fistula, atherosclerosis, venous hum, jugular bulb anomaly etc.
6. Migraine.
7. Epilepsy.
8. Contraction of intratympanic or palatal muscles.

Another classification of the tinnitus into two types also commonly used:

1. Objective tinnitus: It is tinnitus which is audible everyone as well as the patient. Objective tinnitus is relatively rare. It is sound created somewhere the body, usually in the ear, head or neck, and has muscular or vascular etiology.
2. Subjective tinnitus: When the tinnitus is only audible to the patient. This is the more common type.

Detailed history is very important to find the cause the tinnitus and must include:

- Duration.
- Onset.
- Progression.
- Unilateral or bilateral.
- Associated with deafness or not.
- Character and nature of the tinnitus: like pulsatile or hissing etc. Pulsatile tinnitus is usually of vascular origin.
- Aggravating and relieving factors.
- Others associated symptoms.

VERTIGO

See chapter 13.

ITCHING OR IRRITATION

Itching or *irritation* in the ear is generally associated with some form of otitis externa. It may vary in severity and can be so severe that the patient may even abrade the meatal skin by himself through rubbing or scratching the external auditory canal with a sharp or pointed object like keys, hair pins etc. Sometimes itching may result from the accumulated wax. Otomycosis is another important cause of itching in the ear.

SWELLING OR DEFORMITY

Swelling of the pinna may occur due to perichondritis of the pinna. Postauricular swelling is commonly due to a mastoid abscess. Swelling in the preauricular region may occur due to an infected preauricular sinus or cyst. Causes of swelling in the external auditory canal are boil or osteoma of the canal.

Deformity of the pinna is usually due to a congenital anomaly. Trauma is another cause for deformity of the pinna e.g. boxer's ear.

FACIAL PALSY/ASYMMETRY

See chapter 15.

HYPERACUSIS AND AUTOPHONY

Hyperacusis is the condition where an individual has increased sensitivity to sound. Sound may appear to be unpleasantly loud in this condition that would otherwise appear normal to other people. A patient may develop phonophobia in severe cases. The exact etiology for this is unknown but it is associated with ototoxicity, noise exposure, head injury, Meniere's disease, facial nerve palsy, migraine, depression etc.

Autophony or *tympanophony* is the unusual loud auditory perception of a person's own voice and sometimes even his own breathing sounds. It is typically present in patients with abnormally patent eustachian tube. The other causes are fluid in the middle ear (otitis media with effusion), blocked external auditory canal by the wax and use of hearing aid.

TRAUMA OR FOREIGN BODY

The patient may present a history of trauma or entry of a foreign body in the ear. Trauma to the ear may cause different degrees of cuts, lacerations or hematoma formation. Foreign body in the ear is very common and the body could be *animate or inanimate*. Animate foreign body like cockroach, ant or mosquito may enter by itself while inanimate foreign bodies are introduced mostly by children and mentally retarded persons (see chapter 7 for details).

BLEEDING

Frank bleeding from the ear, although is not very common but is an important and terrifying symptom. It is mostly seen after trauma to the ear or its surrounding region. Vascular tumors like hemangioma of the external ear or glomus jugulare are other important causes of bleeding from the ear.

Chapter Summary and Key Points

As the ear is concerned with hearing and balance, so are its symptoms. Two important symptoms, deafness and tinnitus are related with hearing while vertigo is related with balance. Deafness may be complete or partial and is classified into two main types, conductive and sensorineural deafness. Mixed and non-organic deafness are the other two types. Tinnitus may be associated with any type of deafness. Otalgia is another important symptom, where the cause may be present in the external ear, middle ear or somewhere else in the head and neck region. Diseases of the internal ear are painless. A good number of cases of earache are due to referred otalgia. Discharge from the ear comes from either external ear or middle ear. Mucous glands are absent in external ear, so mucoid discharge always comes from the middle ear.

Best Choice Questions

Q1. What is the maximum normal hearing threshold in an adult?
a. 15 dB.
b. 20 dB.
c. 25 dB.
d. 30 dB.

Q2. A patient was clinically suspected as a case of sensorineural deafness. What is the likely cause from the following?
a. otitis media with effusion.
b. otosclerosis.
c. Meniere's disease.
d. hemotympanum.

Q3. A patient was clinically diagnosed as a case of conductive deafness. What is the most likely cause from the following?
a. Meniere's disease.
b. otosclerosis.
c. presbycusis.
d. ototoxicity.

Q4. A patient came with the complaint of hearing impairment and was diagnosed as a case of impacted wax in both ears. What were his complaints regarding his hearing impairment?
a. sound appears quieter and distorted.
b. sound appears quieter but it is not distorted.
c. distortion occurs mainly at higher frequencies.
d. unable to understand consonant's sound.

Q5. Which of the following disease can result in mixed type of deafness?
a. glue ear.
b. impacted wax.
c. otosclerosis.
d. ototoxicity.

Q6. An 18-year-old male patient came with the complaint of mucoid and sometimes mucopurulent discharge from the right ear. What is the likely possibility among the following?
a. otomycosis.
b. impacted wax.
c. tubotympanic type of CSOM
d. otitis media with effusion.

Q7. In which of the following conditions, pain is typically absent?
a. acute suppurative otitis media.
b. boils in the ear.
c. herpes zoster oticus.
d. otosclerosis.

Q8. A patient came with the complaint of pain in his right ear. After history and clinical examination, doctor said that his right ear is normal. Which of the following condition can be cause of earache in such a case?
a. dental root abscess.
b. malformed tooth.
c. vestibular neuronitis.
d. vocal nodules.

Answers with Explanations

1. c according to WHO classification for severity of deafness, hearing threshold of upto 25 dB considered normal.
2. c Meniere's disease is a inner ear disease that causes sensorineural deafness.
3. b otosclerosis causes ankylosis of the footplate of stapes resulting in conductive loss mainly.
4. b distortion of sound is usually absent in conductive loss.
5. c otosclerosis mainly causes conductive loss but sometimes disease process involves cochlea and causes mixed loss.
6. c presence of mucus shows that it is coming from the middle ear.
7. d all other diseases cause pain.
8. a referred otalgia.

CHAPTER 04

Clinical Examination of the Ear

- Inspection
- Palpation
- Otoscopy
- Hearing tests
  - Voice test
  - Tuning fork tests
    - Rinne's test
    - Weber's test
    - Schwabach's or absolute bone conduction test
  - Hearing test in children
- Vestibular function tests
  - Spontaneous nystagmus
  - Fistula test
  - Romberg's test
  - Dix-hallpike test
  - Gait
  - Cerebellar function tests
  - Caloric test
  - Rotation test
- Facial nerve examination

Clinical examination of the ear, nose and throat requires proper illumination, without which examination is not possible. For illumination purpose, *head mirror* or *head light* is used (Fig. 4.1). Head mirror is a concave mirror having focal length of about 12 inches with a hole in its center, it reflects light from a light source *(Bull's eye lamp)* placed behind the patient. Head light is a direct source of light. Head mirror is cost effective, provides even better illumination but its manipulation is difficult and requires greater skill and practice. Head light provides a direct source of light, easier to use and position of the patient and examiner can be manipulated if required.

The proper position of the patient and examiner is very important for adequate ENT examination(Fig. 4.2 and 4.3). During ear examination, the patient is seated sideways on a revolving chair or stool and the examiner sits opposite the patient, on the side, which is examined. The patient and the examiner should be at the same level and approximately at one arm length distance apart. Before starting examination, the examiner must greet the patient, introduce himself, explain the procedure, take consent and expose the part properly. The clinical examination of the ear consists of:

1. Inspection.
2. Palpation.
3. Otoscopy.
4. Hearing tests.
5. Vestibular function tests.
6. Facial nerve examination.

Fig. 4.1: Head light and head mirror.

Fig. 4.2: Method of holding a child during ENT examination.

INSPECTION

Inspection of the ear begins by inspecting the pinna and structures around the pinna including the lateral surface of pinna, preauricular region, medial surface of the pinna, mastoid region, concha and external auditory meatus. These areas are examined for any abnormality such as swelling, redness, scar, edema, sinus, growth, discharge, skin lesions, etc. External auditory canal is sigmoid shaped, so it has to be straightened first. This is done by pulling the pinna upwards, outwards and backwards in adults and backwards and outwards in children. In infants, owing to the non-development of the bony canal, the auricle has to be drawn backwards and downwards. Sometimes, it is not possible to see the entire length of the canal by this maneuverer due to the presence of hair or slit like external opening. So the ear speculum is used to examine the deeper part of the external auditory canal and tympanic membrane. The ear speculum is held by the thumb and index finger in ipsilateral hand i.e. in left hand if examining the left ear (Fig. 4.3). The speculum is introduced by a slight rotatory movement and must not be inserted beyond the junction of cartilaginous and bony part of the canal. The walls of the external auditory canal are examined for any abnormality or skin lesion. The lumen of the external auditory canal is examined for presence of wax, foreign body, fungus, growth or discharge etc. If discharge is present, it should be cleaned and its content must be noted for color, quantity, consistency, foul smell and presence of blood.

The tympanic membrane is then examined for color, position and landmarks. A normal ear drum is semi-transparent, pearly white to grey in color. It is oval in shape showing handle of malleus, cone of light, umbo, anterior and posterior malleolar folds. It is divided into four quadrants by two imaginary lines, one is drawn along the handle of malleus and the other is drawn horizontally through the umbo (Fig. 1.5). The tympanic membrane is then examined for perforation. If perforation is present, its size (e.g. pinhole, small, medium, large or subtotal), shape (e.g. round, oval, kidney shaped or irregular), site (e.g. anterior, posterior or inferior), type (e.g. attic, marginal or central) and number (single or multiple) must be noted. When the margins of perforation touch the margin of tympanic membrane, it is called 'marginal' perforation and if the margins of perforation are distinct and away from the margins of tympanic membrane, it is called 'central' perforation (Fig. 4.4).

The mobility of tympanic membrane is checked by 'Valsalva maneuverer' or by 'Siegle's pneumatic' speculum. In Valsalva maneuverer the patient is asked to close his nose and lips and breathe out with force, so the pressure in the nasopharynx rises forcing air through the eustachian tube into the middle ear and causes the tympanic membrane to bulge out. This can be seen by an ear speculum or by an otoscope (Fig. 4.5). By Siegel's pneumatic speculum (see chapter 55) the pressure in the external auditory canal is raised by compressing its bulb and the mobility of the tympanic membrane is checked.

PALPATION

Palpation is done over the mastoid region for tenderness which is positive in cases of acute mastoiditis. The tragus

Fig. 4.4: Different types of perforations.

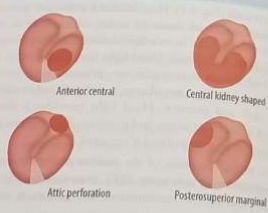
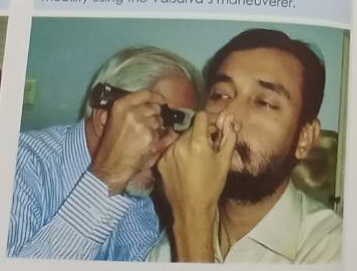


Fig. 4.3: Examination of the left ear with aural speculum.

Fig. 4.5: Checking the tympanic membrane for mobility using the Valsalva's maneuverer.



is pressed for tenderness, which is present in cases of boils within the ear. Pinna is tender in cases of boils and perichondritis of the ear. Palpation of the lymph nodes draining the ear and other cervical lymph nodes is done (see chapter 33).

OTOSCOPY

An otoscope is used to see the tympanic membrane under magnification, so that different pathologies can be seen in detail (Fig. 4.6 and 4.7). Otoscope is held in the ipsilateral hand i.e. if examining right ear then otoscope is held in right ear like a pen or pencil and to stabilize your hand during otoscopy the little finger of your hand can be placed on the patient's head just in front of the ear. Video otoscopes are now available in most clinical setups for examination and recording of the findings which can be shown to the patients and attendants as well. Examination under microscope (EUM) is another option for assessing pathologies of external auditory canal and tympanic membrane under high magnification.

HEARING TESTS

During assessment of the hearing function in adults, the basic aim of clinical examination is to find out the severity or degree and the type of deafness. Severity of deafness is assessed by *'voice test'* while the type of deafness is assessed by performing different *'tuning fork tests'*.

Fig. 4.6: An otoscope.

Fig. 4.7: Examination with an otoscope.

Voice Test

Turn the patient on one side so that his ear faces the examiner. Block the other ear by putting the patient's index finger on the external auditory meatus. Put your hand to shield patient's eye so as to reduce guessing by lipreading (Fig. 4.8). Now at a distance of about one arm length, say some numbers or words in a low whisper and ask the patient to repeat it. If the patient is unable to hear a low whisper, raise your volume and repeat the procedure till the patient can hear. It is not a quantitative test instead it gives a rough idea about the severity of deafness and standardization is difficult to achieve.

Tuning Fork Tests

Normally in clinical practice the tuning fork of 512 Hz frequency is used (Fig. 4.9). Three tuning fork tests are commonly done in clinical practice.

1. Rinne's test.

Fig. 4.8: Method of performing voice test.

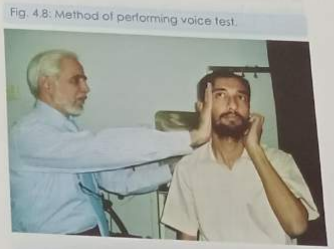
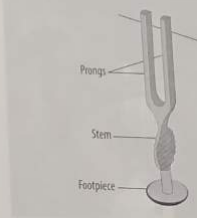


Fig. 4.9: Tuning fork and its parts.



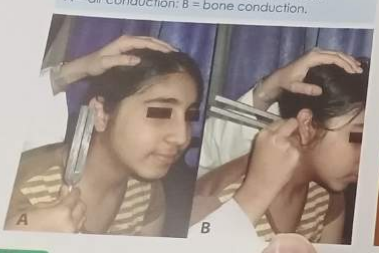
2. Weber's test.
3. Schwabach's or absolute bone conduction test.

The final diagnosis about the type of deafness is made by interpreting the results of all the three tuning fork tests.

1. Rinne's Test

In this test, air conduction is compared with bone conduction of the same ear of the patient. Air conduction is checked first by placing a vibrating tuning fork near the external auditory meatus with acoustic axis parallel to the canal (Fig. 4.10). When the patient stops listening through air conduction, the footpiece of tuning fork is placed over the mastoid process to check bone conduction and ask the patient whether he can listen to the sound (Fig. 4.10). Normally air conduction is better than bone conduction (for tuning fork only), so the patient will not hear through bone conduction after he stops hearing through air conduction. This is called Rinne's positive. Whenever there is a defect or pathology in the sound conducting system (conductive deafness), the air conduction will be less than the bone conduction and the patient will hear the sound through bone conduction after he stops hearing through air conduction. This is called Rinne's negative. The finding can be confirmed by performing the test in reverse order i.e. bone conduction is checked first followed by air conduction. There is one another quick method of doing Rinne's test in a busy OPD. First perform air conduction and then immediately put the same vibrating tuning fork on mastoid bone. Ask the patient which sound is better either air conduction or bone conduction. In sensorineural deafness both the air conduction and bone conduction will be reduced equally, with the air conduction still being better than the bone conduction. This is called Rinne's reduced positive. In profound or total sensorineural deafness, while performing bone conduction, sound may be perceived by the other ear. This gives a wrong impression that bone conduction is better than air conduction and so is called Rinne's false negative.

Fig. 4.10: Method of performing Rinne's test. A = air conduction; B = bone conduction.



2. Weber's Test

This is also called the test of lateralization. In this test, bone conduction of both ears of the patient is compared. Footpiece of a vibrating tuning fork is placed over the forehead or the vertex in the midline and the patient is asked where they can hear it. (Fig. 4.11) Normally, the patient will hear it to the same extent in both ears or will hear it in the center. In conductive type of deafness, the sound will be lateralized towards the disease or the worse ear and in sensorineural deafness, it will be lateralized to the better ear.

3. Schwabach's or Absolute Bone Conduction Test

It is called the *test of nerve deafness* and determines the cochlear reserve. The bone conduction of the patient is compared with the bone conduction of examiner. The foot piece of a vibrating tuning fork is placed first over the mastoid tip of the patient for bone conduction (similar to bone conduction in Rinne's test). When the patients says he cannot listen to the sound any more, the same tuning fork is placed on the mastoid tip of the examiner (yourself) and listen for the sound. If the tuning fork is still vibrating and a sound is heard, it means patient's hearing (bone conduction) is less than the examiner. This finding is present in cases of sensorineural deafness, where cochlear reserve of the patient is less. In a normal ear, bone conduction of the patient is equal to that of examiner, thus on putting tuning fork on examiner's mastoid tip, no sound is heard. In conductive deafness bone conduction of the patient may be equal or more than the examiner (prolonged), thus on putting the tuning fork on examiner's mastoid tip, again no sound is heard.

Absolute bone conduction test is similar to Schwabach's test, except that in this test external auditory canal is blocked to eliminate air conduction.

Hearing Test in Children

In case of a child, if mother suspects that the child is deaf, he/she should be considered deaf until proved

Fig. 4.11: Method of performing Weber's test.

otherwise. Hearing assessment in children depends on the age and mental status of the child. At about 3 months of age, 'smiling' is present i.e. the child quietens in response to a sound stimuli. At 5 months of age, a child can move his/her eyes and at 6 months, he/she can move the head in response to a sound stimuli. A 'distraction test' can be employed after 7 months of age. The child is seated on the mother's lap, one person tries to distract the child from the front while another person either from behind or the sides from the sides, produces some sound stimuli. As a response to this, the child tries to locate the sound by moving his/her head towards the sound.

VESTIBULAR FUNCTION TESTS

Evaluation of the vestibular system must be considered in a patient having a complaint of vertigo. A full oto-neurological history and examination must be carried out in these cases. Following are the important clinical and laboratory tests for assessing vestibular function:

Spontaneous Nystagmus

Nystagmus is involuntary, rhythmical, often jerky oscillations of the eyes which may be horizontal, vertical or rotatory in nature. Horizontal nystagmus is often due to vestibular or cerebellar dysfunction. Nystagmus due to vestibular dysfunction has a slow and a fast component. The direction of the nystagmus is indicated by direction of the fast component. The examiner keeps his index finger at about 12 inches distance from the patient's eyes in the midline and moves in right, left, up and down position and checks for nystagmus in the eyes. (Fig. 4.12)

Fistula Test

Fistula test is used in detecting a fistula or communication between the labyrinth and the middle ear. The fistula is formed where part of the bony wall of the inner ear is eroded by disease with exposure of endosteum. The pressure in the external auditory canal is increased by repeatedly pressing the tragus inwards with the thumb or a finger. (Fig. 4.13) This pressure is transmitted to the fluid in the labyrinth through the fistula and induces nystagmus.

Fig. 4.12: Method of checking spontaneous nystagmus.

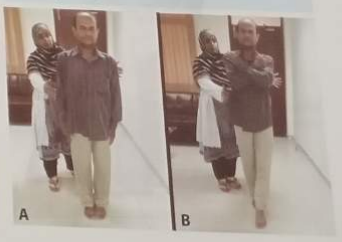
Romberg's Test

In this test, patient is asked to stand bare feet closed together, arms by his sides, eyes open and looking forward. Then, he is asked to close his eyes and the examiner looks for swaying of the patient on either side. For safety of the patient, it is essential that the observer should stand close to him to prevent potential injury if he falls (Fig. 4.14A). In peripheral vestibular lesion, the patient always sways towards the side of lesion.

The Sharpened or Tandem Romberg test is a variation of the original test but its implementation is mainly the same. In this test, the patient has to place his feet in heel-to-toe position, with one foot directly in front of the other. The patient also crosses his arms over his chest, and the open palm of the hand lies on the opposite shoulder (Fig 4.14B). The assessment is performed first with the eyes open and then with eyes closed.

Fig. 4.13: Method of performing fistula test.

Fig. 4.14 A: Romberg's test B: Sharpend or Tandem Romberg's test.



Dix-Hallpike Test

The Dix-Hallpike test is the maneuverer used to diagnose the cause of a vertigo in certain cases. This test is performed with the patient sitting on the examination couch in an upright position with the legs extended. The patient's head is then rotated to one side by approximately 45°. (Fig. 4.15 a) While holding his head, the patient is lowered quickly to lie down in supine position and the head is extended approximately 20° over the edge of the couch. (Fig. 4.15 b) The patient's eyes are then observed for nystagmus for about 45 seconds and the patient is then brought back in an upright position. The test is repeated again by turning the patient's head on the opposite side. This test is typically positive in cases of benign parosysmal positional vertigo, where characteristically the nystagmus is rotational, with 5–10 seconds of latency period and fatigable on repeated testing. In the positive test, the fast phase of the rotatory nystagmus is toward the affected ear, which is the ear closer to the ground.

Gait

Gait of the patient is checked by asking him to walk in a straight line with both open and closed eyes.

Cerebellar Function Tests

Following are the important cerebellar function tests, which should be performed on a patient complaining about experiencing vertigo.

1. Rapid alternating movements (dysdiadocokinesia)
2. Test for coordination or finger-nose test.
3. Test for rebound phenomenon (positive).
4. Test for tone and power (hypotonia and reduced power).
5. Speech (slurred speech).

Caloric Test

Caloric test is an important laboratory test for assessing vestibular function. The main advantage of this test is that each labyrinth can be tested separately. The principle of caloric test is to stimulate the *lateral semicircular canal* and measure the nystagmus induced as a result. The patient lies with the head at an angle of 30° so that the lateral semicircular canal is brought into a vertical plane.

Water is introduced into the ear 7°C above and below the body temperature (30° and 44°C) for 40 seconds. This induces convectional currents within the lateral semicircular canal and causes the flow of endolymph. Cold water cools the most superficial part of the canal and cooler fluid tends to fall causing a movement of endolymph away from the ampulla. The reverse occurs by the introduction of warm water. The nystagmus is noted either directly or by electronystagmography. In normal individuals, this nystagmus lasts for 2 to 3 minutes (120–180 seconds). When there is a depression of vestibular function on one side the response to warm and cold water on that side will be diminished and known as 'canal paresis'. (Fig. 4.16) Canal paresis is suggestive of a lesion in the peripheral vestibular apparatus. *No response on a caloric test is obtained in case of a 'dead labyrinth'.*

Rotation Test

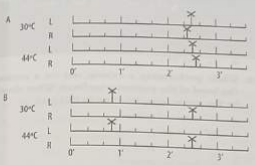
In a rotation test, both the labyrinths are stimulated simultaneously. Therefore they have very little clinical application.

FACIAL NERVE EXAMINATION

As the facial nerve passes through the temporal bone, it is intimately related with the ear. Many diseases of the ear can affect the facial nerve and cause facial palsy. So the examination of the facial nerve for its integrity must be done with the examination of the ear (see chapter 15).

Fig. 4.15: Method of performing Dix-hallpike test.

Fig. 4.16: Caloric test: A = normal, B = left sided canal paresis.



Checklist for Clinical Examination of the Ear

1. Greet and introduce yourself.
2. Explain the procedure.
3. Take appropriate consent.
4. Sit in a proper position.
5. Expose the examining part properly.
6. Illuminate the part properly with a head light or head mirror.
7. Begin by inspection of:
   a. lateral surface of the pinna.
   b. preauricular region.
   c. mastoid region.
   d. medial surface of the pinna.
   e. concha and external auditory meatus.
8. Examine external auditory canal by pulling pinna in the proper direction.
9. Hold the ear speculum in a proper way.
10. Clean the external auditory canal (if wax or discharge is present).
11. Assess characteristics of the discharge (if present).
12. Check the tympanic membrane and its mobility.
13. Palpate the following regions:
    a. preauricular region.
    b. tragus.
    c. mastoid region.
    d. cervical lymph nodes.
14. Perform a voice test.
15. Perform tuning fork tests:
    a. handle the tuning fork correctly.
    b. strike the tuning fork against a hard surface properly.
    c. perform air conduction test properly.
    d. perform bone conduction test properly.
    e. perform Weber's test properly.
    f. perform Schwabach's/ABC test properly.
    g. interpret the result properly.
16. Perform vestibular function tests.
    a. Spontaneous nystagmus.
    b. Fistula test.
    c. Romberg's test.
    d. Dix-Hallpike's test.
    e. Gait.
    f. Cerebellar functions tests.
17. Check facial nerve functions:
    a. wrinkling on forehead.
    b. closing of eyes.
    c. movement of alae nasi.
    d. showing teeth.
    e. whistling.
    f. blowing air.
18. Examine the other ear in the same way.
19. Dispose the used instruments properly.
20. Record the findings adequately.
21. Rewrap the exposed part and say thanks.

Best Choice Questions

Q1. What is the name for perforation in pars flaccida of the tympanic membrane?

a. attic perforation.
b. central perforation.
c. marginal perforation.
d. peripheral perforation.

Q2. Which of the following perforation is typically associated with attico-antral type of chronic suppurative otitis media?

a. anteroinferior central perforation.
b. central kidney shaped perforation.
c. pin hole central perforation.
d. posterosuperior marginal perforation.

Q3. Voice test was performed during the clinical examination of the ear on a 32-year-old patient. What parameter can you assess on this test?
a. cause of deafness.
b. frequencies affected by deafness.
c. severity of deafness.
d. type of deafness.

Q4. Rinne's test was performed on a patient who had a bone conduction greater than air conduction in his right ear. Which of the following is the most likely cause for it?
a. labyrinthitis.
b. Meniere's disease.
c. noise induced deafness.
d. otosclerosis.

Q5. Rinne's test was performed on a patient who had complaint of deafness in both ears, it showed positive in both ears. Which of the following condition is the most likely cause for it?
a. acro-otitis.
b. chronic suppurative otitis media.
c. glue ear.
d. noise induced deafness.

Q6. Weber's test was performed on a patient and the result showed that it is lateralized towards his right ear. What is the likely possibility for this?
a. there is conductive type of deafness in left ear.
b. there is conductive type of deafness in right ear.
c. there is sensorineural type of deafness in both ears.
d. there is sensorineural type of deafness in right ear.

Q7. Weber's test was performed on a patient complaining of deafness in both ears, the result showed that it was centralized. Which of the following is the most likely possibility for this?
a. there is conductive deafness in the left ear and sensorineural deafness in the right ear.
b. there is conductive deafness in the right ear and sensorineural deafness in the left ear.
c. there is conductive deafness in the right ear.
d. there is equal conductive deafness in both ears.

Q8. A child was brought to the OPD with the complaint of deafness since birth. What should be the minimum age of the child for the distraction test to be performed?
a. 1 month.
b. 3 months.
c. 5 months.
d. 7 months.

Q9. During caloric test, hot and cold water is introduced in the external auditory canal. What should be the temperature of water in this test?
a. 28° and 40°C.
b. 30° and 38°C.
c. 30° and 44°C.
d. 32° and 44°C.

Q10. While performing a caloric test on a patient, the head of the patient is inclined. What should be the angle of inclination in this test?
a. 20° from the ground.
b. 30° from the ground.
c. 40° from the ground.
d. 50° from the ground.

Q11. While performing caloric test, the inner ear is stimulated with hot and cold water. Which of the following part of the inner ear is stimulated in this test?
a. lateral semicircular canal.
b. posterior semicircular canal.
c. superior semicircular canal.
d. utricle.

Q12. Tuning fork tests were performed on a patient. The result for Rinne's test was positive in both ears and the result of Weber's test was lateralized towards the right ear. What is the most likely possibility for this?
a. moderately severe conductive deafness in both the ears.
b. moderately severe conductive deafness in the right ear.
c. moderately severe sensorineural deafness in the left ear.
d. moderately severe sensorineural deafness in the right ear.

Answers with Explanations

1. a also called as pars flaccida perforation.
2. d attico-antral type of CSOM is typically associated with posterosuperior or attic perforation.
3. c through voice test we can only assess severity of deafness.
4. d.
5. d.
6. b it will be lateralized towards the diseased ear.
7. d.
8. d.
9. c 7° above and below body temperature.
10. b so lateral semicircular canal will become vertical.
11. a.
12. c.

CHAPTER 05

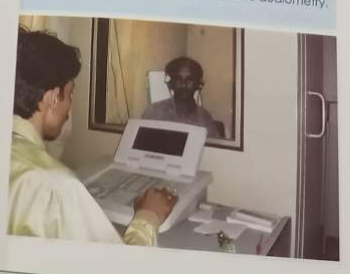
Audiometry

- Pure Tone Audiometry (PTA)
- Speech audiometry
- Impedance audiometry
  - Type A
  - Type A_s
  - Type A_D
  - Type B
  - Type C
- Brainstem Evoked Response Audiometry (BERA)
- Otoacoustic emissions

Audiology is the science of hearing. It includes all the aspects like acoustics, physiology of hearing, disorders of hearing, functional examination of hearing, education and rehabilitation of the deaf, hearing aids and cochlear implants. *Audiometry* is the measuring of hearing acuity. Hearing requires far more than just intact ear and its central connections. It is a perceptive process including the ability to detect sounds and then to associate these sounds with a specific memory, so that it becomes meaningful. Audiometry is broadly classified into two types:

1. *Subjective audiometry:* It shows the entire system functions and needs the patient's response. Commonly performed subjective audiometry include 'pure tone audiometry' and 'speech audiometry'.
2. *Objective audiometry:* It identifies response to sound stimuli at lower neurological and peripheral level and does not need a patient's response. Commonly used objective audiometry include 'impedance audiometry, 'Brainstem Evoked Response Audiometry (BERA)' and 'otoacoustic emission'.

Fig. 5.1: Method of performing pure tone audiometry.

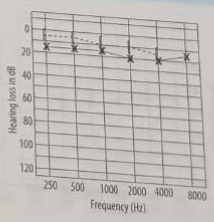


PURE TONE AUDIOMETRY (PTA)

This is the most common method of measuring hearing acuity. As the name suggests, pure tones are delivered to the ear by an audiometer (Fig. 5.1) through a suitable earphone (air conduction) or by a vibrator applied to the mastoid (bone conduction). The testing frequencies usually range from 250Hz to 8000Hz at intensities from 0dB to 120dB, in 5dB steps. A series of short signals or tone pips are put and the patient is instructed to signal every time he hears the sound. In this way, threshold for hearing in particular frequencies are noted for both air conduction and bone conduction. The results are charted on a graph like pattern as an audiogram.

In individuals with normal hearing, both air conduction and bone conduction lines lie within 0 to 25 dB with no air bone gap (Fig. 5.2). In individuals having conductive type of deafness, the air conduction line goes down while the bone conduction line remains within normal limits. This gap between the lines of air conduction and bone conduction is called the 'air bone gap' and it shows the severity of

Fig. 5.2: Pure tone audiogram of an individua with normal hearing.



conductive loss (Fig. 5.3). In sensorineural deafness, both air conduction and bone conduction are affected and both lines go down with no air bone gap in between (Fig. 5.4). In mixed type of deafness, both air and bone conductions go down but still there is an air bone gap in between (Fig. 5.5). This air bone gap shows severity of conductive loss while sensorineural loss is measured by bone conduction line.

SPEECH AUDIOMETRY

This measures the patient's ability to understand speech. A series of pre-recorded words are presented to the patient through an earphone. The words are phonetically balanced to encompass the whole speech range from 500Hz to 2000Hz and the intensity is varied. The results are charted by recording the total percentage of words correctly repeated by the patient. This score is called *'speech discrimination score'* (SDS) or 'speech recognition score'. In an individual with normal hearing, 100% discrimination score is generally achieved. In an individual having conductive type of deafness, 100% or near discrimination score is achieved but at a higher intensity level. In sensory deafness patients are unable to reach high score. The usual score remains between 50% to 70%. Classically, in a neural type of deafness, discrimination score is very poor, about 30% or less. Patients who achieve good discrimination score on speech audiometry are likely to be benefited more by a hearing aid than patients having poor discrimination score. Another parameter that is assessed on speech audiometry is the *'speech reception threshold'*. It is the minimum intensity of sound at which 50% of the double syllable words are correctly repeated by the patient.

IMPEDANCE AUDIOMETRY

This test is now widely used and provides a quick objective measurement of the state of middle ear. A tone played into the ear will be partly absorbed and partly reflected back from the surface of the tympanic membrane (Fig. 5.6). The sound energy which is reflected back

Fig. 5.3: Pure tone audiogram of a person with conductive deafness.

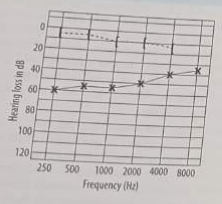


Fig. 5.4: Pure tone audiogram of a person with sensorineural deafness.

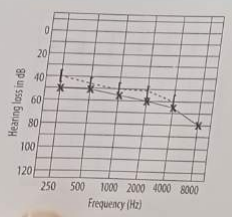


Fig. 5.5: Pure tone audiogram of a person with mixed type of deafness.

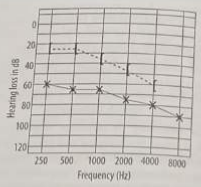


Fig. 5.6: Mechanism of impedance audiometry. Sound is delivered by a loudspeaker and the reflected sound is recorded by a microphone. Air pressure in the external auditory canal is changed and recorded by the third tube.

depends upon the compliance of the tympanic membrane. This reflected sound is measured using a microphone. If the tympanic membrane is stiff, more of the sound is reflected back as compared to if the tympanic membrane is mobile. The tympanic membrane can be made artificially stiffer by changing the pressure in the external auditory canal using a small air pump attached to a manometer. An ear probe of the impedance audiometer has three channels or tubes. One is connected with a speaker to deliver sound, second is connected to a microphone to record the reflected sound and the third is connected to an air pump to change pressure in the external auditory canal (Fig. 5.6 to 5.8). Changes in the acoustic impedance is automatically plotted as a graph against the pressure changes. The compliance is maximum when the pressure in the external auditory canal is equal to the middle ear pressure. The compliance decreases as pressure in the external auditory canal becomes more or less than the middle ear pressure. In this way, we can indirectly measure pressure of the middle ear. Thus, by this method we can measure compliance of the ear i.e. how much sound is absorbed and how much is reflected back and also the pressure in the middle ear (tympanometry). Secondly, we can also assess the stapedial reflex or acoustic reflex. It is a protective reflex against a loud sound, which causes contraction of the stapedius muscle and stiffening of the ossicular chain. This stiffening of the ossicular chain causes reduction in the middle ear compliance and can be recorded by impedance audiometer. In tympanometry, different types of graphs are obtained called the tympanogram. Following are the different types of tympanogram:

1. **Type A**

   It is present in individuals having normal middle ear compliance and pressure (Fig. 5.9).

2. **Type A_S**

   In this type of tympanogram, compliance is low but the middle ear pressure is normal (Fig. 5.10). This type of graph is obtained characteristically in conditions where the ossicles are fixed like otosclerosis or tympanosclerosis.

Fig. 5.7: Ear probe of the impedance audiometer with three tubes.

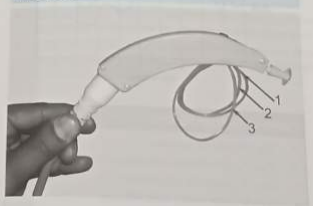


Fig. 5.8: Method of performing impedance audiometry.

Fig. 5.9: Type A tympanogram.

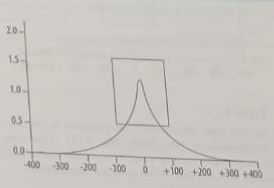


Fig. 5.10: Type AS tympanogram.

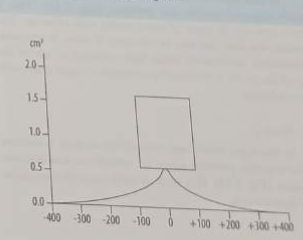


Fig. 5.11: Type A_D tympanogram.

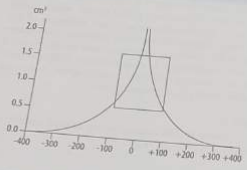


Fig. 5.12: Type B tympanogram.

3. Type A_S

In this type, the middle ear pressure is normal but the compliance is very high (Fig. 5.11). This type of graph is typically seen in cases of ossicular dislocation or disconnection and thin or lax tympanic membrane.

4. Type B

In this type, characteristically a flat curve is obtained with negative middle ear pressure (Fig. 5.12). This is seen typically in cases of otitis media with effusion. The similar flat line can also be obtained if there is tympanic membrane perforation (with high volume) or where the tip of the probe is blocked by cerumen or canal wall (with low volume).

5. Type C

In this type, maximum compliance or peak is present in the negative pressure range i.e. middle ear has negative pressure (Fig. 5.13). It is seen in early cases of eustachian tube dysfunction.

Fig. 5.13: Type C tympanogram.

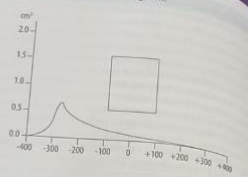
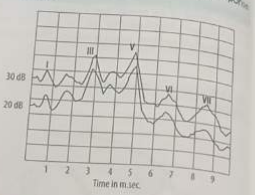


Fig. 5.14: Wave pattern in brainstem evoked response audiometry.



Types of Tympanograms

- Type A: normal person.
- Type A_S: otosclerosis, tympanosclerosis.
- Type A_D: ossicular dislocation.
- Type B: otitis media with effusion.
- Type C: eustachian tube dysfunction.

BRAINSTEM EVOKED RESPONSE AUDIOMETRY (BERA)

This is also called *Auditory Brainstem Response (ABR)*. This is the measurement of physiological electrical events occurring in the brainstem in response to a sound stimulation. The electrodes are placed on the mastoid bone, forehead and vertex. By giving sound stimuli in the ear, a series of waves (wave I to VII) are obtained, which can be recorded on a paper (Fig. 5.14). Among all these waves, wave I, III and V are most important. These waves are studied for their absolute latency, interwave latencies. It is useful in demonstrating the integrity of central connections of hearing.

BERA is mostly used for determination of hearing threshold in children, infants or even newborn, who cannot be tested otherwise by subjective audiometry. BERA is considered as an effective screening tool in the evaluation of suspected retrocochlear pathologies like acoustic neuroma or vestibular schwannoma. In addition, it can be used for intraoperative monitoring during neuro-orologic surgeries, monitoring of hearing status in the ICU or of comatosed patients and determination of hearing threshold in cases of malingering.

OTOACOUSTIC EMISSIONS

Otoacoustic Emissions (OAE) are acoustic signals emitted from the cochlea by the outermost hair cells and transmitted to the middle ear and into the external ear canal where they are recorded. They are most probably generated by active mechanical contraction of the outer hair cells. They are either spontaneous (spontaneous otoacoustic emission, SOAE) or are generated as a response to a sound stimuli (evoked otoacoustic emission). The otoacoustic emissions can be recorded with a sensitive microphone placed in the sealed external auditory canal. The absence of otoacoustic emission indicates disorder of the outer hair cells like in congenital deafness, ototoxicity and acoustic trauma. It is usually normal in cases of retrocochlear hearing loss as the outer hair cells are normal. Thus, the main use of this tool is in the screening of the neonates and uncooperative patients while also to distinguish between cochlear and retrocochlear deafness.

Chapter Summary and Key Points

Audiometry is broadly classified into subjective and objective types. In the subjective type, Pure Tone Audiometry (PTA) and speech audiometry are important. In objective type, impedance audiometry (tympanometry), Auditory Brainstem Response (ABR or BERA) and otoacoustic emission are important. In PTA we can assess type, nature and degree of deafness. In tympanometry we can measure middle ear compliance, middle ear pressure and stapedial reflex. ABR is an important objective method to assess hearing threshold in children, infants and even new born babies.

Difficult words

- *Cochlear deafness:* This is a condition when there is a lesion within the cochlea resulting in deafness, Perceptive deafness and sensory deafness are two types e.g. ototoxicity, noise induced deafness.
- *Retrocochlear deafness:* Any lesion beyond the sensory organ or cochlea i.e. from the spiral ganglion till the higher center or auditory cortex is called retrocochlear or neural deafness e.g. acoustic neuroma, CVA.

Best Choice Questions

Q1. What is the usual frequency range tested in pure tone audiometry?
a. 32 to 512 Hz.
b. 250 to 8000 Hz.
c. 128 to 1024 Hz.
d. 512 to 2048 Hz.

Q2. Pure tone audiogram was performed on a 30-year-old male patient which showed an air bone gap of 40 dB in most frequencies with a normal bone conduction line. What is the likely possibility for this among the following?
a. patient has conductive deafness of 40 dB.
b. patient has sensorineural deafness of 40 dB.
c. patient has mixed deafness of 40 dB.
d. patient has mixed deafness of 80 dB.

Q3. Speech audiometry was done on a 20-year-old lady of chronic suppurative otitis media with mild to moderate conductive hearing loss. What will be the expected speech discrimination score in this patient?
a. nearly 30%.
b. nearly 50%.
c. nearly 70%.
d. nearly 100%.

Q4. Which of the following parameters cannot be assessed by impedance audiometry?
a. acoustic reflex.
b. middle ear compliance.
c. middle ear pressure.
d. type of deafness.

Q5. Tympanogram was performed on a 24-year-old male patient which showed type B tympanogram. What is the most likely diagnosis?
a. Meniere's disease.
b. otitis media with effusion.
c. otosclerosis.
d. presbycusis.

Q6. Tympanogram of a 20-year-male patient showed type A_D tympanogram. What is the likely possibility for this?
a. middle ear effusion.
b. ossicular chain dislocation.
c. ossicular chain fixation.
d. otosclerosis.

Q7. In which of the following assessment, Brainstem Evoked Response Audiometry (BERA) is most useful?
a. to assess fluid in the middle ear.
b. to assess hearing threshold in infants.
c. to assess status of the ossicular chain continuity.
d. to measure middle ear compliance.

Q8. Which of the following are subjective type of audiometry?
a. impedance and speech audiometry.
b. pure tone and impedance audiometry.
c. pure tone and speech audiometry.
d. speech and brainstem evoked response audiometry.

Q9. Which of the following are objective type of audiometry:
a. impedance and brainstem evoked response audiometry.
b. impedance and speech audiometry.
c. pure tone and impedance audiometry.
d. speech and brainstem evoked response audiometry.

Answers

1. b.
2. a.
3. d.
4. d.
5. b.
6. b.
7. b.
8. c.
9. a.

Congenital Malformations of the Ear

CHAPTER 06

- Congenital malformations of the external ear
  - Preauricular sinus or cyst
  - Atresia of external auditory meatus
  - Complete or partial absence of auricle
  - Accessory auricle
  - Anomalies in size or shape of pinna
- Congenital malformations of the middle ear
  - Treacher collin's syndrome
  - Abnormal ossicles
  - Congenital fixation of stapes
  - Others
- Congenital malformations of the inner ear

CONGENITAL MALFORMATIONS OF THE EXTERNAL EAR

The more extensive congenital defects of the external ear may be associated with other anomalies in the middle ear, inner ear, face and lower jaw Following are the common congenital malformations of the external ear.

Preauricular Sinus or Cyst

Preauricular sinus forms due to failure of complete fusion between the first and second branchial arch elements in the auricle. External opening of preauricular sinus is situated between the tragus and crus helix (Fig. 6.1). A cyst may develop in the tract. Usually no symptoms are produced except a visible opening in front of the ear. However, the sinus or cyst may get infected and produce symptoms (Fig. 6.2). These symptoms are pain, swelling, redness and discharge. After treating the infection, complete surgical excision of the cyst and sinus tract is needed.

Fig. 6.1: Preauricular sinus.

Atresia of External Auditory Meatus

Atresia is characterized by non-canalization of the external auditory canal (Fig. 6.3). It is often associated with a microtia. A patient who has conductive deafness, on examination, there will be absence of the external auditory meatus. This is treated by reconstructive surgery of the external auditory canal.

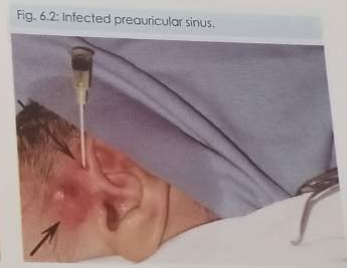
Complete or Partial Absence of Auricle

Anomalies of the pinna occurs due to failure of the development of the six auricular tubercles. Anotia is the complete absence of the pinna. This condition is treated by a reconstructive surgery.

Accessory Auricle

As mentioned earlier, the pinna is developed from six tubercles of the first and second arch, which fuse together. Sometimes, one of them fails to do so and forms the

Fig. 6.2: Infected preauricular sinus.



accessory auricle (Fig. 6.4). It is treated by surgical removal of that part.

Anomalies in size or shape of pinna

Microtia is a small pinna (Fig. 6.5). Bat ear or Lop ear is an unusually big, outwardly projecting pinna (Fig. 6.6). Treatment for this is a plastic reconstructive surgery.

CONGENITAL MALFORMATIONS OF THE MIDDLE EAR

Various degrees of developmental failure of the middle ear cavity and ossicles can occur causing conductive type of deafness. It may be unilateral or bilateral. Severe abnormalities of the middle ear cleft are usually associated with deformity of the external ear. The inner ear being of different origin, may not always be involved. The origin of the deformities may be either genetic or teratogenic.

Treacher Collin's Syndrome

It is also called the 'first arch syndrome'. This is a hereditary malformation of the lower face, which is hypoplastic together with varying degree of developmental failure of the external and middle ear (Fig. 6.7). It may be unilateral or bilateral.

Abnormal Ossicles

Ossicles are deformed most commonly the incus and malleus. The ossicles may either be fused together or sometimes to the bony wall of the middle ear cavity. This is treated by the removal of the deformed ossicles, followed by a tympanoplasty.

Congenital Fixation of Stapes

In this condition, a footplate of stapes is congenitally fixed to the oval window or may be fused into into the window. This is treated by performing a 'stapes mobilization' operation.

Others

Other anatomical abnormalities not causing deafness may be encountered during operation in the middle ear e.g. dehiscence of the facial nerve canal, dehiscence in the floor of the tympanic cavity and persistent stapedial artery etc.

Fig. 6.3: Atresia of the external auditory canal.

Fig. 6.5: Patient with microtia.

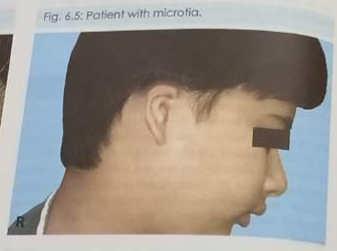


Fig. 6.4: Accessory auricle.

Fig. 6.6: Bat ear or Lop ear.

Fig. 6.7: Patient with Treacher collin's syndrome.

CONGENITAL MALFORMATIONS OF THE INNER EAR

The bony and membranous part of the labyrinth may be absent or show only rudimentary development. Four anatomical types are described:

1. *Scheibe dysplasia:* Involves the saccule and the cochlea. This type accounts for 70% of cases of hereditary deafness.
2. *Mondini dysplasia:* The cochlear duct is reduced to one and a half turns and the organ of Corti may be absent.
3. *Bing Siebenmann dysplasia:* In this condition, the membranous labyrinth is underdeveloped.
4. *Michael dysplasia:* There is total absence of both labyrinths.

Chapter Summary and Key Points

Congenital malformations may be present in any part of the ear. One congenital anomaly is usually associated with anomalies in other parts of the ear or somewhere else in the body. Anomalies in the external and middle ear may cause conductive type of deafness, while anomalies of the cochlea will lead to perceptive (sensory) type of deafness. Preauricular sinus is a common congenital anomaly and most of the time remains asymptomatic, unless it gets infected and produces symptoms. In anomalies involving the vestibular part of the inner ear, symptoms are usually not apparent. Malformations of the external and middle ear are treated by a reconstructive surgery. Deafness due to cochlear malformation is treated either by a 'hearing aid' or a 'cochlear implant'.

Best Choice Questions

Q1. Preauricular sinus results from failure of complete fusion between the branchial arches. Which of the branchial arches are responsible for this condition?

a. first and second branchial arch.
b. second and third branchial arch.
c. third and fourth branchial arch.
d. first and third branchial arch.

Q2. A 10-year-old girl was diagnosed with preauricular sinus on both sides. Where will you look for the sinus's external opening?

a. behind the tragus.
b. in front of crus helix.
c. in front of the ear lobule.
d. in front of tragus.

Q3. A 12-year-old boy came in with a history of recurrent infection in his preauricular sinus on the right side. At the time of presenting problem, the sinus was not infected. What should be its further management?

a. excision of the sinus tract.
b. marsupialization of the tract.
c. regular follow-up till the age of 18 years.
d. regular suction cleaning of the sinus.

Q4. What is the other name for 'Treacher Collin's syndrome'?

a. first arch syndrome.
b. second arch syndrome.
c. Scheibe dysplasia.
d. Bing Siebenmann dysplasia.

Answers with Explanations

1. a.
2. b it is mostly situated in front of the crus helix between the tragus and crus helix.
3. a surgical excision of the opening and the whole tract is the treatment.
4. a there is a malformation of the structures that develops from the first arch.

CHAPTER

07 Injuries Involving the Ear

- Injuries involving the external ear
  - Hematoma of the pinna
  - Frostbite
  - Lacerations and cuts
  - Foreign Body in the ear
  - Clinical features
  - Treatment
- Injuries involving the middle ear
  - Traumatic rupture of the ear drum
  - Traumatic dislocation of the ossicular chain
  - Fracture of the temporal bone
- Injuries involving the inner ear
  - Fracture of temporal bone
  - Direct trauma

INJURIES INVOLVING THE EXTERNAL EAR

Hematoma of the Pinna

A direct blow to the pinna, can rupture the blood vessels in the perichondrium. This leads to a collection of blood under the perichondrium (Fig. 7.1). A hematoma or serous effusion may sometimes occur spontaneously in elderly patients, if not treated properly, necrosis of the cartilage occurs as the cartilage draws its nutrition from the perichondrium. Necrosed cartilage is absorbed and replaced by fibrous tissues. This gives rise to a badly deformed, lobulated auricle called *'Cauliflower ear'* (Fig. 7.2). This condition is common in boxers due to repeated trauma, so is also called *'Boxer's ear'*.

A small hematoma or serous effusion can be aspirated with a wide bore needle. However, if it is large, incision and drainage has to be done. The pinna is then compressed with splints and dressing.

Fig. 7.1: Hematoma of the pinna (before and after aspiration)

Frostbite

Due to excessive exposure to cold, frostbite of the pinna may occur. Initially red or blue areas appear which later become white. The whole ear then swells up and becomes painful and finally gangrene of the pinna occurs. In the early stages of frostbite, gentle rewarming is required. In the later stages gangrenous portion is to be removed surgically.

Lacerations and Cuts

All degrees of lacerations and cuts are encountered on the pinna and external auditory canal. These should be repaired by primary suturing (Fig. 7.3) or reconstruction later on, accordingly.

Foreign Body in the Ear

Foreign bodies in the ear may be *animate* such as insects or *inanimate* such as bodies that are usually introduced

Fig. 7.2: Cauliflower ear or Boxer's ear.

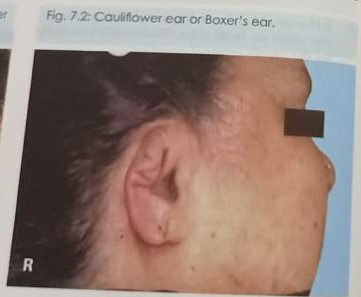
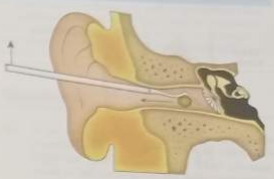


Fig. 7.3: Cuts on the pinna after a dog bite. A = before primary repair. B = after primary repair.

Fig. 7.4: Method for removal of smooth and rounded foreign body with a ring probe.



by children and mentally retarded people by themselves. Inanimate foreign body may be *hygroscopic* (which absorbs water) like seeds or *non-hygroscopic* (metals, plastic and other materials). A hygroscopic foreign body absorbs water and moisture present in the canal, swells up and gets impacted in the canal. Isthmus of the external auditory canal is its narrowest part and most of the foreign bodies are impacted in the isthmus.

Types of Foreign Bodies

1. Animate e.g. insects.
2. Inanimate:
   a. Hygroscopic e.g. seeds, peanut, beetle nut.
   b. Nonhygroscopic e.g. buttons, plastics, beads, rubber, stones, metal pieces etc.

Clinical Features

History of introducing foreign bodies in the ear may or may not be present. Symptoms produced by a foreign body depend upon the type and size of the foreign body. Deafness is present when the canal is totally obstructed. Pain may be present if it is impacted. Tinnitus and reflex cough may also be present. Sometimes bleeding from the ears or clots may be present because of a primary injury or injury during an attempt to remove foreign bodies by the patient or others.

Clinical Features of a Foreign Body in the Ear

- Usually children or mentally retarded person.
- History of foreign body introduction.
- Pain.
- Deafness.
- Tinnitus.
- Reflex cough.
- Bleeding from ears.

Treatment

Method of removal depends upon the size, site and type of foreign body present. Removal under general anesthesia is essential in children and sensitive adults. Smooth and rounded foreign body can be removed by a ring probe (Fig. 7.4). Forceps must not be used in such foreign bodies as it can push the foreign body further inside. Animate foreign bodies (insects) must be killed by an instilling spirit, oil or chloroform drops before syringing. Small pieces of foreign bodies can be removed through suction. Rarely, it is impossible to remove the foreign body through the meatus because of the site of impact and swelling in the canal. Such foreign bodies are removed by making a post-aural incision to allow extraction through the posterior wall of the canal (Fig. 7.5).

INJURIES INVOLVING THE MIDDLE EAR

Traumatic Rupture of the Ear Drum

Rupture or perforation of the tympanic membrane can occur by the following types of trauma:

a. Foreign bodies especially a sharp foreign body.
b. Unskilled instrumentation and syringing of the ear.
c. Sudden air compression e.g. a hand slap to the ear, a bomb blast and rapid descent in non-pressurized aircraft.
d. Sudden fluid compression as occur in under water swimming without proper protection.
e. Fractures of the temporal bone.
f. Forceful inflation of the middle ear by Valsalva's maneuverer especially if the tympanic membrane is thin.

Patient presents a history of trauma to the ear, followed by deafness, tinnitus, bleeding and sometimes vertigo. On examination, tympanic membrane is found to be found to be ruptured with congested and irregular margins (Fig. 7.6). Fresh bleeding or blood clots may be present in the external auditory canal.

Fig. 7.5: Method for removal of impacted foreign body through postauricular approach.

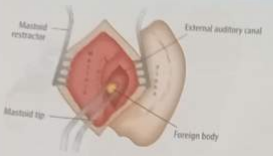


Fig. 7.6: Traumatic perforation in the left tympanic membrane with a blood clot.

Treatment includes prophylactic antibiotics to prevent infection. Ear drops are contraindicated in these cases. In addition swimming, diving and Valsalva's maneuverer must be avoided to prevent infection in the middle ear. Plugging of the auditory canal is advised by a sterile lubricated swab during bath to avoid entry of water into the middle ear. Majority of the traumatic perforations heal spontaneously. Myringoplasty is done if the perforation fails to heal after a period of four to six weeks.

Treatment of Traumatic Rupture of Ear Drum

- Prophylactic antibiotic.
- Ear drops are contraindicated.
- Avoid swimming, diving and Valsalva's maneuverer.
- Plugging of ear canal during bath.
- Myringoplasty: later on in persistent perforation.

Traumatic Dislocation of the Ossicular Chain

Dislocation or disconnection of the ossicular chain is caused by direct or indirect trauma to the head and temporal bone. Dislocation of the incudostapedial joint is the most common site.

Patient presents a history of trauma and moderate to severe deafness. On examination, the tympanic membrane is normal. Pure tone audiometry and impedance audiometry show the characteristic changes. On PTA, there will be conductive deafness with air bone gap. On impedance, there is a high peak compliance curve with normal middle ear pressure (type A_D, see Fig. 5.11). The condition is treated by a *tympanoplasty*.

Fracture of the Temporal Bone

Fractures of the temporal bone are classified into:

a. Longitudinal fracture.
b. Transverse fracture.

Longitudinal fracture is the most common type (about 80%). Fracture line is along the long axis of petrous temporal bone. It can involve the middle ear cavity, the tympanic membrane and the external auditory canal. Conductive type of deafness is present usually in such cases.

Transverse fractures are less common (about 20%). The fracture line is at right angle to the long axis of the petrous temporal bone. This type of fracture can involve the labyrinth and the internal auditory canal with sensorineural deafness as a result. Facial nerve paralysis is common in this type.

The diagnosis is made on history, clinical examination and investigations including imaging studies. CT scan has prime importance in locating the site and extent of the fracture. Management of such patients may require multidisciplinary approach of an ENT surgeon, a neurotologist and a neurosurgeon.

INJURIES INVOLVING THE INNER EAR

Fracture of the Temporal Bone

Discussed above.

Direct Trauma

Direct trauma to the labyrinth may be caused by a sharp foreign body penetrating through the middle ear and causing direct damage to the labyrinth. Direct trauma to the labyrinth may also be caused by bullet injuries. Patient will present a history of trauma and deafness, vertigo or both.

Chapter Summary and Key Points

Injuries may occur to any part of the ear. Hematoma of the pinna should be drained as early as possible to avoid necrosis of auricular cartilage. Ear drops are contraindicated in traumatic perforations of the tympanic membrane. Prophylactic antibiotic is required in most of the cases of trauma involving the ear. Foreign bodies are common in children and mentally retarded persons. Removal of rounded and smooth foreign bodies must not be tried with a pair of forceps as it will further push the foreign body deep into the canal.

Best Choice Questions

Q1. A young boxer came with hematoma formation on his right pinna after a fight. What is the likely complication that can arise if it is not treated properly?
a. bat ear.
b. cauliflower ear.
c. cavernous sinus thrombosis.
d. Gradenigo's syndrome.

Q2. A 19-year-old male patient came after a blunt trauma and was diagnosed with a hematoma formation on his left pinna. What is the usual location of this blood collection?
a. between the perichondrium and cartilage.
b. between the skin and perichondrium.
c. between the skin and subcutaneous tissues.
d. within the layers of the skin.

Q3. A father brought his 3-year-old son with the complaint that he had inserted a rounded bead in his right ear. What is the most common position for impact of such foreign bodies?
a. cartilaginous part of the external auditory canal.
b. the concha.
c. isthmus of the external auditory canal.
d. junction of the cartilaginous and the bony part.

Q4. A 4-year-old boy was brought in with a complaint of a smooth and round foreign body having entered his right ear. What is the most suitable instrument or tool for removal of this foreign body?
a. crocodile forceps.
b. ring probe.
c. tilley's forceps.
d. tissue forceps.

Q5. A 30-year-old female patient comes in with a complaint that some insect has entered her right ear half an hour ago. What solution is used, to kill or to make the insect unconscious, before its removal?
a. oil drops.
b. halothane drops.
c. ketamine drops.
d. xylocaine drops.

Q6. A 5-year-old boy was brought in with a deeply impacted foreign body in his left ear. He had a history of removal of a foreign body under general anesthesia, that was not successful. What is the most suitable approach for its removal?
a. canal wall down approach.
b. endaural approach.
c. post-aural approach.
d. transcanal approach.

Q7. An 18-year-old male patient came in with a history of a slap on his left ear. On examination, he was found to have a perforation in his left ear. Which type of perforation would you expect in this case?
a. central perforation with irregular and congested margins.
b. irregular perforation in the pars flaccida.
c. posterosuperior marginal perforation of pars tensa.
d. multiple perforations in the pars tensa.

Q8. What is the most common site for dislocation of the ossicular chain?
a. foot plate of the stapes.
b. incudostapedial joint.
c. malleolo-incudal joint.
d. short process of the incus.

Q9. A 22-year-old male patient came to the OPD with a history of road traffic accident one week ago. He had developed impaired hearing from his right ear after this accident. On examination his tympanic membrane was found to be normal. On tuning fork tests, Rinne's test was negative in right ear, Weber's test was lateralized towards the right ear and Schwabach's test was equal to the examiner in the right ear. What is the diagnostic and the most relevant investigation for this patient?

a. brainstem evoked response audiometry.
b. plain X-ray mastoid (Law's view).
c. pure tone audiometry.
d. tympanometry.

Q10. A 28-year-old male patient was suspected of having an ossicular chain dislocation after a road traffic accident. Which type of graph is used for diagnosis in this condition for a tympanometry?

a. type A_D.
b. type A_S.
c. type B.
d. type C.

Q11. A middle aged boxer developed a fluctuant, painful and tender swelling on his pinna next day after a fight. The swelling is gradually increasing in size. What is the most appropriate treatment option for this patient?

a. aspirate the swelling with a needle.
b. drain the swelling and put a pressure dressing.
c. put the patient on broad spectrum antibiotics and anti-inflammatory drugs.
d. watch the swelling for a couple of days and then treat it surgically.

Q12. What is the most common cause of a tympanic membrane perforation in our region?

a. bomb blast and explosions.
b. chronic suppurative otitis media.
c. cleaning of the ear with a sharp object.
d. teachers and parents slapping over the ear.

Answers with Explanations

1. b hematoma leads to necrosis of the cartilage which results in a badly deformed lobulated ear.
2. a.
3. c this is the narrowest part of EAC.
4. b see Fig. 7.4.
5. a.
6. c but it is rarely required.
7. a.
8. b.
9. d type A_D graph will be obtained.
10. a high peak, normal pressure.
11. b.
12. b.

CHAPTER 08

Diseases of the External Ear

- Otitis externa
  - Boils or furuncle
  - Otomycosis
  - Diffuse otitis externa
  - Bullous myringitis
  - Seborrhoeic otitis externa
  - Eczematous otitis externa
  - Malignant otitis externa
  - Herpetic lesion of the external ear
- Wax
  - Syringing of the ear
  - Perichondritis of the pinna
  - Acquired stenosis of the ear
  - Maggots in the ear

OTITIS EXTERNA

Otitis externa is an acute or chronic inflammation of the whole or part of skin of the external ear. Following are the clinical types of otitis externa:

1. Boils or furuncle.
2. Otomycosis.
3. Diffuse otitis externa.
4. Bullous myringitis.
5. Seborrhoic otitis externa.
6. Eczematous otitis externa.
7. Malignant otitis externa.
8. Herpes.

Otitis externa is mostly caused by *local factors* in the external ear and may occur secondary to otitis media. In addition, many diseases of the skin found elsewhere on the body may produce similar lesions in the external ear. Factors that predispose otitis externa include; scratching of the ears with contaminated objects, bad instrumentation or trauma in the external ear, swimming in contaminated water, scalp dandruff, syringing, use of hearing aid and allergy.

Boils or Furuncle

A Boil or furuncle is the acute staphylococcal infection of a hair follicle. In the external auditory canal, hair follicles are only present in the cartilaginous part. There can be either just a single or multiple boils in the ear. Recurrence of boils is common. The predisposing factors are diabetes mellitus, general debilitating diseases, scratching in the ears and swimming. This is a very painful condition because the skin is tightly adherent to the underlying cartilage and the exudate cannot spread in the tissue plane.

Clinical Features

Itching is often the first symptom, followed soon by pain. Pain is usually intense and is aggravated by movement of the pinna or attempts to pass an aural speculum. If the boil is situated anteriorly, it induces pain when opening the mouth during chewing due of close proximity of the temporomandibular joint. Conductive type of deafness is present when the canal is occluded by swelling. Tender and palpable lymph node draining of the affected area is often present. Discharge may be present if the boil bursts. The other symptoms include low grade fever, headache and malaise, tenderness on pressing the tragus and the pinna. Firm nodular swelling of the meatal wall and the adjoining tissues (Fig. 8.1).

Clinical Features of Boils in the Ear

- Pain: intense.
- Deafness: if boil is big enough.
- Discharge: if boil bursts.
- Fever: low grade.
- Swelling: external auditory canal.
- Tenderness: at tragus and pinna.
- Regional lymphadenitis.

Differential Diagnosis

The condition has to be differentiated from *mastoiditis*. Occasionally, these two conditions may coexist. In mastoiditis, preceding history of otitis media, deafness, signs of middle ear infection on tympanic membrane and radiographic changes in the mastoid will be present. An exostosis should not be mistaken for a furuncle as it is a painless, hard and present in the bony part of the external auditory canal, in contrast to a boil that is always present in cartilaginous part of the canal.

Fig. 8.1: A large boil in the external auditory canal.

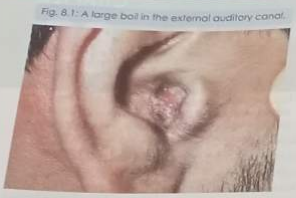


Fig. 8.2: Otomycosis of the external auditory canal.

Treatment

Appropriate antibiotic against the staphylococcus is required. Analgesics must be used to relieve pain. 10% ichthamol in glycerine should be applied locally as a gauze wick daily for few days to have a soothing effect. Topical antibiotic ointment may also be applied. Incision and drainage is occasionally required if the boil is large or infection has spread beyond the external auditory canal.

Incision must always be made parallel to the long axis of the canal to prevent subsequent stenosis of the meatus.

Treatment of Boils in the Ear

- Antibiotic against staphylococcus.
- Analgesics.
- 10% Ichthamol in glycerine wick locally.
- Incision and drainage: occasionally needed.

Otomycosis

It is a fungal infection in the lining skin of the external auditory canal. It is common in tropical and subtropical climate. Swimming in dirty water or a continuous discharge due to otitis media, are important predisposing factors.

In most of the cases, the fungus causing this condition is aspergillus. Three variations of this fungus are found; aspergillus niger, aspergillus albus and aspergillus flavus. Candida albicans is also found in some cases.

Clinical Features

In the early stage of the disease, patient complains of itching or irritation in the ears. Blockage or conductive deafness occurs when the mass blocks the external auditory canal completely. Secondary bacterial infection occurs later on, causing pain and discharge. On examination, the external auditory canal is found to be filled with a wet *neus paper* or *blotting paper* like mass (Fig. 8.2).

Differential Diagnosis

This condition can be differentiated from other type of otitis externa when routine treatment fails to relieve diffuse otitis externa. Microscopic examination of a smear from the debris will confirm the diagnosis.

Treatment

Treatment consists of thorough cleaning of the meatus by dry mopping or suction cleaning. Regular attendance for suction cleaning and follow-up is necessary for elimination of the infection. Local application of antifungal lotion e.g. clotrimazole is effective against both aspergillus and candida. Secondary bacterial infection if present should be treated accordingly.

Diffuse Otitis Externa

It is the diffuse inflammation of the lining skin of external auditory canal. Mostly occurs as 'acute' but a *'chronic'* form can occur. Gram +ve bacteria mostly causes it but gram-ve and mixed flora can be present. The proportion of these organisms vary with the geographical area.

Clinical Features

Acute form of diffuse otitis externa mostly occurs as pain in the ear that is aggravated by movement of jaw and the pinna. Discharge from the ear is initially thin and serous but later becomes thick and purulent. Deafness may be present due to the accumulation of discharge and epithelial debris in the canal. On examination, the meatal skin is found to be inflamed, swollen, tender and may be covered by pus or discharge (Fig. 8.3). Draining lymph nodes may be enlarged and tender.

Chronic form is comorbid with constant irritation, itching or discharge. On examination, the meatal skin is found to be thick and edematous.

Fig. 8.3: Diffuse otitis externa.

Fig. 8.4: Bullous myringitis.

Differential Diagnosis

This condition is to be differentiated with *suppurative otitis media* and other types of otitis externa. In suppurative otitis media, there will be a perforated and congested eardrum, mucoid discharge, pronounced deafness and a hazy mastoid on X-ray with normal external auditory canal.

Clinical Features of Acute Diffuse Otitis Externa

- Pain or irritation.
- Discharge.
- Deafness: rarely, due to accumulation of discharge and debris.
- Inflammed meatal skin.
- Tenderness on moving the pinna.
- Enlarged and tender lymph nodes.

Treatment

The principle of treatment in both acute and chronic forms is to keep the ear dry, avoid trauma by scratching, regular cleaning of the ear, instillation of topical antibiotic drops with or without corticosteroid and treatment of the associated skin condition. Systemic antibiotic may be required if the condition does not improve by the topical antibiotic drops. Systemic analgesic or NSAID may be required in severe pain and inflammation.

Bullous Myringitis

Also called *'otitis externa hemorrhagica'*, this condition includes inflammation of the tympanic membrane with blebs, swelling and redness (Fig. 8.4). As it is often seen during influenza epidemics, the causative organism for this condition is most probably the influenza virus.

Clinical Features

Hemorrhagic blebs are formed on the ear drum and adjoining deep external auditory canal. They may rupture quickly with discharge of the hemorrhagic fluid. Pain in the ear is the predominant symptom. Deafness is present, which is conductive in type. Prognosis is good in uncomplicated cases.

Treatment

Symptomatic treatment is given including analgesics for pain. Prophylactic antibiotic is prescribed to prevent secondary infection. The ear is kept dry with repeated aural toilet.

Seborrhoeic Otitis Externa

This is a greasy, scaling and crusting condition of the skin of external auditory canal and pinna. It is associated with dandruff on the scalp. Etiology is unknown but the causative organism is probably a fungus called 'pityrosporon'. The aural condition is best regarded as part of that affecting the scalp.

Clinical Features

Itching is the predominant symptom. Secondary infection may result from scratching inducing pain in the ear. On examination, greasy yellow to white scales are found in the external auditory canal. The pinna, lobule and postauricular sulcus are also commonly affected. Scalp is found to be full of dandruff.

Treatment

Regular cleaning of the scalp and ear with antidandruff shampoo e.g. selenium sulphide shampoo. Local broad spectrum antifungal cream e.g. ketoconazole may be applied in the external auditory canal and pinna.

Eczematous Otitis Externa

It is an *allergic* dermatitis involving the skin of the external auditory canal and pinna. The allergy is mostly due to local factors causing contact dermatitis e.g. from spectacle frames, jewellry, allergy because of tropical antibiotic drops, creams, cosmetics or from bacterial and fungal antigens.

Fig. 8.7: Method of performing ear syringing.

Fig. 8.8: Maggots or larvae of housefly.

PERICHONDRITIS OF THE PINNA

Perichondritis is an infection of the auricular cartilage. Cartilage are avascular structures depending on the covering perichondrium for oxygen and nutrition. As a result of perichondritis, abscess forms between the cartilage and the covering perichondrium. This deprives the cartilage from receiving oxygen and other nutrients and leads its necrosis. This results in shrinkage and deformity of the pinna.

Clinical Features

Perichondritis of the pinna may follow a hematoma auris due to trauma or bleeding tendency. Other causes include frostbite, operations involving auricular cartilage and extension of otitis externa. Swelling over the pinna and pain are the common symptoms. Fluctuation will be present if there is abscess formation.

Treatment

Incision and drainage is essential if fluctuation is present. Pressure bandage is needed to prevent reaccumulation of pus. Systemic antibiotics having broad spectrum coverage must be started. They can be changed subsequently after the culture and sensitivity report of the pus. If necrotic cartilage is present, it should be removed at the same time. Reconstructive surgery of the pinna may be needed later, if deformity occurs as a result of cartilage necrosis.

ACQUIRED STENOSIS OF EXTERNAL AUDITORY MEATUS (EAM)

Acquired stenosis of the External Auditory Meatus (EAM) is the narrowing of the meatus as a result of excess of fibrous (soft) or bony (hard) tissue. Chronic otitis externa is the most common cause of acquired stenosis of the meatus. Other causes include operations on the external auditory canal, perichondritis, tumors, exostosis, trauma, corrosive burns and fracture of the tympanic plate.

Clinical Features

No symptoms is produced in minor cases. Unclean canal leads to accumulation of wax and other secretions within it, producing symptoms. Deafness results when the stenosis is complete.

Treatment

Surgical treatment *(meatoplasty)* is referred only when deafness is present, especially in bilateral cases or when aural toilet is rendered impossible.

MAGGOTS IN THE EAR

Maggots are the larvae of housefly. These flies are attracted by the foul smelling discharge present in the ears or nose and lay their eggs into the external auditory canal and the nasal cavity. Within 24 hours these eggs hatch into larvae/maggots (Fig. 8.8).

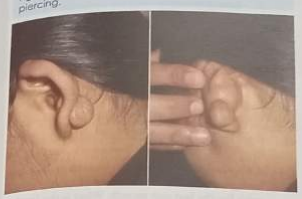
Maggots produce severe pain, irritation, swelling, foul smell and blood stained discharge. On examination, maggots are seen to be visibly crawling in the external auditory canal. They may cause extensive soft tissue necrosis.

Treatment includes the removal of all maggots with forceps as they are usually firmly attached to the meatal wall. Maggot oil (turpentine oil) or chloroform water is instilled which causes asphyxia and maggot death, therefore facilitating their removal.

KELOID IN THE EAR

Keloid results from the overgrowth of denise fibrous tissues after any kind of skin injury. It usually extends beyond the borders of initial injury, does not regress spontaneously and also tends to reform after an excision. It is different from a hypertrophic scar, which is a raised fibrous lesion over the skin scar and does not extend beyond the initial injury. A hypertrophic scar may also regress spontaneously with time. On the pinna, a keloid formation is relatively

Fig. 8.9: Keloid formation on the pinna after ear piercing.



common after ear piercing (Fig. 8.9). It is more common in younger age group female patients. People with black ethnicity are more prone to keloid formation suggesting a genetic predisposition. On examination, it appears as a smooth, rounded and localized swelling with firm to hard consistency.

Treatment of keloid includes surgical excision. As reformation is common, long acting steroid injection (e.g. triamcinolone acetonide) at the site of excision is used to prevent recurrence. Surgical excision with the laser can also be done with less chances of reformation. A number of other drug have been tried for its treatment including 5-flourouracil, doxorubicin, bleomycin, verapamil, retinoic acid, tamoxifen and botulinum toxin A etc.

Chapter Summary and Key Points

Different types of otitis externa can occur. Predisposing factors include scratching, syringing, instrumentation, swimming, allergy, use of hearing aid, scalp dandruff, diabetes and other immunocompromised states. Boil in the ear is very painful because of the tightly adherent skin with underlying cartilage. Otomycosis is a common condition in our region and in most cases aspergillus is the causative organism. Acute diffuse otitis externa is sometimes confused with suppurative otitis media. Malignant otitis externa is not a malignant tumor however, it is called malignant because of its serious and fatal outcome. It is seen in elderly, uncontrolled diabetics with other immunocompromised conditions and has very poor prognosis. Wax is the normal secretion of glands present in the external auditory canal. Accumulation of wax results either from excessive formation or by retention due to stiff hair, exostosis or stenosis. Syringing is the method of ear cleaning by a normal saline solution. Maggots are larvae of housefly, which are attracted by the foul smelling discharge in the ear or nose.

Best Choice Questions

Q1. What is the usual location of a boil in the ear?
- a. outer half of the external auditory canal.
- b. outer one-third the of external auditory canal.
- c. outer two-thirds of the external auditory canal.
- d. inner one-third of the external auditory canal.

Q2. What is the most usual number of boils present in the ear?
- a. one.
- b. two.
- c. three.
- d. multiple.

Q3. How recurrent are boils or furuncles in the ear?
- a. common.
- b. uncommon.
- c. rare.
- d. never reoccur.

Q4. Why are boils or furuncles of the ear very painful?
- a. hair follicles are close to each other.
- b. skin of the external auditory canal is more vascular.
- c. skin of the external auditory canal is thin and delicate.
- d. skin of the external auditory canal is tightly adherent to the underlying cartilage.

Q5. A 20-year-old male patient comes in OPD and is diagnosed with a boil in his right ear. What is the most common symptom that the patient presents?
- a. deafness.
- b. itching.
- c. otorrhea.
- d. pain.

Q6. An 18-year-old female patient was diagnosed with a boil in her left external auditory canal. At what location is the tenderness maximum on palpation?

a. mastoid process.
b. mastoid tip.
c. parotid region.
d. tragus.

Q7. What is the most common fungus responsible for otomycosis?

a. aspergillus.
b. candida.
c. mucormycosis.
d. rhizopus.

Q8. A 38-year-old female patient was diagnosed with otomycosis in both ears. What is the most constant and common symptom presented by the patient?

a. blood stained otorrhea.
b. itching.
c. pain.
d. tinnitus.

Q9. What is the other name for bullous myringitis?

a. herpes zoster oticus.
b. otitis externa hemorrhagica.
c. Ramsay Hunt syndrome.
d. seborrhoeic otitis externa.

Q10. In which of the following disease epidemics, bullous myringitis is common?

a. influenza.
b. malaria.
c. mumps.
d. scarlet fever.

Q11. What is the causative organism for seborrhoeic otitis externa?

a. aspergillus.
b. candida.
c. pityrosporon.
d. rhizopus.

Q12. A 68-year-old male patient with uncontrolled diabetes mellitus came with complaints of severe pain and blood stained purulent discharge from his right ear. On examination, granulation tissues are present in the floor of the external auditory canal. What is the most likely organism responsible for this condition?

a. beta hemolytic streptococci.
b. Epstein Barr virus.
c. proteus mirabilis.
d. pseudomonas aeruginosa.

Q13. In which of the following group of patients, malignant otitis externa is most common?

a. patients who had completed antitubercular therapy.
b. patients with osteomyelitis of the mandible.
c. patients with poorly controlled diabetes mellitus.
d. patients with squamous cell carcinoma of the external auditory canal.

Q14. A 65-year-old male patient was diagnosed with malignant otitis externa. He was taking antibiotics for the last one month. What is the further surgical management for this patient?

a. local debridement.
b. modified radical mastoidectomy.
c. radical mastoidectomy.
d. simple mastoidectomy.

Q15. An 18-year-old female patient comes in the OPD with hard and impacted wax in both ears. Which of the following agent is used for softening of the wax?

a. carbolic acid in glycerine.
b. potassium chloride in glycerine.
c. sodium bicarbonate in glycerine.
d. sodium chloride in glycerine.

Q16. A 22-year-old female patient was diagnosed with wax in her right ear. She also mentioned that her right ear drum is perforated. What is the best option for removal of wax in this case?

a. dry mopping.
b. ring probe.
c. suction cleaning.
d. syringing.

Q17. In which of the following condition, 'ear syringing' is contraindicated?

a. a completely deaf patient.
b. otosclerosis.
c. perforated ear drum.
d. tympanosclerosis.

Q18. Ear syringing was performed on a 20-year-old female patient for removal of wax from her right ear. Which of the following is the least likely complication?

a. facial nerve paralysis.
b. otitis externa.
c. perforation of the tympanic membrane.
d. trauma to the external auditory canal.

Q19. Which of the following insect's larvae are called 'maggots'?

a. earthworm.
b. honey bee.
c. housefly.
d. mosquito.

Q20. An 8-year-old boy was brought in with maggots in his right ear. Which of the following will be used for removal of maggots?

a. glycerine.
b. liquid paraffin.
c. olive oil.
d. turpentine oil.

Q21. Syringing was advised for removal of wax in a 25-year-old male patient. Which of the following will be used?

a. distilled water at room temperature.
b. normal saline solution at body temperature.
c. normal saline solution at room temperature.
d. tap water at room temperature.

Q22. Syringing was planned for a 18-year-old male patient for wax removal. What should be the direction of the nozzle of syringe during this procedure?

a. anteroinferior wall of EAC.
b. anterosuperior wall of EAC.
c. posteroinferior wall of EAC.
d. posterosuperior wall of EAC.

Q23. What is the most common finding on clinical examination of the ear in a patient with otomycosis?

a. soggy, blotting paper like material filling the external auditory canal.
b. dry ear with identifiable spores in the external auditory canal.
c. inflamed external auditory canal with flakes of epithelium sticking to its walls.
d. squamous debris filling the external auditory canal.

Answers with Explanations

1. b hair follicles are only present in the outer one-third of the EAC.
2. a boil is mostly single but multiple may occur.
3. a.
4. d.
5. d boil in the ear is very painful.
6. d.
7. a three varieties of aspergillus.
8. b.
9. b.
10. a.
11. c.
12. d.
13. c.
14. a removal of necrotic bone and tissues.
15. c to make glycerine slightly alkaline.
16. d suction cleaning is the safest method.
17. c it will lead to infection of the middle ear.
18. a.
19. c housefly is attracted by foul smell.
20. d also called maggot oil.
21. b isotonic solution at body temperature.
22. d.
23. a.

CHAPTER

09 Otitis Media

- Acute Otitis Media (AOM)
- Chronic Otitis Media (COM)
- Tubotympanic type of CSOM
- Attico-antral type of CSOM
  - Cholesteatoma
  - Classification of cholesteatoma
  - Theories for origin of cholesteatoma
- Surgical treatment of CSOM
  - Simple mastoidectomy
  - Modified radical mastoidectomy
  - Radical mastoidectomy
  - Atticotomy
  - Posterior tympanotomy
  - Tympanoplasty
  - Surgical approaches
  - Graft materials
  - Complications of mastoid and middle ear surgery tuberculous otitis media
- Otitis Media with Effusion (OME)
- Aero-otitis

Otitis media is the collective term used to describe inflammatory conditions of the middle ear cleft. Middle ear cleft includes the eustachian tube, middle ear cavity, aditus, mastoid antrum and other mastoid air cells. Following are the clinical types of otitis media:

1. *Suppurative:*
   a. *Acute otitis media (AOM)*
   b. *Chronic otitis media: (COM)*
      i. *Tubotympanic.*
      ii. *Attico-antral.*
2. *Non-suppurative:*
   a. *Otitis media with effusion.*
   b. *Aero-otitis.*

ACUTE OTITIS MEDIA (AOM)

Acute otitis media, previously called Acute Suppurative Otitis Media (ASOM) is the acute inflammation of the lining mucous membrane of the middle ear cleft. The type of inflammatory reaction and its progress depends upon the virulence of the infecting organism, age and resistance of the patient, therapy with antibiotics, degree of pneumatization of the mastoid and the previous infection.

Acute otitis media may affect infants of any age and is very common in childhood. It is distinctly less common in adults. This is due to regression of the adenoids, a reduction in the number of upper respiratory tract infections and eustachian tube dysfunction in adults. Eustachian tube in children is more wider, shorter and horizontally placed as compared to adults.

Etiology

The middle ear cleft usually gets infected by extension of infection from the nasopharynx either directly through the eustachian tube lining or submucosal lymphatic along the tube. The common predisposing factors are rhinosinusitis, tonsillitis, enlarged adenoid, pharyngitis and faulty method of infant feeding etc. Infection may also enter through a perforated eardrum or through a grommet.

Operation of the nose and throat may also give rise to acute otitis media especially when a postnasal pack has been placed.

Wide range of organisms are found. The most common being *streptococci, pneumococci, hemophilus influenza, moraxella catarrhalis* and *staphylococci*. A number of cases of acute otitis media are also *viral* in origin, which is secondarily invaded by bacteria.

Etiology of Acute Otitis Media

- Extension of infection from nasopharynx.
- Through perforation or grommet.
- Bacterial: streptococci, pneumococci, H. influenzae, M.catarrhalis, staphylococci etc.
- Often starts with a viral infection.

Pathology

An acute infection can spread very rapidly over the whole lining of the middle ear cleft but the symptoms form an ordered progression, suggesting successive infection. We can divide this progression into four stages:

1. *Stage of tubotympanitis:* In this stage, tubal occlusion occurs quickly and there is an engorgement and edema of the lining of middle ear cleft.
2. *Stage of catarrhal inflammation:* In this stage exudation occurs from the lining of the cleft and fluid is collected in the middle ear and mastoid air cells. The exudate is serous in nature at this stage.
3. *Stage of suppuration:* In this stage, the middle ear cleft is filled with the mucopurulent exudate or frank pus.
4. *Stage of resolution or complication:* During this stage, either resolution occurs by appropriate therapy and pus gets absorbed, or if appropriate treatment is not given, the pus may find its way to the outside by perforating the ear drum. Sometimes infection may spread and lead to mastoiditis and other complications.

Clinical Features

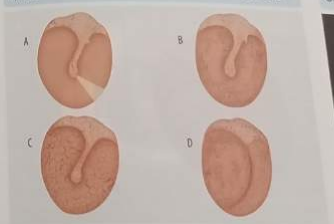
Clinical features depend upon the stage and vary accordingly. Initially, there is fullness in the ear which soon changes into deep-seated pain. Pain is very severe when the pus is present under pressure before the perforation of the tympanic membrane. After perforation, pus is discharged outside and pain is relieved.

Clinical Features of Acute Otitis Media

Symptoms
- Pain, deafness, discharge, fever, malaise and headache.

Signs: depend on the stage
- Initially congested tympanic membrane.
- Loss of landmarks.
- Bulging of ear drum.
- Perforation of ear drum.

Fig. 9.1: Tympanic membrane at different stages of acute otitis media. A= normal tympanic membrane: B= early stage, showing congestion especially along the handle of malleus: C= intense vascular congestion of the whole tympanic membrane: D= bulging of tympanic membrane due to pus in the middle ear.



Deafness, which is conductive in type, is present in all the stages. Discharge from the ear occurs after the perforation of tympanic membrane. Discharge is mucopurulent or purulent, profuse, sometimes blood stained and pulsating in nature.

On examination in the early stages, the tympanic membrane is retracted with prominent blood vessels along the handle of malleus (Fig. 9.1). Later on, congestion increases to involve the pars flaccida, periphery of pars tensa landmarks of the tympanic membrane. Normal pus is present under pressure in the middle ear causing it to bulge (Fig. 9.2). After perforation, discharge is seen in the external auditory canal and perforation is seen after cleaning the discharge. If the ear dries up by appropriate treatment, dry perforation of the eardrum remains. If mastoiditis occurs, there is pain in the mastoid region with edema and tenderness.

Other constitutional symptoms like fever, malaise, and headache are also present which are more prevalent in children.

Differential Diagnosis

Acute otitis media is to be differentiated from diffuse otitis externa and furuncle. In diffuse otitis externa, pain is not deep seated, discharge is serous, tympanic membrane is normal with no conductive deafness. The other differential diagnoses are conditions causing referred otalgia, where tympanic membrane and external auditory canal will be normal with no hearing loss. Herpetic lesion of the ear may also cause difficulty in diagnosis, especially after a ruptured vesicle. Postauricular adenitis from an infected scalp will produce a swelling over the mastoid but there will be no deafness and eardrum will be normal.

Treatment

Broad spectrum antibiotics must be started immediately. Pus if present, is taken for culture and

Fig. 9.2: Bulging of the tympanic membrane in case of acute otitis media.

Differential Diagnosis of ASOM

- Diffuse otitis externa or furuncle.
- Conditions causing referred otalgia.
- Herpes zoster oticus.
- Postauricular adenitis.

sensitivity before the starting antibiotics. Antibiotics should be adjusted according to the culture and sensitivity report. *Myringotomy* is required if pus is present in the middle ear and causes bulging of the tympanic membrane. Myringotomy is an operation where an opening is made in the tympanic membrane with a *myringotomy knife* (Fig. 9.3), to evacuate secretions or pus from the middle ear. As the pus is collected in the posterior part of the middle ear, incision in cases of acute suppurative otitis media is made in the posteroinferior quadrant of the tympanic membrane (Fig. 9.3). The line of incision on the tympanic membrane in cases of acute suppurative otitis media may be *radial* or *circumferential*.

After eardrum rupture, regular aural toilet is required to keep the ear dry. This can be followed by antibiotic drops. Other symptomatic treatments include analgesics, sedation, nasal decongestants and advised. The condition usually resolves by this treatment and perforation may heal. If the perforation persists, tympanoplasty is done after the acute infection has settled.

Treatment of Acute Otitis Media

- *Symptomatic: rest, analgesics, sedation, nasal decongestant.*
- *Antibiotics.*
- *Myringotomy: if bulging ear drum.*
- *Aural toilet and antibiotic ear drops after rupture of ear drum.*
- *Tympanoplasty: if perforation persists.*

Sequelae

The infection may stop at any stage. Healing may be complete with recovery of normal hearing. Sometimes, the tympanic membrane is closed by a thin paper like membrane. On other occasions, dry or moist perforation may remain. This may cause some residual deafness. Perforation causes recurrent ear infections with progressive destruction of the tympanic membrane and middle ear contents. (COM) If the condition is not treated appropriately, complications may arise due to the spread of infection to other regions.

Complications

See chapter 10.

CHRONIC OTITIS MEDIA (COM)

Chronic Otitis Media (COM) or previously called *Chronic Suppurative Otitis Media (CSOM)* is the chronic inflammation of mucosa of the middle ear cleft. This is conventionally divided into two main clinical types. The first variety is *'tubo-tympanic'* type, which tends to follow a more benign course. The other name for this variety is *'CSOM without cholesteatoma'*. The second variety more aggressive and carries a significant risk of serious complications, called *'attico-antral'* type or *'CSOM with cholesteatoma'*. A newer classification of chronic otitis media is also in use where it is classified on the basis of *activity* (with inflammation and pus) or *inactive* (with no inflammation or pus) disease and *mucosal* (tubotympanic) or *squamous* (cholesteatoma) disease into following five types:

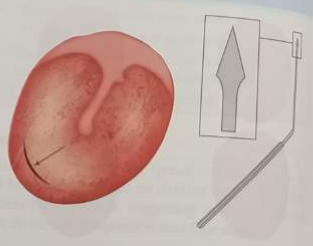
1. Inactive mucosal COM syn. dry perforation.
2. Active mucosal COM syn. tubotympanic COM with discharge.
3. Inactive squamous COM syn. retraction pocket.
4. Active squamous COM syn. chronic otitis media with cholesteatoma.
5. Healed COM syn. tympanosclerosis, healed scarred ear drum or end result of surgery.

Although the clinical features may be very similar the two types are described separately because of the differences in their management.

TUBOTYMPANIC TYPE OF CSOM

It is virtually always a complication of acute otitis media, where there is persistent perforation of the tympanic membrane. It is relatively more common than the attico-antral type. In majority of cases there is recurrent infection, which spreads via the eustachian tube into the tympanic cavity and so is called tubotympanic type. Sometimes recurrent infections of the middle ear cleft occur due to the perforation itself, where infection reaches the middle

Fig. 9.3: Myringotomy knife and myringotomy incision in ASOM (circumferential incision in posteroinferior quadrant).



ear via the external auditory canal. Serious complications are rare in this type of disease.

Pathology

This is the residue of acute otitis media usually acquired during infancy or early childhood. The perforation does not heal after the initial acute attack because of the persistent or recurrent infection. If perforation remains for long enough, the edges of perforation are covered by a squamous epithelium from the outer surface and joins the mucous lining of the middle ear, so the perforation does not close. Recurrent infection of the middle ear occurs either through the eustachian tube or external auditory canal.

The perforation is nearly always central in this type and can be of any size and shape. The mucosa of the middle ear is red, velvety and edematous. The ossicles usually remain intact. Occasionally, a *polyp* (a pedunculated swelling of the mucous membrane) may be present. The mastoid is usually cellular and the mucosa of the mastoid air cells may show similar changes.

The organisms causing this type of infection are usually the same causing upper respiratory tract infection, including *streptococcus, pneumococcus, staphylococcus* etc. Gram-negative organisms are also present in a number of cases including *B. proteus, pseudomonas, E. coli, klebsiella* etc.

Clinical Features

The main symptom is mucopurulent discharge, which may be intermittent or persistent. Conductive deafness is present, ranging from mild to moderate in severity. More severe deafness is unusual. Pain may be present during acute exacerbation.

On examination, there is a central perforation of varying size and shape (Fig. 9.4). Discharge will be seen in the external auditory canal, mucopurulent or purulent and profuse in nature. Hearing tests will confirm the presence of conductive deafness.

Fig. 9.4: Subtotal perforation of the tympanic membrane. Middle ear is visible through perforation.

Clinical Features of Tubotympanic Type

- Discharge: thin, profuse, mucopurulent, not foul smelling, not blood stained.
- Deafness: mild to moderate.
- Pain: in acute exacerbation only.
- Perforation: central type.
- Tuning fork test: conductive deafness.

Investigations

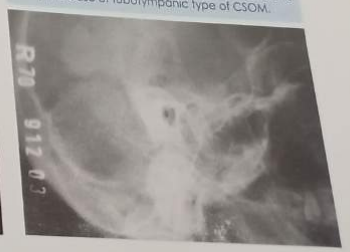
1. *Aural swab:* A swab of the ear discharge is to be submitted for culture and sensitivity.
2. *X-ray mastoid (Law's view):* It will show that the mastoid is cellular. If there has been prolonged infection, it may be sclerotic but there will be no evidence of bone destruction (Fig. 9.5).
3. *Audiometry:* Pure tone audiogram will show conductive type of deafness with an average hearing loss of 40dB (see chapter 5).
4. *CT scan of temporal bone:* It is indicated in selected cases where there is suspicion of cholesteatoma, bone erosion or any other complication.

Treatment

Systemic antibiotics are given to treat the infection during the acute and active phase. Aural toilet should be performed meticulously whenever discharge is present to keep the ear dry. Topical antibiotic eardrops with or without steroid are also used. Analgesics are prescribed to control pain. Elimination of the source of infection if present in tonsils, adenoids or sinuses is undertaken accordingly.

Infection is usually cured by medical treatment alone in these cases. In some cases, failure to improve even after medical treatment along with clouding of the mastoid air cells on radiography would require cortical mastoidectomy to eradicate the reservoir of infection

Fig. 9.5: X-ray mastoid (oblique lateral view or Law's view) in a case of tubotympanic type of CSOM.



in the mastoid air cells. After the ear becomes dry, tympanoplasty can be done to repair the perforation.

Treatment of Tubotympanic Type of CSOM

- Systemic antibiotic.
- Topical antibiotic with or without steroid.
- Aural toilet.
- Elimination of foci of infection.
- Tympanoplasty: when the ear is dry.
- Cortical mastoidectomy: where ever required.

Complications

Complications are extremely rare and usually not fatal. With prolonged discharge, a polyp may form in the middle ear and come out through perforation. Sometimes polyp may be so large that it comes out through the external auditory meatus (Fig. 9.6). Chronic discharge may lead to otitis externa. Rarely, necrosis of the ossicular chain may occur in a particularly long process of incus due to recurrent or persistent infection.

ATTICO-ANTRAL TYPE OF CSOM

This type is considered as *the dangerous* type because of its aggressive nature. If untreated, serious complications may follow including intratemporal and intracranial complications. The underlying bones are involved, which give rise to formation of granulation tissues.

Pathology

This type of chronic otitis media is associated with *cholesteatoma*. *Granulation tissue* is also present which is basically a low-grade osteitis of the mastoid bone. It may be localized to one area or extend throughout the middle ear and the mastoid. It can also cause destruction of the surrounding structures. *Cholesterol granuloma* can be seen on its own or in combination with cholesteatoma or granulations. It consists of cholesterol crystals surrounded by foreign body giant cells and granulation tissues.

Fig. 9.6: A patient with polyp.

Cholesteatoma

Cholesteatoma is a bag of stratified squamous epithelium which contains keratin debris and shed epithelium. It has a tendency of expanding and causing necrosis of the neighbouring structures and bones. To put it more simply, it is *'bad skin in the middle ear cleft'*.

Classification of Cholesteatoma

Cholesteatoma is classified into two types:

1. *Congenital cholesteatoma:* It arises from embryonic cell rest in the middle ear cleft or the temporal bone. It may be present in the middle ear, petrous apex or Cerebellopontine Angle (CPA).
2. *Acquired cholesteatoma:* It is further classified as:
   a. Primary acquired cholesteatoma: It is associated with a defect in the pars flaccida. There is usually no history of previous otitis media or a pre-existing perforation.
   b. Secondary acquired cholesteatoma: It is associated with a defect in the pars tensa. In this type, there is a history of pre-existing perforation and otitis media.

Theories of Origin of a Cholesteatoma

There are several theories for the formation of cholesteatoma:

1. *Congenital cell rest theory:* It arises from the embryonic epithelium tissues. This is unrelated to chronic suppurative otitis media.
2. *Metaplasia theory:* According to this theory, cholesteatoma is formed due to metaplasia of the middle ear mucosa as a result of long standing infection.
3. *In-growth of squamous epithelium theory:* According to this theory, the squamous epithelium migrates from the external auditory canal into the middle ear through a marginal perforation. That is why a marginal perforation is considered dangerous.
4. *Retraction pocket theory:* The most widely accepted explanation of the origin of cholesteatoma is that it starts as a retraction pocket of the tympanic membrane. When the eustachian tube is blocked, the tympanic membrane is retracted due to negative middle ear pressure. This retraction is prominent in the pars flaccida where the middle fibrous layer is absent (Fig. 9.7). If the retraction pocket becomes more marked, a sac may be formed with a narrow neck. At this stage, keratin debris may accumulate in the sac thus, unable to escape through a narrow neck. Once formed, the cholesteatomatous sac will continue to grow at the expense of any structure in its path.

Clinical Features

The clinical features and bacteriology are similar to those of the tubotympanic type. The main symptom is recurrent or persistent discharge from the ear, but nature

Fig. 9.7: Retraction pocket theory of cholesteatoma formation: A = normal ear drum with a malleus and middle ear cavity; B = negative pressure in the middle ear causes retraction pocket formation at the attic (pars flaccida); C = increase of retraction pocket with a narrow neck and collection of debris; D = well formed cholesteatoma.

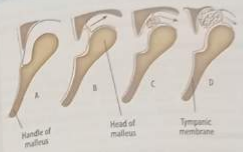
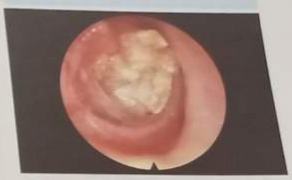


Fig. 9.8: Microscopic photo of left ear showing extensive cholesteatoma.



of discharge is different. The discharge is purulent, thick, scanty, foul smelling and often blood stained. Deafness is present and varies from mild to severe in nature because of frequent involvement of the ossicular chain. In some cases, sensorineural deafness may be present along with conductive hearing loss (mixed deafness) due to involvement of the inner ear. Pain is present in acute exacerbation and is particularly prominent when a complication occurs.

On examination, purulent discharge is frequently seen in external auditory canal. The perforation is usually of the attic variety or posterosuperior marginal in nature. Polypi or granulation tissues are frequently seen protruding through the perforation. Cholesteatoma may be seen as a greyish substance projecting from or filling an attic or a marginal perforation (Fig. 9.8). Headache, vertigo and facial paralysis all indicate complications of CSOM.

Clinical Features of Attico-antral type of CSOM

- Discharge: thick, scanty, purulent, foul smelling and blood stained.
- Deafness: mild to severe, conductive or mixed.
- Pain: in the presence of complications.
- Perforation: attic or posterosuperior marginal.
- Cholesteatoma: present.
- Granulation tissues: present.
- Complications: frequent and serious.

Differential Diagnosis

The essential differential diagnosis is between the two types of chronic suppurative otitis media and other causes of discharging ears.

Investigations

The investigations are same as for the tubotympanic type. Plain X-ray of the mastoid (oblique lateral or Law's view) will show the presence of cholesteatoma as an area of radiotranslucency with clear outlined bony margins. CT scan of the temporal bone is of great help in case of a cholesteatoma to assess the site and extent of the disease, bony erosions caused by it and to evaluate the intratemporal and intracranial complications. Audiometry may show severe conductive deafness because of the ossicular chain involvement or mixed deafness due to involvement of the inner ear.

Treatment

Treatment depends upon nature and degree of the disease progress and the presence and extent of cholesteatoma. In all cases of cholesteatoma surgical treatment is required. Surgery depends upon the site and extent of the disease. Basic aims of surgery in these cases are:

1. Eradication of the disease so as to make the ear free from cholesteatoma, dry and safe.
2. To restore the functional hearing loss.

Both of the above mentioned aims of surgery can be achieved by single stage surgery to first make the ear secure and then a tympanoplasty in the second stage.

Surgical Treatment of CSOM

As mentioned earlier, the aims of a surgical treatment is to make the ear dry and secure, and to restore or improve the hearing. Whether this can be achieved or not depends on the nature and extent of the disease.

For eradication of the disease, a number of surgical procedures are described which are classified into:

1. Canal wall up procedures.
2. Canal wall down procedures.

In canal wall up procedures, the posterior meatal wall called the 'bridge' remains intact. These procedures include:

a. Simple mastoidectomy.
b. Posterior tympanotomy or combined approach tympanoplasty (CAT).

In canal wall down procedure, the posterior meatal wall or bridge is removed. These procedures are done to eradicate the disease from the middle ear and include:

a. Radical mastoidectomy.
b. Modified radical mastoidectomy.
c. Atticotomy.

Simple Mastoidectomy

In simple mastoidectomy (also called cortical or Schwartz mastoidectomy), mastoid antrum is opened by removing its cortex and all the mastoid air cells are cleared of the disease (Fig. 9.9). The bony meatal wall remains intact. This operation is done when the disease is limited to the mastoid antrum and mastoid air cells. Procedure only in cases of tubotympanic type of CSOM.

Modified Radical Mastoidectomy

This operation is done when the disease is extensive involving both middle ear cavity and the mastoid antrum or other air cells. The bony meatal wall is removed and middle ear is reached (Fig. 9.10). The disease is cleared from the entire mastoid and middle ear. The ossicles, which are healthy and normal, are preserved so that a tympanoplasty can be done either at the same time or later on.

Radical Mastoidectomy

In this operation, in addition to clearing of the disease all the ossicles except the footplate of stapes are removed. This operation is done in extensive disease cases where the ossicles are already involved.

Atticotomy

This operation is done when the disease is limited to the attic area only. Attic is usually approached by a transcanal or per-meatal approach.

Posterior Tympanotomy

In this operation, the middle ear can be reached from the mastoid antrum without lowering the posterior meatal wall. The middle ear is exposed from a triangular opening made between the facial nerve and chorda tympani nerve (facial recess), bounded superiorly by the fossa incudis.

Tympanoplasty

Tympanoplasty is an operation to reconstruct hearing mechanism of the middle ear. Repair is done after the disease is cleared from the mastoid and middle ear. Tympanoplasty may be combined with mastoid surgery when the disease has spread in the mastoid region as well. This can be done at the same time after clearing the disease or can be done later on in a second stage operation. Wullstein in 1953 has described five types of tympanoplasty operation:

1. *Type I:* Reconstruction of the tympanic membrane with an intact and mobile ossicular chain (myringoplasty).
2. *Type II:* Handle of malleus is absent along with perforation. Tympanic membrane is reconstructed over the remnant of malleus or long process of incus.
3. *Type III:* The incus and malleus both are absent with perforation. Tympanic membrane is reconstructed to lie on stapes head directly (myringostapediopexy).
4. *Type IV:* Only footplate of stapes is present. In this type, a round window is acoustically shielded by the graft creating a round window baffle. Sound waves will act directly on the foot plate which is being exteriorized.
5. *Type V:* The foot plate of the stapes is fixed and a fenestration of the lateral semicircular canal is performed *(fenestration operation)*.

Fig. 9.9: Simple or cortical mastoidectomy showing removal of the cortex of mastoid bone and clearance of the disease from all mastoid air cells.

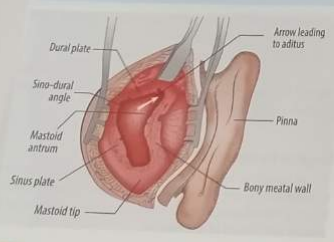
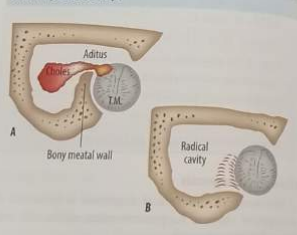


Fig. 9.10: A = showing extension of cholesteatoma from attic region to the mastoid antrum; B = modified radical mastoidectomy showing removal of the bony meatal wall with formation of one cavity (canal wall down procedure).



Surgical Approaches

The various approaches or incisions of mastoidectomy or tympanoplasty operations are:

1. *Transcanal (endomeatal or per-meatal):*
Incision is done on the posterior meatal wall 5–7 mm lateral to the tympanic annulus, to raise the tympanomeatal flap and the middle ear is approached.
2. *Endaural:*
In this approach, incision is done on the posterior meatal wall at the junction of the bony and cartilaginous part from 6 o'clock to 12 o'clock position and extends upward between the tragus and crus helix and then extends posteriorly. By this approach both the middle ear and mastoid can be approached simultaneously.
3. *Post-aural:*
In this approach, incision is done behind the ear, posterior and parallel to the postauricular sulcus. This approach is suitable for all types of mastoidectomy operations, facial nerve exploration, surgery to the semicircular canal and endolymphatic sac decompression.

Ear surgeries are conventionally done with the help of operating microscope (with an objective lens of 250 mm focal length) using any of the above mentioned approaches. Endoscopic ear surgery is becoming more popular and is mostly done through transcanal approach.

Graft Materials

The autograft (from same individual) material used to repair the tympanic membrane are temporalis fascia, tragal perichondrium, fat from the ear lobule, veins etc. Temporalis fascia is the most common graft material used for myringoplasty.

The homograft materials (from the other individual) used for myringoplasty includes temporalis fascia, veins, cadaveric tympanic membrane, cadaveric dura mater, fascia lata, serosa etc.

The graft material used for ossicular chain reconstruction are autografts like malleus, incus, septal cartilage or conchal cartilage etc. and homograft like the ossicles. Prosthetic graft materials are also available for ossicular chain reconstruction like TORP (Total Ossicular Replacement Prosthesis) or PORP (Partial Ossicular Replacement Prosthesis).

The techniques to repair the tympanic membrane or myringoplasty is of mainly two types:

1. Onlay or overlay graft technique:
The graft is placed lateral or on top of the remnant of tympanic membrane after removing stratified squamous epithelium from it.
2. Inlay or underlay graft technique:
The graft is placed medial to the tympanic membrane by raising the tympanomeatal flap.

Complications of Mastoid and Middle Ear Surgery (Mastoidectomy)

Mastoid antrum, air cells and middle ear cavity are all surrounded by important and vital structures. Surgery in the region may lead to damaged structures. Complications of mastoid and middle ear surgery are:

1. Anesthetic complications.
2. Damage to the facial nerve leading to facial paralysis.
3. Damage to the dural plate and dura mater leading to intracranial complications.
4. Damage to the sinus plate and sigmoid sinus causing profused bleeding.
5. Damage to the ossicles and ossicular joints causing conductive deafness.
6. Damage to the internal ear causing sensorineural deafness.
7. Labyrinthitis.
8. Other complications like wound infection, perichondritis, non-healing wound etc. may occur.

TUBERCULOUS OTITIS MEDIA

Involvement of the middle ear mucosa by the *mycobacterium* can occur but this condition is uncommon. Tuberculous otitis media in almost all cases is secondary to pulmonary tuberculosis or by tuberculosis of the tonsils, larynx and cervical lymph nodes. Route of infection can be through the eustachian tube or blood borne. Characteristically in tuberculous, multiple perforations of otitis media occur which in later stage of the disease may coalesce to form a single large perforation. Other clinical features are similar to chronic suppurative otitis media as super added bacterial infection is common. Systemic antituberculous therapy is given in other cases along with medical and surgical treatment as described in chronic suppurative otitis media.

OTITIS MEDIA WITH EFFUSION (OME)

The term *'otitis media with effusion'* or *'non-suppurative otitis media'* is applied to the clinical condition characterized by the presence of non-purulent fluid in the middle ear cleft. Acute and chronic forms can sometimes be

distinguished according to the mode of onset or by duration, but the distinction may not always be clear and the condition is often recurrent. There are many commonly used synonyms for this condition like *secretory otitis media, serous otitis media, mucinous otitis media, catarrhal otitis media, exudative otitis media and glue ear.*

Etiology

The exact etiology of this condition is unknown. The following factors are described as etiological factors for this condition:

1. *Eustachian tube dysfunction:* This may result from enlarged adenoids, inflammation in the eustachian tube, strictures or adhesions after an adenoidectomy, paralysis of palatal muscles, space occupying lesions of the nasopharynx or other causes of tubal occlusion.
2. *Allergy:* Different forms of allergy either seasonal or perennial may cause changes in the nose, nasopharynx and middle ear cleft leading to effusion in the middle ear.
3. *Viral infections:* The different viral infections including adenovirus or rhinovirus causing nasopharyngitis and rhinitis may lead to this form of non-suppurative otitis media.
4. *Unresolved acute otitis media:* Acute suppurative otitis media may not resolve completely. After antibiotic therapy, the exudate in the middle ear may become sterile, leading to this condition.
5. *Cleft palate:* It may lead to poor eustachian tube function.

Clinical Features

Conductive deafness is the principle feature and often the only symptom of this condition. One or both ears may be affected. Onset may be sudden or gradual. Changes in the position of the head often cause, changes in the degree of deafness, when the fluid is thin. Deafness is often associated with tinnitus, including crackling and bubbling noises and sensation of fluid in the ear. Vertigo and pain are typically absent.

On examination, the tympanic membrane is usually dull and retracted. Sometimes a crescentic hairline is seen horizontally across the tympanic membrane, which shows fluid level in the middle ear (Fig. 9.11). Infrequently, bubbles may be seen in this fluid. The color of the tympanic membrane depends upon effusion and may vary from pale yellow to slaty grey or even blue. The fluid in the middle ear also varies in quantity, viscosity and color.

Investigations

1. *Pure tone audiometry:* On pure tone audiometry conductive hearing loss with air bone gap of about 30–40 dB especially in low frequencies will be seen.
2. *Tympanometry:* It will show in early stage, a reduction

Fig. 9.11: Tympanic membrane in case of otitis media with effusion showing fluid level.

Clinical Features of Otitis Media with Effusion

- Deafness: conductive in type.
- Tinnitus.
- Dull and retracted tympanic membrane.
- Presence of fluid in the middle ear.
- Blocked eustachian tubes.

in compliance with negative pressure (type C tympanogram, see Fig. 5.13) and later on a flat curve (type B tympanogram, see Fig. 5.12).

Treatment

If there is any predisposing factor like allergy, viral infection, upper respiratory tract infection or enlarged adenoids, it should be treated accordingly. The condition may resolve by this treatment. Steam inhalation with Valsalva's maneuverer and nasal decongestant drops may be helpful. Myringotomy and evacuation of fluid is done by incision in the anteroinferior quadrant of the tympanic membrane under operating microscope. Indwelling teflon ventilation tube or grommet is inserted through the tympanic membrane for ventilation and drainage purpose (Fig. 9.12 and 9.13). It is left in position until it comes out spontaneously or may be removed after six months.

Treatment of Otitis Media with Effusion

- Treatment for predisposing factors.
- Steam inhalation.
- Nasal decongestant drops.
- Myringotomy and grommet insertion.

AERO-OTITIS

It is also called otitic barotrauma, a noninfective inflammatory reaction produced in the lining of middle ear cleft as a result of negative intratympanic pressure.

Fig. 9.12: Method of performing myringotomy with insertion of a grommet in the anteroinferior quadrant of the tympanic membrane. Inset = grommet with wire.

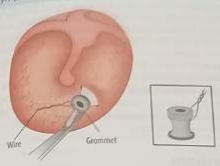


Fig. 9.13: Grommet in position at anteroinferior quadrant of the right tympanic membrane.

Clinical Features of Aero-otitis

- Pain and discomfort.
- Deafness.
- Tinnitus.
- Vertigo: sometimes.
- Retracted and congested tympanic membrane.
- Fluid level with bubbles.

Pathology

The eustachian tubes are normally opened through the muscular action of the palate. In a rapid descent of the aircraft especially in unpressurized aircraft, there are sudden atmospheric pressure changes. During the ascent in aircraft, the pressure in the middle ear is more as the surrounding pressure decreases. This causes a passive flow of air from the middle ear to the nasopharynx, so the pressure is equalized. During the descent, air cannot go passively from the nasopharynx to the middle ear instead it is an active process. The mouth of eustachian tube is opened by the contraction of palatal muscles. If there is a pressure difference of 80 mm Hg or more between the nasopharynx and middle ear, the eustachian tube can not be opened by the muscular contraction and the tube is said to be *'locked'*. If there is an edema or accumulation of lymphoid tissues around the opening, this locking occurs at a smaller difference of pressure. When there is rapid descent in unpressurized aircraft, the eustachian tubes are locked and there is a negative pressure in middle ear. The tympanic membrane is pushed inwards with vascular engorgement of the mucosal lining and transudation of fluid in the middle ear. Secondary infection of the fluid may sometimes occur.

Clinical Features

The patient complains of discomfort and pain in the ear, which is followed by deafness and tinnitus. Deafness is conductive in type. There may be autophony and a sensation of fluid in the ear. Vertigo is occasionally present. On examination, the tympanic membrane is found to be retracted and congested. A fluid level may be seen with bubbles in it. If there is a hemotympanum, the tympanic membrane appears to be dusky blue in color.

Treatment

Medical treatment includes steam inhalation with Valsalva's maneuverer, nasal decongestant drops, systemic decongestants and prophylactic antibiotics. Myringotomy is indicated if fluid is present in the middle ear.

Prevention

Flying should be avoided, if there is upper respiratory tract infection. During descent sleeping should be avoided, as the eustachian tubes are not opened during sleep. Nasal decongestant drops may be applied before the flight. Auto inflation by Valsalva's maneuverer should be performed regularly during descent. If these measures are not successful and recurrent aero-otitis occurs, grommet may be inserted to prevent this condition.

Chapter Summary and Key Points

Acute otitis media is a disease of infants and children and is less common in adults. When the pus is present under pressure in the middle ear, patient has severe earache and myringotomy is indicated at this stage. Pain subsides if the tympanic membrane ruptures and pus comes out. Healing of the tympanic membrane is usually complete, with no residual hearing loss (if infection is controlled). There are two types of chronic suppurative otitis media, one is benign while the other is dangerous and unsafe. This second types is associated with cholesteatoma, which has the capability of eroding the bones and ossicles and give rise to serious complications. Tubotympanic type is much more common than the attico-antral type. In treating attico-antral type, the initial purpose is to make the ear free of disease and secure, and then to restore hearing loss by reconstructing the middle ear conducting apparatus.

Otitis media with effusion is characterized by collecuon of non-purulent fluid in the middle ear cleft. Pain is typically absent in this condition. Fluid present in the middle ear may vary in type, nature, consistency and amount. If condition is not resolved by medical treatment, myringotomy with insertion of grommet is needed. Acro-otitis occurs due to rapid descent in an unpressurized aircraft as a result of locked eustachian tubes.

Best Choice Questions

Q1. What is the age group when acute suppurative otitis media is very common?

a. newborns.
b. early childhood.
c. adolescents.
d. middle aged people.

Q2. An 8-year-old boy suffering from acute suppurative otitis media has bulging tympanic membrane despite receiving adequate medical therapy for the last 5 days. What is the most appropriate treatment option at this point?

a. continue antibiotic therapy for next 5 days.
b. perform immediate cortical mastoidectomy.
c. perform myringotomy only.
d. perform tympanotomy and evacuate pus.

Q3. CT scan was done on a 28-year-old male patient with chronic suppurative otitis media, which showed extensive cholesteatoma with erosion of the ossicular chain. Which surgery is to be done in this case?

a. atticotomy.
b. canal wall down mastoidectomy.
c. canal wall up mastoidectomy.
d. posterior tympanotomy.

Q4. A 5-year-old boy was brought in with complain of severe earache along with fever since last night. On examination, his tympanic membrane on the right side was bulging and congested with pus in the middle ear. What are the common organisms responsible for this condition?

a. staphylococci, E.coli and proteus.
b. staphylococci, moraxella and E.coli.
c. streptococci, pneumococci and H. influenzae.
d. streptococci, staphylococci and E.coli.

Q5. What is the most common route to get to the infection in the middle ear in cases of acute otitis media?

a. arteries.
b. eustachian tube.
c. grommet.
d. veins.

Q6. What is the first stage during progression of acute otitis media?

a. stage of catarrhal inflammation.
b. stage of mastoiditis.
c. stage of suppuration.
d. stage of tubotympanitis.

Q7. A 6-year-old girl was diagnosed with acute otitis media. What is the most common and early symptom which the patient presents?

a. deafness.
b. discharge.
c. pain.
d. tinnitus.

Q8. At which part is the bulging of the tympanic membrane maximum, in cases of acute otitis media?

a. anterior half.
b. anterosuperior quadrant.
c. pars flaccida.
d. posterior half.

Q9. Myringotomy was planned in a 33-year-old male patient of otitis media with effusion. What is the best site for incision on ear drum in this case?

a. anteroinferior quadrant.
b. anterosuperior quadrant.
c. posteroinferior quadrant.
d. posterosuperior quadrant.

Q10. Which of the following disease if not treated properly can lead to 'tubotympanic' type of CSOM?

a. acute suppurative otitis media.
b. cholesteatoma.
c. labyrinthitis.
d. mastoiditis.

Q11. What is the incidence of 'tubotympanic' type CSOM in comparison to 'attico-antral' type?

a. equally common.
b. much less common.
c. much more common.
d. slightly less common.

Q12. What is the incidence rate of serious intracranial complications, in cases of tubotympanic type of CSOM?

a. extremely common.
b. very common.
c. uncommon.
d. rare.

Q13. A 25-year-old man came in with the complaint of intermittent, profuse and non-foul smelling discharge from his right ear for the last 7 to 8 years. Which of the following type of perforation do you expect in such case?

a. attic.
b. central.
c. marginal.
d. total.

Q14. Diagnosis of tubotympanic type of CSOM was made for a 28-year-old female patient. What is the type of discharge in such patient?

a. blood stained discharge.
b. mucopurulent discharge.
c. scanty discharge.
d. watery discharge.

Q15. A 22-year-old girl was diagnosed with tubotympanic type of CSOM with central perforation of the ear drum. What is the expected extent of deafness in such patient?

a. mild to moderate deafness.
b. moderate to severe deafness.
c. severe to profound deafness.
d. profound deafness.

Q16. A 27-year-old lady came in with recurrent discharge from her left ear for the last 2 years. She had central perforation in her left ear drum with unremarkable findings in the nose and throat examination. Which of the following surgical procedure will be required in this case?

a. atticotomy.
b. cortical mastoidectomy.
c. modified radical mastoidectomy.
d. radical mastoidectomy.

Q17. On examination of a 30-year-old female patient, an attic perforation with granulation tissues were found in her right ear. Which type of discharge would you expect in this case?

a. mucopurulent and blood stained.
b. mucopurulent and non-foul smelling.
c. profuse and blood stained.
d. purulent and scanty.

Q18. A 31-year-old male patient was diagnosed with with otitis media and effusion. What is the most frequent and common problem in such case?

a. conductive deafness.
b. mucoid discharge.
c. recurrent pain.
d. vertigo.

Q19. A 23-year-old male patient was diagnosed with otitis media plus effusion, and was not responding to medical treatment. Which of the following surgical procedures is required in this case?

a. myringoplasty.
b. myringotomy.
c. tympanoplasty.
d. tympanotomy.

Answers with Explanations

1. b because of adenoids, repeated URTI.
2. c.
3. b.
4. c.
5. b.
6. d. inflammation of the mucosa.
7. c.
8. d.
9. a safest quadrant.
10. a.
11. c.
12. d safe disease.
13. b.
14. b.
15. a as ossicular necrosis is uncommon.
16. b source of infection is in mastoid air cells.
17. d.
18. a.
19. b.

Complications of Suppurative Otitis Media

CHAPTER 10

- Routes of transmission
- Extracranial complications
  - Mastoiditis
  - Otitis externa
  - Thrombosis of internal jugular vein
  - Petrositis
  - Chronic adhesive otitis media
  - Labyrinthitis
  - Facial nerve paralysis
- Intracranial complications
  - Extradural abscess
  - Subdural abscess
  - Brain abscess
    - Cerebellar abscess
    - Temporal lobe abscess
  - Meningitis
  - Sigmoid sinus thrombosis
  - Otitic hydrocephalus

Acute or chronic complications of suppurative otitis media either occur when the infective process spreads beyond the confines of the middle ear and mastoid air cell mucosa (Fig. 10.1). Complications of otitis media have decreased dramatically now, because of better antibiotic therapy and more effective surgical treatment. However, they are more likely to arise from chronic rather than from acute otitis media. The complications are broadly classified into:

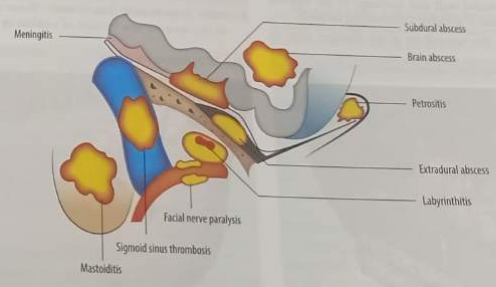
1. Extracranial complications.
2. Intracranial complications.

ROUTES OF TRANSMISSION

The infection may spread from the middle ear and mastoid antrum through the following routes:

1. *Natural defects*: e.g. round window, oval window, sutures lines etc.
2. *Artificial defects*: e.g. fractures, surgical defects and tract produced by the cholesteatoma.
3. *Blood vessels*: infection spreads through blood vessels especially through veins.
4. *Lymphatic channels*.

Fig. 10.1: Infection spreading from the middle ear mucosa causing different complications.



EXTRACRANIAL COMPLICATIONS

The following are the extracranial complications of suppurative otitis media:

1. Mastoiditis.
2. Labyrinthitis.
3. Facial nerve paralysis.
4. Petrositis.
5. Otitis externa.
6. Thrombosis of internal jugular vein.
7. Chronic adhesive otitis media.

Mastoiditis

Mastoiditis is the inflammation of the bony septa of mastoid bone. Mastoiditis occurs when the infection extends beyond the lining mucous membrane of mastoid air cells to involve underlying bone. It may be *acute* or *chronic*. Acute mastoiditis arises from acute otitis media while the chronic mastoiditis occurs with chronic otitis media.

In severe cases of otitis media, mucosa of the mastoid air cells is inflammed and pus is collected in the air cells. This pus is present under pressure in the mastoid air cells and causes extension of the infection to the underlying bone. As a result, resorption of the bone occurs with loss of trabeculation and the formation of an empyema. If this process is extensive enough, it causes resorption of bone on the lateral surface and finally reaches up to the surface and forms subperiosteal *mastoid abscess* (Fig. 10.2). This subperiosteal abscess if untreated may spread further in several directions:

1. Extends laterally to cause destruction of the periosteum and the covering skin over the mastoid antrum to be discharged outside in the form of a discharging fistula. (Fig. 10.3).
2. May extend anteriorly to cause destruction of the posterior meatal wall and discharge in the external auditory canal to simulate a discharging furuncle.
3. May erode the mastoid tip at the digastric ridge to discharge pus into the sheath of posterior belly of the digastric muscle *(Citelli's abscess)*.
4. Pus may extend into the sheath of sternocleidomastoid muscle to form an abscess *(Bezold's abscess)*.
5. May extend into the posterior root of zygoma to form *zygomatic abscess*.
6. May extend in the petrous apex to form an abscess *(Politzer's abscess)*. It may involve the VIth and VIIth cranial nerves to produce *Gradenigo's syndrome*.
7. May extend upwards to give rise to intracranial complications.

Abscesses in relation with Mastoiditis

- Subperiosteal post-aural mastoid abscess.
- Citelli's abscess.
- Bezold's abscess.
- Zygomatic abscess.
- Politzer's abscess.

Clinical Features

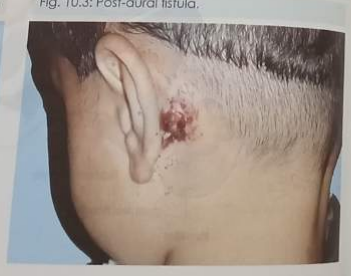
Clinical features depend upon the extent of disease. Severe pain behind the ear and tenderness over the mastoid region shows some degree of mastoiditis. If subperiosteal abscess is present, a fluctuant swelling is present over the mastoid region (Fig. 10.2). Discharging fistula in the mastoid region may be seen. (Fig. 10.3) Fever is present, which is more prevalent in children than adults. Deafness will be present in cases but varies in severity. Other local signs will vary with the stage and extent of infection.

Investigations

1. *Pus for culture and sensitivity:* Pus from the external auditory canal or fistula and pus removed by incision and drainage of the abscess is sent for culture and sensitivity.
2. *Plain X-ray mastoid (Law's view):* There is haziness in the mastoid area because of exudate or pus in the mastoid antrum and air cells along with loss of bony partitions in between the air cells.
3. *CT scan of temporal bone:* It is of great help to assess the extent of the disease and its complications.

Fig. 10.2: Post-aural or subperiosteal mastoid abscess.

Fig. 10.3: Post-aural fistula.



Treatment

The early stage of acute mastoiditis is treated with broad spectrum antibiotics. However, if the abscess is formed, incision and drainage is required to evacuate the pus. Cortical mastoidectomy is done to clear the disease from the mastoid antrum and air cells, if the infection persists in these areas after the above mentioned treatment in cases of acute or tubotympanic type of chronic suppurative otitis media. In cases of chronic suppurative otitis media with cholesteatoma (attico-antral type), canal wall down mastoidectomy is done (see chapter 9 for details).

Otitis Externa

Pus especially when it is thick may accumulate in the external auditory canal. This may lead to different types of otitis externa like diffuse otitis externa and otomycosis (see chapter 8 for details).

Thrombosis of Internal Jugular Vein

This usually occurs as a downward extension of thrombosis from the sigmoid sinus. See sigmoid sinus thrombosis later in this chapter.

Petrositis

It is seen infrequently now because of availability of good antibiotics. It occurs due to direct extension of infection from the middle ear to the pneumatized petrous bone.

Pathology

Pathology is essentially the same as in cases of mastoiditis. Infection may be confined to the petrous bone or may extend intracranially. Transmission of the infection may also occur downwards and cause abscess formation behind the pharynx.

Clinical Features

The initial clinical features are those of otitis media. There is severe unilateral headache in the temporal, supraorbital or retro-orbital regions. This occurs due to irritation of the trigeminal nerve. Paralysis of the VIth cranial nerve causes diplopia. This constitutes *Gradenigo's syndrome* (discharging ear, headache and diplopia).

Treatment

Treatment is essentially the same as of chronic otitis media.

Chronic Adhesive Otitis Media

As a result of suppurative and sometimes non-suppurative otitis media, adhesion may form in the middle ear. This condition of intratympanic adhesion formation is called *chronic adhesive otitis media*. Adhesion formation is often bilateral and is associated with atrophy or thickening of the tympanic membrane. Conductive type of deafness remains due to adhesion formation. Inflation of the middle ear by Valsalva's maneuverer may sometime break the adhesions but usually this is unsuccessful. Adhesion is divided by performing tympanotomy and its further formation is prevented by placing a silastic sheet in the middle ear.

Labyrinthitis

See chapter 13.

Facial Nerve Paralysis

See chapter 15.

INTRACRANIAL COMPLICATIONS

The following are the intracranial complications of the suppurative otitis media:

1. Extradural abscess.
2. Subdural abscess.
3. Brain abscess.
4. Meningitis.
5. Encephalitis.
6. Sigmoid sinus thrombosis.
7. Otitic hydrocephalus.

Extradural Abscess

The pus is collected between the bone and the dura mater. If it is not drained, it is soon followed by other intracranial complications. The extent of the abscess varies greatly. It is more common in the posterior cranial fossa.

Clinical Features

Most of the time, extradural abscess is symptomless. It is discovered only at the time of mastoidectomy operation. It is associated with deep-seated pain, fever and tenderness over the temporal bone. Localizing sign and symptom are absent.

Treatment

When it is discovered accidentally during operation for CSOM, the necrosed bone around the tract is removed and the abscess is drained. The surgical procedure depends upon the primary condition. If it is large enough it should be drained in association with a neurosurgeon.

Subdural Abscess

This is an extremely rare complication. It is a serious complication and has a poor prognosis. The pus is collected in the subdural space, which increases the intracranial pressure and midline shift.

Clinical Features

The patient is extremely ill. Headache is severe with fever. If the infection spreads to the cerebral cortex, focal neurological signs including hemiplegia and hemianesthesia may occur. Drowsiness progresses rapidly into coma. Epileptic fits may occur.

Treatment

Patient should be referred to a neurosurgeon immediately. The treatment includes immediate drainage of the subdural abscess and later on surgery for the ear disease.

Brain Abscess

The pus is collected within the substance of the brain. This is the most common intracranial complication due to ear diseases *(otogenic brain abscess)*. The abscess may be present in the:

1. Cerebellum.
2. Temporal lobe.

Cerebellar Abscess

Brain abscess develops close to the site of the original infection. Majority of the cases are due to chronic otitis media, where bone erosion is caused by a cholesteatoma. Acute otitis media can also sometimes give rise to this complication. Infection reaches the cerebellum either directly from the mastoid or may result from sigmoid sinus thrombosis and the labyrinth.

Clinical Features

The clinical features of a brain abscess are produced by:

1. Raised intracranial pressure.
2. Focal neurological signs and symptoms.
3. Systemic disturbances.

Headache is the most prominent symptom, which is associated with vomiting, drowsiness, confusion, lethargy, eventually resulting in a coma. Papilledema may be present due to raised intracranial pressure. There is high grade fever with rigors and slow pulse rate. The focal neurological signs of a cerebellar lesion are present which include ataxia, nystagmus, past pointing, dysdiadocokinesia, and a positive Romberg's sign.

Clinical Features of a Cerebellar Abscess

- Headache.
- Vomiting.
- Drowsiness, confusion, lethargy or coma.
- Papilledema.
- High grade fever with rigors.
- Slow pulse rate.
- Focal cerebellar neurological signs.

Investigations

Along with the other investigations of chronic otitis media, special investigations for cerebellar abscess should be carried out, including:

1. Radiography: CT scan or MRI. This will demonstrate the presence of abscess in the cerebellum.
2. CSF examination.
3. EEG.

Treatment

Treatment is primarily neurosurgical. The abscess must be drained immediately. High doses of broad spectrum antibiotics are given. Surgical treatment for the causative ear infection is done as soon as possible.

Temporal Lobe Abscess

This is more common than cerebellar abscess and gives rise to typical clinical picture. The signs and symptoms due to raised intracranial pressure and systemic disturbances will be the same as in cerebellar abscess.

Nominal aphasia is a feature of temporal lobe abscess when there is involvement of the speech area of the dominant hemisphere. The fibers of optic radiation as they pass near the temporal lobe may involve and cause homonymous hemianopia. An expanding lesion may cause contralateral paralysis of the limbs, if the internal capsule is affected, hemiplegia may occur. Epileptic fits are also present frequently. Sudden onset of a coma associated with high-grade fever indicates the rupture of abscess into the lateral ventricle. This is of grave prognostic significance.

Investigations and Treatment

Same as in cerebellar abscess.

Clinical Features of Temporal Lobe Abscess

- Headache.
- Vomiting.
- Drowsiness, confusion, lethargy or coma.
- Papilledema.
- High grade fever with rigors.
- Slow pulse rate.
- Nominal aphasia.
- Homonymous hemianopia.
- Contralateral limb paralysis.
- Epileptic fits.

Meningitis

After the brain abscess, meningitis is the second most common intracranial complication of the otitis media.

Pathology

Otogenic meningitis is the ear borne inflammation of the meninges including arachnoid mater, pia mater and the CSF fluid in between. Meningitis can occur due to acute otitis media but it is more commonly associated with chronic otitis media. Infection can reach the meninges through one of the following routes:

1. By thrombophlebitis of the communicating veins.
2. Direct extension through the dura mater due to erosion of bone.
3. Surgical, congenital or traumatic dehiscence in the bone.
4. Extension of suppurative labyrinthitis via the cochlear aqueduct.

The meninges are inflammed and exudation of pus occurs in the subarachnoid space. The organisms are the same causing chronic otitis media.

Clinical Features

Headache and neck stiffness are the two cardinal features of meningitis. Kerning's sign is positive. The level of consciousness varies and there is often marked irritability and confusion. The signs and symptoms of raised intracranial pressure and systemic disturbances are also present. Later on, focal neurological signs with multiple cranial nerve palsies may be present. The patient may become unconscious and comatose.

Investigations

Along with the other routine investigations, lumbar puncture and CSF examination are very important. CSF pressure may be raised and will show all the features of bacterial meningitis.

Differential Diagnosis

The condition has to be differentiated from other intracranial complications and causes of meningitis.

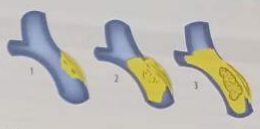
Treatment

The treatment of otogenic meningitis is primarily medical. Broad spectrum full dose of antibiotics should be started immediately, which can be changed later on according to the C/S report. The other measures to reduce intracranial pressure can be employed. After the meningitis is settled, surgery for the primary ear condition is indicated.

Sigmoid Sinus Thrombosis

This condition is now seen much less frequently because of better antibiotics. It is still a dangerous condition, which must be recognized as early as possible and must be treated vigorously.

Fig. 10.4: Stages in the development of sigmoid sinus thrombosis: 1 = mural thrombosis formed as a result of inflammation of walls of the sinus; 2 = thrombus occluding the sinus; 3 = propagating thrombus with central breakdown and abscess formation.



Pathology

Initially, there is inflammation in the walls of the sinus due to direct transmission of infection from the mastoid. This inflammation of the wall results in formation of thrombus, which rapidly increases in size and involves the whole lumen of the sigmoid sinus (Fig. 10.4). The thrombus may extend in either direction to cause involvement of the jugular bulb, internal jugular vein, superior petrosal sinus and sometimes cavernous sinus. If the thrombus gets infected, an abscess can develop which may be carried to the other parts of the body.

Clinical Features

Sigmoid sinus thrombosis may remain symptomless especially in cases where early antibiotic therapy is initiated. Once it gets infected and breaks up into small emboli a patient develops fever with rigors. There may be only one rigor per day. Pulse rate is increased concomitantly. Headache with vomiting may occur occasionally. CSF pressure may be raised on lumbar puncture.

Differential Diagnosis

The condition is to be differentiated with other intracranial complications. This condition is often confused with malaria, typhoid and bronchopneumonia.

Treatment

Treatment is primarily medical. Antibiotic therapy is started immediately. Anticoagulants are also given. Surgical removal of the thrombus can be done along with the surgery for otitis media.

Otitic Hydrocephalus

This is extremely rare and occurs mostly in children and young adults. It probably arises because of sigmoid sinus thrombosis, which extends to other venous sinuses of the skull. There is a rise in intracranial pressure due to inadequate absorption of CSF by the arachnoid villi.

Clinical Features

The usual complaint is severe headache along with alteration in consciousness and vomiting. Papilledema may develop with VIth cranial nerve palsy. Lumbar puncture will show raised intracranial pressure. CT scan and MRI help in diagnosis.

Treatment

Raised intracranial pressure is reduced medically by a combination of steroid and diuretics. If the condition persists, raised pressure is reduced by surgical decompression and ventriculoperitoneal shunt operation.

Chapter Summary and Key Points

Complications occurring as a result of suppurative otitis media have decreased because of better and effective antibiotics. Complications mostly occur as a result of bone erosion caused by cholesteatoma. Among extracranial complications, mastoiditis and facial nerve paralysis are common while in intracranial types, brain abscess and meningitis are common. Some intracranial complications may remain silent or asymptomatic and may be discovered incidentally during surgery.

Difficult words

- *Nominal aphasia:* In this condition, patient is not able to name a common object like a pen or knife but he can demonstrate the use of that object.

Best Choice Questions

Q1. In which of the following ear diseases, complications are most common?
a. acute suppurative otitis media.
b. attico-antral type of CSOM.
c. otitis media with effusion.
d. tubotympanic type of CSOM.

Q2. A 13-year-old boy was diagnosed with Citelli's abscess. Where is the pus located in this case?
a. mastoid tip.
b. petrous apex.
c. posterior belly of digastric muscle.
d. stenocleidomastoid muscle.

Q3. An 8-year-old male child was diagnosed with Bezold's abscess. What is the location of pus in this case?
a. mastoid tip.
b. petrous apex.
c. posterior belly of digastric muscle.
d. stenocleidomastoid muscle.

Q4. What is the most common intracranial complication of CSOM?
a. brain abscess.
b. extradural abscess.
c. meningitis.
d. subdural abscess.

Q5. An 18-year-old male patient developed brain abscess as a complication of CSOM. What is most common site of abscess formation in such case?
a. cerebellum.
b. occipital lobe.
c. parietal lobe.
d. temporal lobe.

Q6. A 25-year-old male had history of foul smelling ear discharge and impaired hearing for the last 4 months. Over a period of last 10 days, he developed left sided body weakness, inability to perform repeated movements with left hand and severe vertigo. What is the most likely reason for this presentation?
a. acute labyrinthitis.
b. cerebellar abscess.
c. subdural abscess.
d. temporal lobe abscess.

Answers with Explanations

1. b because of cholesteatoma and bone erosion.
2. c.
3. d.
4. a second common is meningitis.
5. d because of close proximity.
6. b.

Neoplasia of the Ear

CHAPTER 11

- Osteoma and exostosis
- Other benign tumors of external auditory canal
- Carcinoma of the external and middle ear
- Glomus tumor
- Acoustic neuroma

OSTEOMA AND EXOSTOSIS

Osteoma or exostosis is a benign neoplasm of bony origin projecting into the lumen of the bony external auditory canal. This is the most common benign tumor of the external auditory canal. Different clinical types are:

1. *Sessile:* This is the most frequent type of osteoma. It may be single or multiple and may involve both sides (Fig. 11.1).
2. *Pedunculated:* This type is rare. It is single and usually unilateral. It is regarded as the true osteoma.
3. *Diffuse:* There is a generalized circumferential thickening of the tympanic plate. It is probably a hyperostosis rather than osteoma.

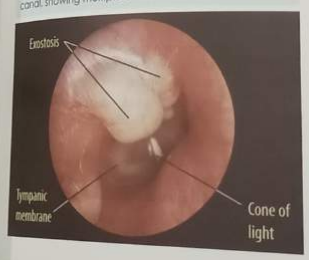
Etiology is unknown but the condition appears to be more common in swimmers. Other contributing factors are trauma and long standing irritation as in otitis externa.

Clinical Features

Initially, the condition is asymptomatic, but when osteoma enlarges, it may produce symptoms. Debris may collect behind the swelling and cause irritation. Deafness may occur later on due to the blockage of external auditory canal either by osteoma itself or by collection of debris between it and the tympanic membrane.

On examination, bony hard, skin covered swelling is seen in the deep bony part of the external auditory canal. The condition has to be differentiated with boils, which are always present in the outer cartilaginous part and are very painful.

Fig. 11.1: Otoscopic view of the external auditory canal, showing multiple osteoma.



Treatment

Treatment includes regular cleaning of the external auditory canal to keep it free from collected debris. Removal through post-aural approach is indicated when it is large enough to result in deafness that can no longer be relieved by an aural toilet.

OTHER BENIGN TUMORS OF THE EXTERNAL AUDITORY CANAL

Besides osteoma, other benign tumors are very rare in External Auditory Canal (EAC). Most important among them are *ceruminoma, adenoma* and *papilloma*.

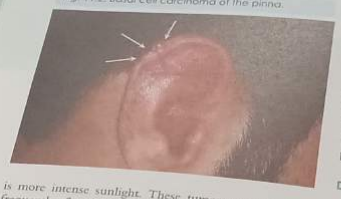
Ceruminoma is a benign tumor of the ceruminous gland. It always occurs in the outer cartilaginous part of the external auditory canal. Patient reports deafness and swelling, which is usually painless. Treatment is through surgical excision.

CARCINOMA OF THE EXTERNAL AND MIDDLE EAR

Carcinoma is a malignant tumor rising from the epithelial lining of external and middle ear. Different varieties including *squamous cell carcinoma, basal cell carcinoma* and *adenocarcinoma* may occur. All are relatively uncommon. Among them, squamous cell carcinoma is the most frequent neoplasm.

Basal cell carcinoma (Rodent ulcer) occurs more frequently on the pinna than the external auditory canal (Fig. 11.2). It is particularly seen in countries where there

Fig. 11.2: Basal cell carcinoma of the pinna.



is more intense sunlight. These tumors are seen more frequently after the fifth decade of life. Males are slightly more affected than females.

Clinical Features

Patient usually complains of deafness, blood stained discharge, earache, swelling and sometimes facial paralysis. On examination, friable and fungating mass is present filling the external auditory canal. The mass usually bleeds on contact and this should always arise suspicion of malignancy. Other cranial nerve palsies may be present in later stages.

Diagnosis is made by taking a punch biopsy from the mass. Routine cytology of the discharge will often detect presence of malignant cells. Radiography including CT scan or MRI are especially useful to detect the extension of the disease.

Treatment

Treatment depends on the pathology, extension of disease, site of origin and the general condition of the patient. Surgical excision, radiation therapy or both combined is employed to treat this condition. Overall, prognosis is poor due to spread into the lymph nodes or intracranial extension.

GLOMUS TUMOR

Glomus tumor results from the glomus bodies, which are present on the dome of bulb of the internal jugular vein and then invades the hypotympanum *(glomus jugulare)*. It may also result from similar bodies lying on the promontory, along the tympanic branch of the glossopharyngeal nerve *(glomus tympanicum)*. These are slow growing tumors arising from non-chromaffin paraganglionic chemoreceptors tissues and are very vascular and locally invasive. They grow slowly within the middle ear and can perforate the tympanic membrane. The tumor may spread to involve the last four cranial nerves. Facial nerve and posterior cranial fossa involvement may occur by direct invasion of the tumor. Rarely, the fifth and sixth cranial nerves may also be involved. Distant metastasis is very rare in these tumors.

Clinical Features

Patient reports deafness, tinnitus, vertigo, severe blood stained discharge and multiple cranial nerve palsies. Tinnitus is characteristically pulsatile in nature. On examination, a red mass may be present behind intact tympanic membrane *(rising sun appearance)* or in the external auditory canal if the tumor has perforated the tympanic membrane. The mass readily and profusely bleeds on contact.

Diagnosis

Biopsy may result in severe hemorrhage so it should be avoided. Jugular and carotid angiography are preferred to find the extent of tumor and its blood supply. Radiography including CT scan and MRI will demonstrate the extension of tumor.

Treatment

The treatment of choice is a surgical excision, if the tumor is resectable. In extensive cases, radiotherapy is given to regress the tumor mass by reducing its vascularity from fibrosis and after radiotherapy surgical resection is done.

ACOUSTIC NEUROMA

Acoustic neuroma is a neurofibroma which originates from the sheath of Schwann (neurilemma) of the eighth cranial nerve. It is a slow growing and non-invasive benign tumor. It appears as a firm, nodular, yellowish tumor with the nerve splayed out on its surface. It usually arises from the point of emergence of the nerve in the internal auditory meatus. Mostly, it is unilateral but some times bilateral cases are seen.

Histologically, it consists of packed sheets of connective tissue cells whose nuclei are arranged in palisades. The tumor occurs equally in both the sexes, with a wide age incidence, usually between ages of 30 and 60 years.

Clinical Features

Patient reports symptoms, which vary with the stage and progress of the tumor. Symptoms usually appear in the following chronological order:

1. *Acoustic symptoms:* include deafness, tinnitus and infrequently vertigo. Deafness is sensorineural and progressive in type.
2. *Trigeminal symptoms:* pain, tingling and numbness occur in any part supplied by the trigeminal nerve. Diminished corneal sensation and reflex also occur.
3. *Headache:* usually dull in intensity and probably occurs due to dural irritation by the enlarging tumor.
4. *Cerebellar symptoms:* occurs when the tumor affects the ipsilateral cerebellar lobe.
5. *Diplopia:* this is usually a result of raised intracranial pressure.
6. *Facial paralysis.*
7. *Terminal symptoms:* it includes blindness from papilledema, delirium and coma.

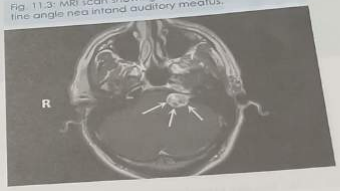
Differential Diagnosis

This condition is to be differentiated from other tumors of the cerebellopontine angle, like meningioma, neuroma of VIIth nerve, congenital cholesteatoma, aneurysm of the basilar or vertebral artery.

Investigations

1. *Radiography:* Its CT scan and MRI reveals a plain radiograph of the internal auditory canal. The plain radiograph (transorbital view, Stenver's view, Towne's view and submentovertical view) will show a funnel-shaped widening of the internal auditory canal while a high resolution CT scan and MRI with gadolinium contrast will show a mass in cerebellopontine angle (Fig. 11.3).
2. *Brainstem Evoked Response Audiometry (BERA):* It is of great help and a sensitive test for initial screening in patients with suspected acoustic neuroma. There is delay in wave I-III and I-V interval.

Fig. 11.3: MRI scan showing a mass in cerebellopontine angle near internal auditory meatus.



Treatment

Treatment is surgical excision of the tumor through approaches like translabyrinthine, middle cranial fossa and the retrosigmoid approach. Gamma knife is also used with good results for treatment of acoustic neuroma. The type of approach used depends on the stage, extension of tumor and involvement of other structures.

Chapter Summary and Key Points

Benign tumors are more common than malignant tumors in the ear. Overall prognosis of malignant tumor in the ear is very poor. In the external auditory canal, osteoma is the most common benign tumor. In a patient with blood stained ear discharge or frank bleeding, the possibility of a glomus tumor must be considered. In the early stages of an acoustic tumor, patient may have only deafness and tinnitus. In a patient with gradually progressive, unilateral sensorineural deafness and tinnitus, an acoustic tumor must be ruled out first.

Best Choice Questions

Q1. What is the most common appearance of an osteoma of an the external auditory canal?
a. diffuse.
b. papillary.
c. pedunculated.
d. sessile.

Q2. What is the nature of 'osteoma' of the external auditory canal?
a. it is a benign tumor.
b. it is a locally aggressive and infiltrative tumor.
c. it is a malignant tumor.
d. it is in a premalignant condition.

Q3. What is the most common site for 'basal cell carcinoma' of the ear?
a. external auditory canal.
b. mastoid region.
c. pinna.
d. preauricular region.

Q4. A 40-year-old male patient reports deafness, tinnitus and earache since last year. On examination of the ear, he has typical 'rising sun' appearance of the left tympanic membrane. Which of the following tumor is the most likely possibility?
a. acoustic neuroma.
b. adenocarcinoma.
c. glomus tumor.
d. squamous cell carcinoma.

Q5. A 45-year-old male patient reports unilateral sensorineural deafness, tinnitus and headache. Which of the following audiological investigation is most helpful for diagnosis?
a. Bekesy audiometry.
b. brainstem evoked response audiometry.
c. speech audiometry.
d. tympanometry.

Answers with Explanations

1. d.
2. a.
3. c.
4. c red mass behind ear drum.
5. b delay in inter-peak latencies.

CHAPTER 12

Otosclerosis

- Etiology
- Pathology
- Clinical features
- Investigations
- Differential diagnosis
- Treatment
- Prognosis

Otosclerosis or *Otospongiosis* is a localized disease of the otic capsule. There is formation of new spongy bone, which causes ankylosis of the footplate of stapes to the margins of the oval window or may invade to involve the cochlea. Ankylosis of the stapes was first described by Valsalva in 1704 and Toynbee described fixation of the stapes to the margins of the oval window in 1841.

Etiology

Exact etiology of otosclerosis is unknown. Certain factors associated with the disease are well known.

1. *Heredity:* It runs in families. In 50% of the cases there is a positive history of otosclerosis in the family. Affected members may belong to the same blood group. If both parents have otosclerosis, the chances in the children are very high. It is inherited in an autosomal dominant pattern with incomplete penetrance.
2. *Viral:* Otosclerosis has some similarity with Paget's disease of the bone which has evidence to be viral in origin. So there is possibility that otosclerosis is due to persistent viral infection in the affected bone.
3. *Autoimmune:* It is postulated that otosclerosis is due to autoimmunity against the type II collagen fibers. Elevated level of autoimmune antibody against type II collagen has been found in many patients with otosclerosis.
4. *Biochemical:* Otosclerosis occurs as a result of reactivation of the arrested secondary remodelling process within the cartilaginous rest area of the otic capsule.
5. *Sex:* It is more common in females.
6. *Race:* Individuals with fair complexion are said to be more prone than with dark complexion.
7. *Age of onset:* The clinical manifestation of the disease usually starts between the age of 20 and 30 years. It rarely starts before the age of 10 and after 40 years.
8. *Effect of pregnancy:* During pregnancy all the symptoms of disease are aggravate, but pregnancy itself is not the cause of the disease. Contraceptive pills and female sex hormone replacement may have similar effects.
9. *Effects of trauma:* Trauma has no direct effect on the onset of disease but it may aggravate the condition. This is of great medico-legal importance in compensation cases.

Pathology

Otosclerosis is a disease limited to the otic capsule, not seen in other bones of the body. Normal bone of the otic capsule is absorbed and replaced by spongy, immature, osteoid bone. This process occurs in the endochondral layer of bony otic capsule. These bony changes occur at one or more constant sites of the otic capsule. The most common site is anterior to the oval window *(fissula antefenestrum)* causing ankylosis of the footplate of stapes to the margins of oval window. Abnormal bone may be present at other sites of otic capsule but usually causes no clinical manifestation.

Measle virus RNA is found in otosclerotic foci in the footplates removed during surgery and it is assumed that this infection may activate the gene responsible for otosclerosis.

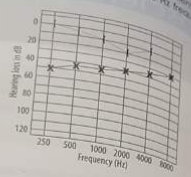
Clinical Features

Deafness is the predominant symptom. In about 80% of cases, it is bilateral. Deafness is conductive in type, starts insidiously and progresses slowly. Rarely a sensorineural deafness may be present when the abnormal bone invades the cochlea. *Paracusis Willisi* is a phenomenon that is frequently present in these patients i.e. the patient hears better in a noisy place. The exact mechanism of this phenomenon is unknown. Tinnitus is nearly always present in otosclerosis. Sometimes patient may complain of vertigo.

On examination, the tympanic membrane is usually normal. In about 10% of the cases a flamingo-pink tinge is seen through the tympanic membrane due to hyperemia of the promontory *(Schwartz's sign)* (Fig. 12.1). Tuning fork

Fig. 12.1: Schwartz's sign.

Fig. 12.2: Pure tone audiogram of a patient suffering from otosclerosis, showing a dip at 2000 Hz frequency in bone conduction.



tests will show a negative Rinne's test on the affected side and Weber's test will be lateralized to that side (conductive deafness). On Valsalva maneuverer, eustachian tube is found to be patent.

Clinical Features of Otosclerosis

- Deafness: conductive with Paracusis Willisi.
- Tinnitus: nearly always.
- Vertigo: sometimes.
- Tuning fork tests: conductive deafness.
- Schwartz's sign: in 10% of cases.
- Patent eustachian tube.

Investigations

1. *Pure tone audiometry:* It shows conductive type of deafness (air bone gap is present), more pronounced at lower frequencies. The bone conduction curve shows a dip which is maximum at 2000 Hz, called *Carhart's notch* (Fig. 12.2). This is characteristic of otosclerosis.
2. *Impedance audiometry:* It shows reduced compliance with normal middle ear pressure (type A_s tympanogram, see Fig. 5.10). Stapedial reflex is absent.
3. *Radiography:* Tomograms and high resolution CT scan may show thickening of the footplate of stapes surrounded by thick bone, but in clinical practice these are not very helpful for diagnosis and hence routinely not done.

Differential Diagnosis

The condition has to be differentiated from other causes of conductive deafness.

1. *Adhesive otitis media* or *healed suppurative otitis media:* Tympanic membrane may show a scar.
2. *Tympanosclerosis:* White chalky patches will be seen on the tympanic membrane.
3. *Otitis media with effusion:* Impedance audiometry will show a flat curve (type B graph).
4. *Ossicular dislocation:* High compliance on impedance audiometry (type AD graph).

Treatment

Treatment of otosclerosis depends on the degree, severity and type of otosclerosis. In the early stages, regular follow-up is indicated. No drug will relieve the disease. Hearing aid is advised with other types of rehabilitation. In cases where surgery is contraindicated. Surgical treatment is indicated when there is a large air bone gap. The surgical treatment was revolutionized by the introduction of '*stapedectomy*' operation in 1958. In stapedectomy, the footplate of stapes is removed and replaced by a prosthesis.

There are many modifications in the technique of stapedectomy and the operation of '*stapedotomy*' performed. In this technique, the footplate of stapes is not removed completely, instead a hole is made in the footplate and a prosthesis like teflon piston is inserted through the hole (Fig. 12.3 and Fig. 12.4). The other end of the piston (hook) is attached with the long process of incus.

Fluoride therapy may be tried in cases of active cochlear otosclerosis to stop the deposition of new spongy bone. There is no firm evidence about the effectiveness of fluoride therapy.

Treatment of Otosclerosis

- **Medical**
  - Fluoride therapy-controversial efficacy.
- **Surgical**
  - Stapedectomy stapedotomy.
  - Hearing aid: where surgery is not possible.

Fig. 12.3: Stapedotomy operation. A = stapes in its position showing new spongy bone around footplate causing its fixation; B= supra-structures of stapes are removed, footplate and piston are in its place. The hook of the titanium piston is attached with long process of the incus.

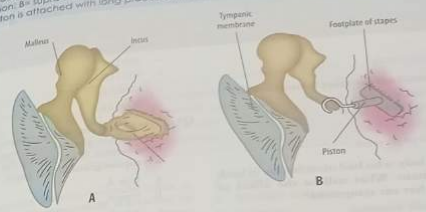
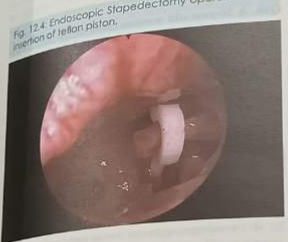


Fig. 12.4: Endoscopic Stapedectomy operation with insertion of teflon piston.



Prognosis

The patient should be reassured about the nature and progress of the disease. The disease is very slowly progressive and is not life threatening. Absolute deafness is rare.

Chapter Summary and Key Points

Otosclerosis is a disease of unknown etiology where the normal bone is replaced by new spongy bone around the footplate of stapes. This causes fixation of the footplate of stapes and results in conductive type of deafness. Progress of the disease is very slow. Medical treatment is not successful and surgery is required to correct deafness in the form of stapedectomy or stapedotomy with placement of a teflon piston.

Best Choice Questions

Q1. Which part of the inner ear is diseased in cases of otosclerosis?
a. membranous labyrinth.
b. otic capsule.
c. saccule.
d. semicircular canals.

Q2. What is the usual age for onset of otosclerosis?
a. below 10 years.
b. between 10 to 15 years.
c. between 20 to 30 years.
d. between 40 to 50 years.

Q3. A 30-year-old lady, who had otosclerosis in both ears got pregnant. What will be the affect of pregnancy on her ear symptoms?
a. symptoms will disappear.
b. symptoms will remain same.
c. symptoms will reduce.
d. symptoms will increase.

Q4. What is the nature of bone that has replaced normal bone, in cases of otosclerosis?
a. avascular bone.
b. dense bone.
c. mature bone.
d. spongy bone.

Q5. What is the most common site at where the bony changes start in patients with otosclerosis?
a. anterior to oval window.
b. anterior to promontory.
c. posterior to oval window.
d. posterior to round window.

Q6. A 31-year-old woman reported deafness in both ears and was diagnosed with otosclerosis. What is the common type of deafness in this case?
a. conductive.
b. mixed.
c. neural.
d. sensory.

Q7. In how many patients of otosclerosis, Schwartz's sign is usually seen?
a. 10% of the cases.
b. 30% of the cases.
c. 50% of the cases.
d. 70% of the cases.

Q8. Pure tone audiogram was performed on a 32-year-old female patient with otosclerosis. What is the frequency at which a dip in bone conduction will be observed in this patient?
a. 250 Hz.
b. 500 Hz.
c. 1000 Hz.
d. 2000 Hz.

Q9. Tympanogram was performed on a 30-year-old female patient who was diagnosed with otosclerosis. What will be the type of graph in a tympanogram in this case?
a. type A_s.
b. type A_D.
c. type B.
d. type C.

Q10. A 36-year-old woman came to the OPD with complaint of marked deafness in both ears and was diagnosed with otosclerosis. What is the surgical option available to treat this patient?
a. myringotomy.
b. stapediopexy.
c. stapedotomy.
d. tympanoplasty.

Answers with Explanations

1. b seen only in this bone of the body.
2. c.
3. d symptoms aggravate during pregnancy.
4. d more spongy, immature and osteoid bone.
5. b fissula antefenestrum.
6. a.
7. a present in active stage only.
8. d.
9. a normal pressure and reduced compliance.
10. c stapedectomy can also be done.

CHAPTER 13

Vertigo

- Peripheral vertigo
- Central vertigo
- Labyrinthitis
  - Otogenic labyrinthitis
  - Hematogenic labyrinthitis
  - Meningitic labyrinthitis
- Meniere's disease
- Acoustic neuroma
- Vestibular neuronitis
- Benign Paroxysmal Positional Vertigo (BPPV)

Vertigo is the subjective sense of movement either in the individual himself or his surrounding. It is caused by the stimulation of the labyrinth or its central connections. Vertigo can be physiological when it is not caused by a fault or pathology in the body, but by stimulation of normal and intact sensory structures, e.g:

1. Vertigo of heights, from visual stimulation.
2. Vertigo after spinning movements from stimulation of the semicircular canals e.g. rotation, travel sickness.
3. Vertigo from sudden change in floor texture from unexpected stimulation of the skin and deeper tissues of the feet.

Vertigo can result from a disease, which affects any part or organ of the body used in balance and equilibrium. According to the site of pathology, it is divided into *'peripheral'* and *'central'* types.

PERIPHERAL VERTIGO

In peripheral type of vertigo, pathology lies either in the vestibular end organ or vestibular nerve. The common causes of vertigo due to peripheral lesions are:

1. Labyrinthitis.
2. Meniere's disease.
3. Acoustic neuroma
4. Vestibular neuronitis.
5. Benign paroxysmal positional vertigo.
6. Vestibulotoxic drugs.
7. Trauma.
8. Perilymph fistula.

CENTRAL VERTIGO

In central type of vertigo, pathology lies in the central nervous system including the brainstem, cerebellum and their connections. The common causes of vertigo of central origin are:

1. Epilepsy.
2. Multiple sclerosis.
3. Migraine.
4. Cerebrovascular accidents.
5. Brainstem ischemia.
6. Cerebellopontine angle tumors.
7. Drugs.

History is very critical in a patient with vertigo and should be focused on the nature of the symptoms. It must include:

- Duration.
- Onset.
- Progression.
- Exact description of the nature and character.
- Continuous or intermittent.
- Relation with the posture, movement, walking, sleeping etc.
- Triggering and alleviating factors.
- Associated symptoms.

LABYRINTHITIS

Labyrinthitis is the inflammation of the membranous labyrinth of the inner ear. Depending upon its etiology labyrinthitis is classified into the following types:

1. Otogenic.
2. Hematogenic.
3. Meningitic.

Otogenic Labyrinthitis

In *otogenic* type, the inner ear is infected by extension of acute or chronic otitis media and bullous myringitis. It may be bacterial or viral in type. Labyrinthitis remains one of the most common complication of chronic suppurative otitis

media, despite of good antibiotics. Infection may spread directly through the oval or round window, through bony erosions by a cholesteatoma or by trauma to the labyrinth by accident or surgery in cases of CSOM.

Varying degrees of changes occur in the labyrinth and the following or clinical forms are described:

1. *Circumscribed labyrinthitis:* It is localized perilabyrinthine inflammatory process lying outside the endosteal lining and results from erosion of the bony wall by a cholesteatoma.
2. *Diffuse serous labyrinthitis:* In this stage, there are few round cells in the perilymphatic spaces. No causative organism is present in the perilymph. The perilymphatic and endolymphatic spaces are distended with transudate.
3. *Diffuse purulent labyrinthitis:* In this stage, purulent infection is present in the perilymphatic and endolymphatic space and these spaces are distended with pus.
4. *Dead labyrinth:* Thus is the last stage. Obliteration of the spaces by granulation or fibrous tissues occurs, which is later on replaced by bone.

Clinical Features

The clinical features depend on the stage of disease. In circumscribed labyrinthitis, symptoms are insignificant and intermittent. Vertigo is the predominant complaint. It may be accompanied by nausea and vomiting. Deafness is initially mild and increases with the stage and may become profound in the later stages. Nystagmus is present and is directed towards the affected side, but changes towards the opposite side when the vestibular paralysis is complete. Approximately two weeks after the onset, the labyrinth becomes dead. This leaves total sensorineural deafness and nonfunctional vestibular apparatus. This functional loss is gradually compensated by the central nervous system.

Clinical Features of Otogenic Labyrinthitis

- Vertigo.
- Nausea and vomiting.
- Deafness: sensorineural type.
- Nystagmus.

Treatment

The treatment includes antibiotic therapy and antivertiginous drugs in cases of an acute infection. Chronic suppurative otitis media leading to labyrinthitis by fistula formation needs surgery.

Hematogenic Labyrinthitis

Infection may enter the labyrinth by a hematogenous route and labyrinthitis is secondary to some systemic diseases. It includes typhoid fever, scarlet fever and mumps. Viral infections like influenza, measles, mumps and may also lead to labyrinthitis.

Though the whole labyrinth is usually involved, cochlea or vestibular apparatus alone may be affected. Serous or purulent exudate in the spaces of cochlea or vestibular apparatus is present. In severe cases, degeneration of the ganglion cells occur with marked destruction of nervous tissues.

Clinical Features

The clinical features are similar to that of otogenic labyrinthitis. It may be masked by a primary systemic condition, which leads to labyrinthitis.

Treatment

The treatment includes antivertiginous drugs, bed rest, avoidance of head movement and treatment of the primary infection. Vestibular irritation usually subsides after treatment and there can also be partial recovery of hearing loss.

Meningitic Labyrinthitis

In this type, labyrinthitis is secondary to meningitis and infection reaches through the internal auditory canal or the aqueduct of vestibule. Meningococcal infection, pyogenic meningitis or tuberculous meningitis all may lead to labyrinthitis. The clinical features and treatment are the same as in other forms of labyrinthitis.

MENIERE'S DISEASE

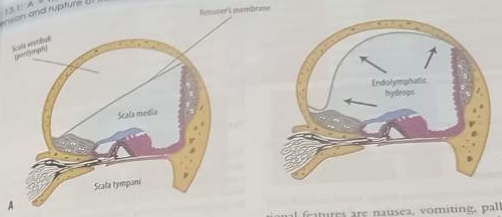
Meniere's disease is the disorder of endolymphatic labyrinth. It is characterized by sudden paroxysmal attacks of vertigo, deafness and tinnitus. Meniere's disease was originally described by Prosper Meniere in 1861. It involves both the cochlear and the vestibular components of the inner ear.

Etiology

Exact etiology is still unknown. Many factors have been postulated which include:

1. Faulty water metabolism.
2. Sodium retention in the body.
3. Histamine sensitivity including allergy.
4. Vasospasm from sympathetic over activity.
5. Hormonal imbalance.
6. Disturbance in water and electrolyte transport across the cells of stria vascularis and Reissner's membrane.
7. Local ischemia.
8. Viral infection.

Fig. 13.1: A = normal cochlea; B = endolymphatic hydrops due to accumulation of endolymph. It causes distension and rupture of Reissner's membrane.



Pathology

The most consistent histological finding in Meniere's disease is the dilatation of the endolymphatic compartment of the inner ear. As mentioned, the etiology of this endolymphatic hydrops is unknown. The basic defect is either over production or diminished absorption of the endolymph. As a result, scala media is distended with endolymph (Fig. 13.1). It is for this reason Meniere's disease is frequently called *'hydrops of scala media'*. Local ischemia has been put forward by many as a cause.

Due to over distension of scala media, the Reissner's membrane ruptures. This leads to mixing of endolymph and perilymph, which disturbs the cochlear microphonics and action potentials of the nerves. It is because endolymph is a potassium rich fluid and perilymph is a sodium rich fluid. The attack continues till the ruptured membrane is healed and local biochemistry is corrected. The same type of attack occurs again when the scala media is over distended. The condition is common in males with a peak age incidence at around 50 years. More than 80% of the cases are unilateral.

Clinical Features

Paroxysms of attacks occur with vertigo as a predominant feature. The onset is sudden and may be severe enough to render the patient helpless. Unconsciousness and diplopia are extremely rare. The vertigo is usually a feeling of rotation and the direction of this is indeterminate. Deafness occurs with the attack and is sensorineural in type. This early deafness is reversible and with each attack deafness tends to progress and higher frequencies are involved. Now, the hearing loss becomes permanent. Tinnitus may be very troublesome. It is exaggerated during the acute attack. In many patients, it is precedes months or even years before any vertiginous episode occurs. Additional features are nausea, vomiting, pallor, sweating, hypotension, headache and sometimes anxiety.

On examination, nystagmus is present during the attack with sensorineural type of deafness. Between the attacks, clinical examination may be completely normal. The duration of the vertigo is variable from a few minutes to hours or few days. Between the attacks there may be no symptoms.

Clinical Features of Meniere's Disease

- Vertigo: in episodic attacks.
- Deafness: sensorineural.
- Tinnitus.
- Nystagmus: during acute phase.
- Nausea and vomiting.
- Pallor, sweating, hypotension, headache.

Investigations

1. *Audiometry:* Pure tone audiogram (PTA) will demonstrate the sensorineural type of deafness with low frequency loss initially and high frequency loss later. Recruitment will be present on pure tone audiometry. Speech audiometry shows a loss of intelligibility out of proportion.
2. *Caloric test:* It is contraindicated during an acute attack. In between the attacks, it shows canal paresis on the affected side.
3. *Glycerol test or diuretic test:* Pure tone and speech audiogram is done before and after giving glycerol or frusemide to the patient. These agent cause reduction in endolymphatic pressure and produce measurable improvement in hearing.

Differential Diagnosis

Meniere's disease must be differentiated from other causes of vertigo, sensorineural deafness and tinnitus. The conditions most likely to be confused with Meniere's disease include labyrinthitis, vestibular neuronitis, acoustic neuroma, benign paroxysmal positional vertigo, multiple sclerosis and epilepsy with vertiginous aura. Examination of Meniere's disease reveals a normal tympanic membrane. History accounts fluctuant hearing loss in early cases, improving between the attacks. In advanced cases, there is residual and persistent sensorineural hearing loss.

Treatment

This condition is treated initially by medical treatment. 80% of the cases benefit from it. Patients who do not respond to medical treatment require surgical treatment.

Medical treatment

It includes rest, antivertiginous drugs, restricted salt and water intake and use of vasodilator drugs. Antivertiginous drugs include labyrinthine sedatives like prochlorperazine, cinnarizine or promethazine. Betahistine appears to be the most useful, recent addition to the medical treatment and at present, it is the drug of choice. The exact mechanism of action of betahistine is unknown. It is a histamine analogue and is thought to work by causing local vasodilatation in the inner ear.

Surgical treatment

Surgery is referred if vertigo is crippling and not relieved by medical treatment. Surgical procedures are broadly classified into *'conservative'* and *'destructive'* operations. Conservative operations are done to preserve hearing in cases where there is good useful hearing. Destructive operations are designed to destroy the entire labyrinth, when no useful hearing is present. Decompression of the endolymphatic sac is gaining popularity as a conservative operation in Meniere's disease. It was done in earlier cases, uncontrolled by medical treatment, where there was still useful hearing in the affected ear (labyrinthectomy). Selective division of the vestibular nerve (vestibular neurectomy) is also considered in some cases. Another type of conservative operation is the endolymphatic shunt operation, where excessive endolymph is drained into a subarachnoid space. Total surgical destruction of the labyrinth is considered in cases where there is no useful residual hearing in the affected ear (labyrinthectomy). Repeated local injection of vestibulotoxic drugs like gentamycin into the middle ear may lead to destruction of the labyrinth by absorbing it through the round window. Ultrasonic destruction of the labyrinth is another method.

Surgical Treatment of Meniere's Disease

Conservative Operations
- Decompression of the endolymphatic sac.
- Vestibular neurectomy.
- Endolymphatic shunt operation.

Destructive Operations
- Total surgical destruction of the labyrinth.
- Vestibulotoxic drugs like gentamycin injections.
- Ultrasonic destruction of the labyrinth.

Prognosis

Spontaneous remission occurs in a number of patients. In about 75%–80% of cases, only medical treatment controls the disease. The disease may be bilateral in upto 40% of the cases. If medical treatment does not control the attacks, the final outcome is bad for the affected ear. Deafness tends to be progressive even if vertigo is controlled.

ACOUSTIC NEUROMA

See chapter 11 for details.

VESTIBULAR NEURONITIS

Vestibular neuronitis is the inflammation of the vestibular nerve. In this condition, the cochlea is not involved. Most probably it is a viral infection. It usually occurs during influenzal epidemics and is probably caused by an influenza virus. Both sexes are equally affected. The vestibular function is severely affected and the cochlear function is normal with no evidence of a brainstem lesion in this condition. This leads to the conclusion that the lesion is somewhere in the vestibular nerve trunk or in the vestibular nuclei.

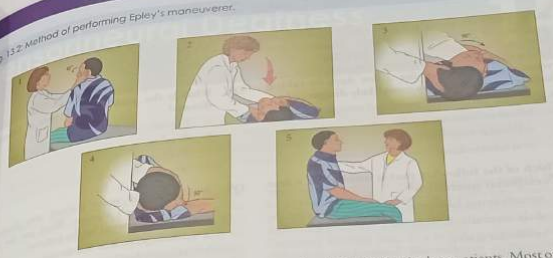
Clinical Features

The onset of symptoms is usually preceded by upper respiratory tract infection. Vertigo is the presenting and predominant symptom. It lasts several days before a gradual recovery begins. Vertigo is associated with nausea and vomiting but hearing is absolutely normal. On examination during acute stage, spontaneous nystagmus is present. Caloric test shows canal paresis usually bilateral or directional preponderance or mixture of both.

Treatment

Antivertiginous drugs are necessary during the acute phase to control vertigo. Bed rest, avoidance of any kind of head movements and vestibular sedative are also advised. Gradual recovery occurs spontaneously and completely with no residual functional loss. Reassurance of the patient is very helpful.

Fig. 13.2: Method of performing Epley's maneuverer.



BENIGN PAROXYSMAL POSITIONAL VERTIGO (BPPV)

In this condition there are recurrent paroxysmal, short-lived attacks of vertigo in certain critical positions of the head. Exact etiology is unknown. It is believed to be caused by head injuries leading to some degenerative changes in the macula of utricle causing a release of otoconial debris, which may settle in the posterior semicircular canal and cause its stimulation.

Clinical Features

Clinical features are its characteristics and diagnosis can usually be made through history and examination. First attacks of vertigo of a sudden onset are noticed when the patient puts his head in certain positions. Turning of the head during sleep may awaken the patient because of vertigo. Nystagmus is present when the head is turned on the affected side in a Dix-Hallpike test (see chapter 4). This nystagmus is delayed on onset and shows fatigability.

Treatment

The head positions that provoke vertigo should be avoided and it is the only requirement. Antivertiginous drugs have limited effect in these patients. Most of the cases settle within a few months but some may persist for years. There are two office procedures to treat BPPV, both are intended to move the otoconial debris from the posterior semicircular canal to some less sensitive areas. These include 'Epley's maneuverer' and 'Semont maneuverer'. In Epley's maneuverer head is moved sequentially into different positions, staying in each position for roughly 30 seconds (Fig. 13.2). Initially patient is advised to sit on a couch (position 1). If the affected ear is left, patient's head is rotated to 45° on the left and then lowered (position 2). Then keeping the patient supine, his head is rotated 90° towards the right (position 3). Again after 30 seconds, the patient's whole body is rolled or rotated towards the right, so that his face is 45° towards the ground (position 4). Patient is then advised to sit again from this position (position 5).

Surgical treatment is indicated in cases of persistent disease for years, which is not responding to any other treatment. It includes 'canal plugging', singular nerve section, vestibular nerve section and labyrinthectomy.

Chapter Summary and Key Points

According to the site of pathology, causes of vertigo are classified into 'peripheral' and 'central'. Labyrinthitis is the inflammation of the membranous labyrinth. In cases of dead labyrinth, vertigo and nystagmus improve gradually after sometime because of compensation by the central nervous system. Meniere's disease is a disorder of the endolymphatic labyrinth of unknown etiology. Symptoms are produced due to rupture of Reissner's membrane and mixing of perilymph and endolymph. Majority of the cases are improved by medical treatment and surgical treatment is needed in some cases only. In vestibular neuronitis, recovery is complete with no functional loss. Caloric test is contraindicated in acute cases of vertigo. In benign paroxysmal positional vertigo, there are recurrent short lived attacks of vertigo in certain head positions. It is treated with an Epley's maneuverer.

Best Choice Questions

Q1. A 50-year-old male patient came in with the complaint of severe vertigo, tinnitus and hearing impairment for the last 2 days. He also had a history of many similar attacks in the past which were relieved for a few days by taking medicines. What is the most likely diagnosis?
a. benign paroxysmal positional vertigo.
b. Meniere's disease.
c. vestibular neuronitis
d. viral labyrinthitis.

Q2. Which of the following part is involved in a case of vestibular neuronitis?
a. membranous labyrinth.
b. scala vestibuli.
c. vestibular artery.
d. vestibular nerve.

Q3. A 30-year-old male patient was diagnosed with vestibular neuronitis. What is the main symptom reported by the patient?
a. headache.
b. sensorineural deafness.
c. tinnitus.
d. vertigo.

Q4. Which part of the inner ear is affected in patients of Meniere's disease?
a. bony labyrinth.
b. endolymphatic labyrinth.
c. otic capsule.
d. spiral ganglion.

Q5. What is the other name for Meniere's disease?
a. hydrops of saccule.
b. hydrops of scala media.
c. hydrops of scala tympani.
d. hydrops of scala vestibuli.

Q6. Which of the following structure ruptures in patients of Meniere's disease due to over distension by endolymph?
a. Reissner's membrane.
b. spiral lamina.
c. stria vascularis.
d. tectorial membrane.

Q7. In which of the following group of patients, Meniere's disease is most common?
a. infants.
b. children.
c. young girls.
d. old males.

Q8. What is the peak age incidence of Meniere's disease?
a. 10 years.
b. 20 years.
c. 30 years.
d. 50 years.

Q9. A 55-year-old male patient was diagnosed with Meniere's disease. What are the main symptoms reported by the patient?
a. discharge, earache and tinnitus.
b. tinnitus, deafness and itching.
c. vertigo, deafness and tinnitus.
d. vertigo, discharge and earache.

Q10. What is the drug of choice during acute attack of Meniere's disease?
a. betahistine.
b. citrizine.
c. ebastine.
d. fexofenadine.

Answers with Explanations

1. b.
2. d.
3. d cochlear symptoms are absent.
4. b also called hydrops of scala media.
5. b.
6. a leads to mixing of perilymph and endolymph.
7. d common in males around 50 years of age.
8. d.
9. c triad of symptoms.
10. a.

Sensorineural Deafness

CHAPTER 14

- Presbycusis
- Ototoxicity
- Acoustic trauma
- Noise Induced Deafness (NIHL)
- Idiopathic Sudden Sensorineural Hearing Loss (ISSNHL)

Sensorineural deafness has two components, sensory deafness and neural deafness. In sensory deafness, the pathology lies in the sensory organ of hearing i.e. cochlea or organ of Corti. In neural deafness, pathology may be present anywhere from the cochlear nerve to the higher centers or auditory cortex. The common causes of sensorineural deafness are already mentioned in chapter 3.

PRESBYCUSIS

The term *presbycusis* or *senile deafness* is used to describe hearing loss resulting from degenerative changes of aging. Many individuals over the age of 60 years complain of this problem. Many more have a considerable degree of this problem without being aware of any deterioration. Deafness is characteristically bilateral, symmetrical and slowly progressive. It affects both the sexes equally. Patients affected by presbycusis depend upon individual susceptibility, inherited predisposition and by exposure to noise.

Pathology

These degenerative and atrophic changes occur throughout the auditory system from the hair cells of the cochlea to the auditory cortex in the temporal lobe of the brain. These changes may correlate with different clinical findings and audiotory test results, depending on the severity of the changes and the anatomic level at which they occur. Following are the common sites for degenerative and atrophic changes:

1. Epithelial tissues in the organ of Corti in basal turn of cochlea. The number of both inner and outer hair cells is reduced. This leads to high frequency and sensory hearing loss.
2. Neural tissues in the spiral ganglion cells with loss of neurons population.
3. Stria vascularis.
4. Basal membrane which causes alteration in the cochlear microphonics.

Clinical Features

Many patients with presbycusis are unaware of their hearing loss and are diagnosed during routine check-up. Characteristically, people complain of difficulty in understanding speech, even though the speech appears to be loud enough. They also have difficulty hearing in the presence of background noises. Group conversation is very difficult for them. This difficulty is mainly due to high frequency hearing loss, as a result, consonant sounds are difficult to understand. Recruitment is typically present, which also causes further distortion of sound. Loss of the neural tissues result in very poor discrimination of speech. These difficulties aggravate by lack of concentration associated with the slowing down of mental processes.

Investigations

1. Pure tone audiogram: There is sensorineural deafness more pronounced in higher frequencies (slopping curve Fig.14.1).
2. Speech audiogram: There is marked reduction in speech discrimination score.

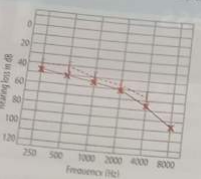
Clinical Features of Presbycusis
- Age: above 60 years.
- Deafness: bilateral, symmetrical and slowly progressive.
- Difficulty in understanding speech in the presence of background noise in group conversations.
- Recruitment is present.

Treatment

Reassurance and explaining the nature of disability of presbycusis is very helpful in its management. Lip reading and auditory training is of great help. Modern hearing aids offer good hearing in majority of the cases, unless marked recruitment is present. In those with neural presbycusis, poor speech discrimination may limit the beneficial results.

Treatment of Presbycusis
- Reassurance.
- Lip reading.
- Auditory training.
- Hearing aid.

Fig. 14.1: Pure tone audiogram of a patient with presbycusis.



OTOTOXICITY

Ototoxicity is the damage to the cochlear, vestibular or both parts of the inner ear by drugs. A number of drugs have the side effect of ototoxicity. Important among them are:

1. *Aminoglycoside:* Almost all of the aminoglycosides including streptomycin, gentamycin, neomycin, kenamycin and tobramycin are ototoxic. More recent aminoglycosides are claimed to be less ototoxic, though not free from risk.
2. *Diuretics:* Particularly loop diuretics like frusemide and ethacrynic acid.
3. *Anti-malarial:* Including quinine and chloroquine.
4. *Salicylates:* e.g. aspirin.
5. *Cytotoxic drugs:* e.g. cisplatin.
6. *Anti-epileptic drugs:* e.g. phenytoin, ethosuximide.
7. NSAIDs: e.g. ibuprofen.

Ototoxic effects of most of the drugs are produced by parenteral administration and less commonly through oral route. These drugs reach the inner ear via blood. Patients having renal failure and attaining high serum drug level are mostly affected. Some drugs have potentiating effects when given concomitantly. Topical application of some drugs in the form of eardrops are also ototoxic, when the drug reaches the inner ear directly through the round window membrane.

Factors Affecting Ototoxic Drugs

- Parenteral administration.
- Patients having renal failure.
- High serum drug level.
- Concomitant administration of other ototoxic drug.
- Topical application with absorption through round window.

Pathology

Degenerative changes may occur either in the cochlear or vestibular part of the inner ear. Almost all ototoxic drugs cause degeneration of stria vascularis. Degeneration of the sensory epithelium including the organ of Corti and vestibular apparatus also occurs. Outer hair cells are affected more than the inner hair cells. The degeneration changes diminish from the base to the apex of cochlea. Degeneration of ganglion cells and neural elements occur secondary to degeneration of the sensory epithelium.

Ototoxic drugs given to the pregnant women may pass the placental barrier to cause degeneration of inner ear of the fetus.

Clinical Features

Tinnitus is often the first presenting symptom. Any patient receiving ototoxic drugs, if complaints of tinnitus should be investigated properly. Deafness is sensorineural in type, affecting mainly the higher frequencies. Vertigo or sense of imbalance may occur if the drug has vestibulotoxic effect.

Clinical Features of Ototoxicity

- Tinnitus.
- Deafness: sensorineural type.
- Vertigo: if vestibulotoxic.

Investigations

Detailed history regarding drug therapy, its duration, route of administration and dosage should be recorded properly. Serum drug level is noted if complaint arises during drug therapy. Renal functions test should also be carried out. Pure tone audiogram shows sensorineural hearing loss affecting mainly high frequencies. Otoacoustic emission is a new investigation and it is advised in neonates for early detection of ototoxicity. Tests for vertigo should be carried out, if vestibular symptoms are also present.

Treatment

Treatment is mainly preventive. Once the degeneration occurs, no medical or surgical treatment is effective to revert the changes. Hearing aid and auditory rehabilitation is used in established cases.

ACOUSTIC TRAUMA

Acoustic trauma is the sensorineural hearing loss due to very brief exposure to a very loud sound. It may be caused by a firearm or magazine explosion, which is associated with explosive pressure waves. It may also be caused by brief but intense explosions (bomb blast). Single and very loud sound unassociated with explosions may also cause aural damage. The greater an explosive force, the greater will be the degree of damage. Explosions in closed spaces have more effect than those in open spaces.

Clinical Features

Deafness is sensorineural in type and is associated with tinnitus which is variable in intensity and duration. The tinnitus may be *temporary* or *permanent* depending on the exposure to sound. It is usually severe and often abrupt for higher frequencies. This condition has to be differentiated from blast deafness of conductive type, which is caused by traumatic rupture of the tympanic membrane and dislocation of ossicles due to pressure changes as a result of a blast.

Treatment

The treatment aims at the prevention of this condition by using earplugs or earmuffs. After the occurrence of acoustic trauma, the treatment includes rest and sedation with avoidance of further exposure. In temporary cases, the condition improves spontaneously. In permanent deafness hearing aid and auditory training is necessary.

Treatment of Acoustic Trauma

- Prevention: by earplugs and earmuffs.
- Rest and sedation.
- Avoidance to further exposure.
- Hearing aid and auditory training.

NOISE INDUCED DEAFNESS (NIHL)

Noise Induced Deafness or Hearing Loss (NIHL) is caused by prolong exposure to a loud sound. In these cases only cochlea is affected and vestibular function remains normal in almost all cases. Tinnitus is present with deafness and may be very troublesome.

Noise induced hearing loss occurs in people who are exposed to sound pressures above the safe and permissible level for certain time period daily. Continued exposure to sound above a sound pressure level of 85 dB is unsafe. The degree of deafness is proportional to sound intensity and duration of daily exposure, though, there is a marked variation in individual susceptibility. OSHA (Occupational Safety and Health Administration, USA) standard for the safe exposure to different sound intensity levels per day for five days a week is listed below. These levels are referred to as the permissible exposure level (PEL).

16 hours	85 dB
8 hours	90 dB
6 hours	92 dB
4 hours	95 dB
3 hours	97 dB
2 hours	100 dB
1.5 hours	102 dB
1.0 hours	105 dB
30 minutes	110 dB
15 minutes	115 dB

Noise induced hearing loss occurs in industrial workers such as textile mills, boiler makers, machine shop workers etc. NIHL may also occur due to nonindustrial noise exposure. The example of this includes transportation noise of rails or rickshaws, as occurs in drivers or traffic constables, civil works like building constructions and constant use of loud music etc.

Causes of Noise Induced Hearing Loss (NIHL)

- Industries: textile mills, machine shops etc.
- Transportation noise: railways, aeroplanes, rickshaws etc.
- Social gatherings: busy markets, etc.
- Roadside engineering works.
- Constant use of loud music.

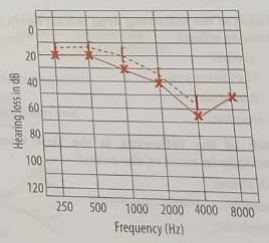
Clinical Features

Hearing loss of sensorineural type occurs which is characteristically greatest at around 4000Hz frequency (Fig.14.2). Tinnitus is present, which may be very troublesome. No vestibular symptom is present. There is a definite history of exposure to loud noise for a prolonged period.

Treatment

Treatment is mainly preventive by use of proper protective devices like earplugs and earmuffs, proper sound insulation devices in workrooms and use of silencers on noisy machines. A patient complaining of early symptoms needs resting period and rehabilitation. The established cases need rest and avoidance from further exposure to prevent further hearing loss. Change of occupation or work place is advised. Hearing aid can be prescribed in established cases.

Fig. 14.2: Pure tone audiogram of a patient with NIHL.



IDIOPATHIC SUDDEN SENSORINEURAL HEARING LOSS (ISSNHL)

There is still no standard definition of this condition but it is a sensorineural deafness of sudden origin, which develops over a period of few hours to 2–3 days with no known cause. Mostly, it is unilateral but bilateral hearing loss may occur in some cases. By definition, the etiology of this condition is unknown but there are number of proposed or postulated causes like:

a. Viral infections: either specifically affecting the cochlea or cochlear nerve or as a part of widespread viral infection.
b. Vascular occulusion, thrombosis, hemorrhage or spasm.
c. Autoimmune disorder.
d. Rupture of the membranes in the cochlea.

The diagnosis is usually made on exclusion of other causes. The treatment is mainly empirical where a number of agents have been tried like steroids, vasodilators, thrombolytic agents, anticoagulants, hyperbaric oxygen, carbogens, diuretics etc. High doses of steroids have given good results if started early. Complete spontaneous recovery is seen in about 50% of cases while some have partial recovery and others have no improvement in hearing at all.

Chapter Summary and Key Points

In senile deafness, hearing loss is characteristically bilateral, symmetrical and slowly progressive. The risk of ototoxicity must be borne in mind, if an ototoxic drug is required especially in patients of renal failure, where high serum drug levels are attained. Ototoxicity is irreversible and thus its prevention is very important. Regarding noise induced deafness, exposure to sound of 90 dB for more than 8 hours or 100 dB for more than 2 hours per day is harmful and must be avoided without proper protective measures.

Best Choice Questions

Q1. Which of the following part is affected in patients who are suffering from sensory deafness?
a. cochlea.
b. cochlear nerve.
c. cochlear nucleus.
d. lateral laminiscus.

Q2. A 69-year-old retired bank manager came in with the complaint of difficulty in understanding speech for the last couple of years, which was now increasing gradually. What is the most likely cause for it?
a. Menière's disease.
b. noise induced deafness.
c. otosclerosis.
d. presbycusis.

Q3. At which of the following frequenc, hearing impairment is most pronounced in patients with presbycusis?
a. low frequencies.
b. middle frequencies.
c. high frequencies.
d. all frequencies.

Q4. Which of the following drug is least likely to have an ototoxic effect?
a. aspirin.
b. clarithromycin.
c. frusemide.
d. quinine.

Q5. Which of the following is the first symptom of ototoxicity in most of the cases?
a. deafness.
b. earache.
c. headache.
d. tinnitus.

Q6. Which of the following is a Permissible Exposure Level (PEL) of sound per day?
a. 90 dB for 10 hours.
b. 92 dB for 8 hours.
c. 95 dB for 4 hours.
d. 100 dB for 3 hours.

Q7. A 50-year-old textile factory worker came in with complaints of deafness and difficulty in understanding speech for past many years, which has increased now. What is the best option for treating this patient?
a. auditory rehabilitation.
b. cochlear implant.
c. hearing aid.
d. lip reading.

Q8. A 40-year-old factory worker came in for advice regarding the sound level of about 95 dB at his work place. For how long every day can he work at that place safely?
a. two hours.
b. three hours.
c. four hour.
d. six hours.

Answers with Explanations

1. a other are neural types.
2. d.
3. c leads to difficulty in understanding speech.
4. b.
5. d.
6. c according to OSHA.
7. c.
8. c according to OSHA.

CHAPTER 15

Facial Nerve Paralysis

- Anatomy of the facial nerve
- Clinical examination of the facial nerve
- Causes of facial nerve paralysis
- Pathology
- Investigations
- Otogenic facial paralysis
- Bell's palsy

ANATOMY OF THE FACIAL NERVE

The facial nerve is a mixed nerve containing motor, sensory and secretomotor fibers. Motor nucleus of the facial nerve lies in the pons. Its upper part supplies the mimic fibers to the muscles of upper half of the face and it receives fibers from both the cerebral hemispheres. The lower part of the nucleus supplies lower half of the face and receives fibers only from the opposite cerebral hemisphere. Secretomotor supply of the facial nerve is to the lacrimal, submandibular, sublingual glands and to the mucous glands of the nose and palate. The nerve emerges at the junction of pons and medulla and travels in the posterior cranial fossa to enter into the internal acoustic meatus. The whole course of the nerve is divided into three parts (Fig. 15.1):

1. Intracranial part.
2. Intratemporal part.
3. Extracranial part.

Intracranial part includes the part of the nerve after emerging from the brainstem till it enters into the internal acoustic meatus.

Intratemporal part lies within the temporal bone after entering into the internal acoustic meatus till its exit from the stylomastoid foramen. In the internal acoustic canal, the nerve runs laterally till the geniculate ganglion, where it turns posteriorly forming the first genu. Then, the nerve runs horizontally and posteriorly till just above the pyramidal eminence *(horizontal part)*. Again, it bends downward to form the second genu and comes out from the stylomastoid foramen *(vertical part)*.

Extracranial part emerges from the stylomastoid foramen and enters into the substance of the parotid gland where it divides into its terminal branches (Fig. 15.2).

In its course, the facial nerve branches into the following:

1. Greater superficial petrosal nerve.
2. Nerve to stapedius.
3. Chorda tympani nerve.

Fig. 15.1: Schematic diagram showing course, branches and distribution of the facial nerve.

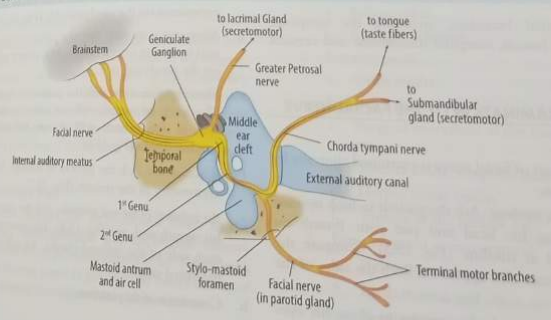


Fig. 15.2: Extracranial part of the facial nerve and its terminal branches.

Fig. 15.3: Checking for frowning of the forehead.

4. A sensory branch which communicates with the vagus nerve.
5. Posterior auricular nerve.
6. Nerve to the stylohyoid and posterior belly of digastric muscle.
7. Five terminal branches, including the temporal, zygomatic, buccal, marginal mandibular and cervical branch.

CLINICAL EXAMINATION OF THE FACIAL NERVE

1. Motor Part

The motor part of facial nerve is examined clinically by the following tests:

a. *Frowning of the forehead:* Ask the patient to look upward without tilting his head and put your thumb on the forehead at midline (Fig. 15.3). Compare the horizontal creases that appear on both the sides of the forehead.

b. *Closure of the eyes:* Ask the patient to close his eyes forcibly and try to open his eyes with your thumb and index finger (Fig. 15.4). Note the force needed to open the eyes on both sides.

Fig. 15.4: Checking for power in the eye muscles.

Fig. 15.5: Facial nerve paralysis involving the entire right side of the face with loss of nasolabial fold.

c. *Inspection of the nasolabial fold:* Compare the nasolabial fold on two sides of the face. Fold will be absent or less prominent on the paralyzed side (Fig. 15.5).

d. *Movement of ala nasi:* Ask the patient to move the ala nasi by taking a deep breath. Movement will be absent on the paralyzed side.

e. *Showing of the teeth:* Ask the patient to show his teeth. The angle of mouth will not move on the paralyzed side so the mouth will deviate towards the non-paralyzed side (Fig.15.6).

f. *Whistling test:* Ask the patient to whistle. There will be asymmetry of the mouth (Fig. 15.7).

g. *Air inflation in the oral vestibule:* Ask the patient to inflate his mouth with air (Fig. 15.8). Tap your index finger on each side of the inflated cheeks. Air will leak from the paralyzed side.

h. *Contraction of the platysma.*

Fig. 15.6: Deviation of the mouth during showing of the teeth.

Fig. 15.7: Asymmetry and air leak during whistling or air blow.

i. *Stapedius reflex:* Nerve to stapedius is a branch of facial nerve which supplies the stapedius muscle. Contraction of this muscle (stapedius reflex) can be checked by an impedance audiometry (see chapter 5 for details).

2. Sensory Part (Taste Sensations)

Chorda tympani is a branch of facial nerve which carries taste fibers from the anterior two-thirds of the tongue. Ask the patient to protrude his tongue, grasp it and dry it. Put a drop of solution of different tastes (glucose, salt, citric acid and quinine) on the tongue and ask the patient about its taste. Tongue should be held outside during testing and avoid touching of the tongue with the soft palate.

3. Secretomotor Part

Facial nerve supplies the secretomotor fibers to the lacrimal gland, submandibular and sublingual salivary glands. Lacrimation can be tested clinically by *'Schrimmer's test'*, where a blotting paper is put in both lower fornix of the eyes and wetting is compared on the two sides.

Fig. 15.8: Asymmetry of the mouth on air inflation in the oral vestibule.

CAUSES OF FACIAL NERVE PARALYSIS

Following are the causes of facial nerve paralysis:

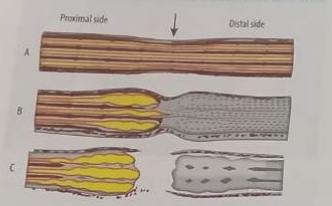
A. *Supranuclear paralysis:* In this type, only the lower half of the face is affected while the upper half escapes paralysis. It is due to the facial nucleus which controls the upper half of the face, receiving fibers from both side of the cerebral cortex.

B. *Nuclear paralysis:* The facial motor nucleus is affected and the clinical picture is similar to that of the infranuclear type.

C. *Infranuclear paralysis:* The whole side of the face is affected along with other structures supplied by the facial nerve. The common causes of infranuclear facial paralysis are:

1. Intracranial:
   a. Brainstem tumors.
   b. Cerebellopontine angle tumors: e.g. the acoustic neuroma, primary cholesteatoma and meningioma.
   c. Vascular accidents.
   d. Poliomyelitis.
   e. Multiple sclerosis.
2. Intratemporal:
   a. Otitis media.
   b. Bell's palsy.
   c. Surgical operations of the mastoid and middle ear.
   d. Trauma to the temporal bone.
   e. Herpes zoster oticus.
   f. Tumors of the middle ear.
3. Extratemporal or extracranial:
   a. Parotid tumors.
   b. Birth trauma and other accidents.
   c. Surgical operations of the parotid gland.

Fig. 15.9: Seddon's classification.
A = neuraprexia with no anatomical discontinuity.
B = axonotmesis with distal degeneration of the axons.
C= neurotmesis with complete section of the nerve.



Pathology

The facial nerve may be affected by inflammation, compression, contusion, ischemia, stretching, sectioning, application of excessive heat, cold and local anesthetic drugs. Two classifications are used to describe the severity of pathological injury of the facial nerve. First classification was described by Seddon in 1943, while the other was described by Sunderland in 1951. According to Seddon's classification, there are three degrees or classes of nerve injury (Fig. 15.9).

1. *Neuraprexia (class 1):* This is a physiological block with no anatomical discontinuity. It is temporary and full recovery is expected.
2. *Axonotmesis (class 2):* In this, the axon sheath is intact but the axon is divided. The axons distal to the division degenerates (distal degeneration). As the axon sheath is intact, most of the fibers tend to regenerate. Unfortunately, a degree of mismatching may occur.
3. *Neurotmesis (class 3):* In this type of lesion, the whole nerve is sectioned and distal degeneration occurs. Unless this type of lesion is accurately repaired, the end result is poor.

According to Sunderland's classification, there are five degrees of nerve injury:

1. *First degree:* It is same as in neuraprexia.
2. *Second degree:* It is same as in axonotmesis. Axons are divided but endoneurium remains intact.
3. *Third degree:* Axons and endoneurium are divided but perineurium and epineurium remain intact.
4. *Fourth degree:* Axons, endoneurium and perineurium are divided but epineurium remains intact.
5. *Fifth degree:* Complete transection of the nerve with injury to all above structures along with epineurium.

The *House-Brackmann* classification or facial nerve grading System is widely used to characterize the degree of facial paralysis. In this scale, grade I is assigned to normal function, and grade VI represents complete paralysis. Intermediate grades vary according to function at rest and with effort.

Investigations

Different types of electrodiagnostic tests are available to determine whether only neuraprexia or axon degeneration has occurred. It also gives certain clues regarding the gross continuity of the nerve and the progress of recovery during reinnervation. These test include:

1. *Minimal nerve excitability test:* In this test, minimal amount of electrical stimulation needed to cause facial muscle twitching is detected and compared with the normal side.
2. *Electromyography (EMG):* In this test, electrical activity of the resting facial muscles are noted. This test has a prognostic value for detecting regeneration in the facial nerve.
3. *Electroneuronography (ENoG):* Through this test, we can assess percentage of degenerated nerve fibers in the facial nerve.

OTOGENIC FACIAL PARALYSIS

The facial nerve is intimately related to the ear, so ear diseases can cause facial paralysis like:

1. *Acute otitis media:* Facial nerve palsy usually recovers as the acute inflammation settles.
2. *Chronic otitis media:* The facial nerve is affected due to erosion of its canal by cholesteatoma. Initially, the nerve is only compressed but in long-standing cases, nerve may be destroyed and the chances of recovery becomes poor.
3. *Surgical operations:* Surgical operations on the mastoid and middle ear may cause damage to the facial nerve. The severity of injury varies greatly from slight weakness to complete transection of the nerve. If there is complete paralysis immediately after surgery immediate re-exploration is necessary. Sometimes incomplete weakness of delayed onset may occur after surgery. This usually results from pressure of the ear pack and local edema. In such situations the pack must be promptly removed and good recovery is expected.
4. *Herpes zoster oticus:* Facial nerve may be affected by herpes zoster of the external ear (Ramsay Hunt syndrome). Paralysis usually develops suddenly and often completely. High proportion of fibers usually degenerates, so the recovery is slow.
5. *Malignant otitis externa:* Facial nerve may be involved in this condition along with other cranial nerve palsies. Overall prognosis is poor.
6. *Malignant tumors of the ear:* This is a rare cause of facial palsy.

Causes of Otogenic Facial Paralysis

- Acute otitis media.
- Chronic otitis media.
- Surgical operations: e.g. mastoidectomy.
- Herpes zoster oticus.
- Malignant otitis externa.
- Tumors of the ear: malignant tumors.

BELL'S PALSY

Bell's palsy is the most common cause of facial nerve paralysis. The exact etiology is unknown but viral infection or local ischemia is considered to be the cause. Local ischemia is caused by spasm of the vasa-nervorum, which results in ischemia of the nerve and its swelling in the facial canal. This causes its compression within the canal leading to neuraprexia.

Clinical Features

Bell's palsy has a sudden onset and is lower motor neuron type, where one whole side of the face is paralyzed (Fig. 15.3). Pain is usually absent but may occur in few cases, especially before paralysis begins. Paralysis of the chorda tympani nerve may lead to impairment of taste. Paralysis of the nerve to stapedius may sometimes cause hyperacusis. The greater superficial petrosal nerve often escapes paralysis but if involved, may lead to diminished lacrimation. On examination, there will be partial or complete paralysis on one side of the face. Tests for taste, stapedius function (stapedial reflex by impedance audiometry), salivation and lacrimation indicate probable site and severity of the lesion. Ear and other cranial nerves are normal.

Treatment

At the onset of paralysis, the nature and prognosis of paralysis must be explained to the patient. Reassurance is very important especially when early recovery is expected. Analgesic is given if there is pain. Care of the eye is done to prevent corneal abrasions as the eye closure is not proper due to paralysis of the orbicularis oculi. Artificial tears, topical antibiotic eye ointment, covering of the eye during sleep and protection from dust or wind during the day is required. Self massage and physiotherapy of the facial muscles should be done regularly to prevent muscle atrophy.

Full dose of steroids (prednisolone 1mg/kg/day) to reduce inflammation is found to be effective if started early for 7–10 days, but its role is still controversial. Systemic antiviral agent like acyclovir is also found to be effective in this condition. Surgical decompression of the nerve is rarely advised in cases that do not respond to the medical incomplete.

Treatment of Bell's Palsy

- General measurements:
  - Reassurance.
  - Analgesics for pain.
  - Care of the eye: artificial tear, eye ointment etc.
  - Physiotherapy.
- Steroids.
- Antiviral agents.
- Surgical decompression.

Prognosis

Overall prognosis of Bell's palsy is good. Complete recovery in two to four weeks occurs in incomplete paralysis. Complete paralysis is also followed by full recovery in most of the cases. In 10–15% of cases, recovery may be delayed for many months and final recovery may be imperfect.

Chapter Summary and Key Points

Besides Bell's palsy, otogenic cause is the second most common cause of facial nerve paralysis. A number of otogenic diseases can affect the facial nerve. Among them, cholesteatoma and ear surgery are common causes. Etiology of Bell's palsy is still controversial but prognosis is good. In cases of cholesteatoma if management is delayed, the chances of facial nerve recovery is poor. Congenital anomaly in the course of facial nerve increases the chances of damage during middle ear surgery.

Difficult words

- *Hyperacusis:* It is an auditory hyperesthesia or abnormal increase in the sense of hearing.

Best Choice Questions

Q1. What is the nature of facial nerve?
a. mixed motor and secretomotor nerve.
b. mixed motor and sensory nerve.
c. mixed motor, sensory and secretomotor nerve.
d. mixed sensory and secretomotor nerve.

Q2. Where is the location of motor nucleus of the facial nerve?
a. internal capsule.
b. medulla.
c. midbrain.
d. pons.

Q3. A 30-year-old lady was diagnosed with Bell's palsy on the right side. What will be the site of muscle paralysis of the face in this patient?
a. lower half of right side of the face.
b. upper half of right side of the face.
c. entire left side of the face.
d. entire right side of the face.

Q4. Which of the following ear disease is most commonly associated with otogenic facial paralysis?
a. cholesteatoma.
b. otitis media with effusion.
c. otosclerosis.
d. tympanosclerosis.

Q5. Which of the following is the first branch of facial nerve?
a. chorda tympani nerve.
b. greater superficial petrosal nerve.
c. nerve to stapedius.
d. nerve to stylohyoid.

Q6. From which of the following foramen, facial nerve emerges from the cranium?
a. foramen rotundum.
b. internal acoustic meatus.
c. jugular foramen.
d. stylomastoid foramen.

Q7. A 35-year-old male patient came in with right sided facial nerve paralysis. Which of the following test will be helpful to find out the involvement of nerve to stapedius?
a. brainstem evoked response audiometry.
b. electrocochleography.
c. electroneuronography.
d. impedance audiometry.

Q8. Which part of the tongue is supplied by the chorda tympani nerve?
a. anterior one-third of the tongue.
b. anterior two-thirds of the tongue.
c. middle-third of the tongue.
d. posterior one-third of the tongue.

Q9. A 40-year-old man came in with facial nerve paralysis, where the upper half of the face had escaped paralysis. What is the most likely site of pathology in this patient?
a. extratemporal.
b. infranuclear.
c. intratemporal.
d. supranuclear.

Q10. What is the most common cause of facial nerve paralysis?
a. Bell's palsy.
b. cholesteatoma.
c. mastoid surgery.
d. surgery of the parotid gland.

Answers with Explanations

1. c.
2. d called facial nucleus.
3. d infranuclear, it type of paralysis.
4. a because of bone erosion.
5. b.
6. d after emerging enters into the parotid gland.
7. d contraction causes decrease in compliance.
8. b.
9. d because of supply from both the cerebral hemispheres.
10. a.

CHAPTER 16

Auditory Rehabilitation

- Speech reading or lip reading
- Auditory training
- Speech conservation
- Hearing aid
  - Air conduction hearing aids
  - Bone conduction hearing aids
- Cochlear implant

Treatment of the hearing impaired patients depend on the cause and severity of deafness. In many patients, in addition to treatment of the primary cause, auditory rehabilitation is required for better communication. The same is done in cases where other treatment options are not available. Following are the different options available for auditory rehabilitation:

1. Training:
   a. Speech reading or lip reading.
   b. Auditory training.
   c. Speech conservation.
2. Instruments or devices:
   a. Hearing aid.
   b. Cochlear implant.
   c. Auditory brainstem implant.
   d. Assistive devices.

SPEECH READING OR LIP READING

It is very useful in deaf patients who have high frequency sensorineural loss and have difficulty in understanding speech in noisy backgrounds. It is the process of understanding speech by observing the movement of lips, facial expressions and gestures.

AUDITORY TRAINING

Auditory training is mainly required to understand speech after a cochlear implant but it is also used after fitting of hearing aid in some individuals.

SPEECH CONSERVATION

Many patients with sudden or severe hearing impairment, lose their ability to monitor their own speech. These patients are trained to monitor their own speech by tactile or proprioceptive feedback.

HEARING AID

It is a device which is used for amplification of the sound and helps in hearing. In the past, different non electrical devices were used as hearing aids. They include auricles, trumpets and speaking tubes. The basic mechanism of these devices was to collect sound and deliver it to the ear. Now electrical and digital hearing aids are available. The basic mechanism of these electrical hearing aids is the same i.e. to collect sound, amplify and deliver it to the ear. The three essential components of an electrical hearing aid are:

1. Microphone: it collects the sound.
2. Amplifier: this amplifies the sound.
3. Receiver or speaker: this delivers amplified sound to the ear.

Types

Hearing aids are broadly classified into 2 types:

1. Air conduction hearing aids.
2. Bone conduction hearing aids.

1. Air Conduction Hearing Aids

The sound is delivered using normal middle ear conductive apparatus. In most of the cases, this type of hearing aid is used. According to the shape and site where it is placed, there are several varieties of air conduction hearing aids:

a. *Body worn type:* The main part of the hearing aid i.e. microphone, amplifier and power supply is placed in the pocket. Receiver is fitted in the ear canal and it is connected to the main unit through an external cord.
b. *Behind The Ear (BTE) type:* The hearing aid is fit behind the ear (Fig. 16.1). Sound is delivered through a tube which is connected to the ear mould placed in the auditory canal.
c. *Spectacle type:* The hearing aid unit is present in the spectacles.

d. *In The Ear (ITE) type:* The hearing aid unit is present in an earmould, which is worn in the ear.

e. *In The Canal (ITC) type:* The entire unit is placed in the external auditory canal (Fig. 16.2).

f. *Completely In the Canal (CIC):* Hearing aid lies completely within the canal and is not visible from outside.

2. Bone Conduction Hearing Aids

The sound is delivered through a bone vibrator which is placed on the mastoid bone. Cochlea is stimulated by bone conduction. This type is used in patients where air conduction hearing aid is contra indicated, e.g. in patients having discharging ears or atresia of the external auditory canal.

Another advancement in the bone conduction hearing aid is 'Bone Anchored Hearing Aid' (BAHA) which is an implantable type of hearing aid. In BAHA the vibrator is implanted surgically into the temporal bone, so the sound is transmitted directly to cochlea through the bone.

COCHLEAR IMPLANT

Cochlear implant is a new development for restoration of hearing in patients having severe sensory or cochlear hearing loss. The function of the cochlea is performed by this device i.e. it converts sound energy into electrical impulses which stimulates the cochlear nerve. Cochlear implant (Fig. 16.3, Fig. 16.4 and Fig. 16.5) is made up of following basic elements:

1. Microphone: It receives the sound and transmits it to the speech processor.
2. Speech processor: It analyzes the sound received from the microphone, converts it into electrical impulses and sends it to the transmitter coil.
3. Transmitter coil: It transmits the impulses to the internal receiver coil.
4. Receiver coil: It is implanted under the skin. It receives signals from the transmitter coil and sends it to the electrodes.
5. Array of electrodes: It is placed within the cochlea and stimulates the first order neurons of the cochlear nerve directly. In the past, single channel electrode was used but now multiple channels with upto 24 electrodes are available.

At present, cochlear implant is indicated in a patient having bilateral profound sensory deafness with

Fig. 16.1: Behind The Ear (BTE) type hearing aid.

Fig. 16.2: In The Canal (ITC) type hearing aid.

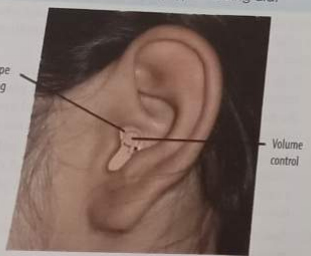


Fig. 16.3: Components of a cochlear implant.

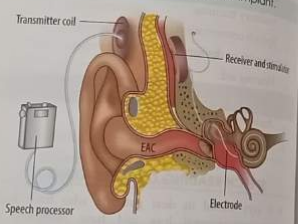


Fig. 16.4: Components of a cochlear implant.

measurable speech discrimination and even the most powerful hearing aid is not effective. It is most useful in *post-lingually* deaf adults and children i.e. where hearing loss occurs after acquisition of speech. *Pre-lingually* deaf adults may also get some benefit from cochlear implant. Congenitally deaf children get minimum benefit from cochlear implant.

Difficult words

- *Pre-lingual deafness:* Deafness has occurred even before the normal development of speech e.g. congenital deafness.
- *Post-lingual deafness:* Deafness has occurred after the normal development of speech in a child.

Fig. 16.5: Patient with cochlear implant.

Chapter Summary and Key Points

Hearing aid simply amplifies the sound deliver to the ear. Modern hearing aids are very tiny and may fit in the external auditory canal. These types are not visible from outside and are very popular for cosmetic reasons. Cochlear implant converts sound energy into electrical impulses and stimulates the cochlear nerve directly. Post-lingually deaf patient gets maximum benefit from a cochlear implant.

Best Choice Questions

Q1. Which of the following group of patients will get maximum benefit from a cochlear implant?

a. post-lingually deaf adult.
b. post-lingually deaf child.
c. pre-lingually deaf adult.
d. pre-lingually deaf child.

Q2. A 65-year-old diabetic patient developed progressively increasing hearing impairment in the last 2 years. Pure tone audiogram showed a bilateral moderate sensorineural hearing loss with a slopping curve at higher frequencies. What is the most suitable treatment option for this patient?

a. consider cochlear implant.
b. develop lip reading skill.
c. fit hearing aids in both ears.
d. learn sign language.

Q3. A mother brought her 2-year-old son with the complaint that he is completely deaf and dumb. On brainstem evoked response audiometry, there was no response in any ear on maximum stimulation. What is the best treatment option for this child?

a. behind the ear hearing aid.
b. bone anchored hearing aid.
c. bone conduction type hearing aid.
d. cochlear implant.

Answers

1. b.
2. c.
3. d.

SECTION II

Nose and Paranasal Sinuses (PNS)

Contents

Floor

Floor is formed anteriorly by palatine processes of the maxilla and posteriorly by horizontal plates of the palatine bone.

Roof

Roof is very narrow and is mainly formed by cribriform plate of the ethmoid bone. Anteriorly, it slopes downwards and forwards and is formed by the nasal process of frontal bone. Posteriorly, it slopes downward and is formed by the body of sphenoid bone.

Medial Wall

Medial wall of the nasal cavity is formed by the nasal septum, which separates the two nasal cavities. The nasal septum is formed by both bony and cartilaginous parts (Fig. 17.5). The cartilaginous part is mainly formed by the septal cartilage. The bony part is mainly formed by the perpendicular plate of ethmoid above and behind and by the vomer bone from below and behind.

Lateral Wall

Lateral wall is bony and mainly formed by the maxilla, ethmoid and lacrimal bones. On the lateral wall three convoluted turbinates are present, the superior, middle and inferior turbinate (Fig. 17.6 and 17.7). The inferior turbinate is the largest of all and is a separate bone attached to the maxilla. Three meati are present, each below the corresponding turbinate. Superior meatus contains the opening of posterior ethmoidal cells. Middle meatus is the most complex and has the opening of maxillary, anterior ethmoidal and frontal sinuses. This area is termed as *'osteomeatal complex'* and comprises of air cells of the anterior ethmoid, their ostia, ethmoidal infundibulum, maxillary sinus ostium and frontal sinus ostium. As a functional entity, this area represents the final common drainage and ventilation pathway of the frontal, maxillary and anterior ethmoid sinuses (Fig. 17.8 and 17.9). In the middle of this area, there is a round bulge called the *'bulla ethmoidalis'*. It is due to the ethmoidal air cells. Below and in front of the bulla ethmoidalis there is a semilunar recess called *'hiatus semilunaris inferior'*, which leads into a funnel-

Fig. 17.6: Lateral wall of the nose in a cadaver.

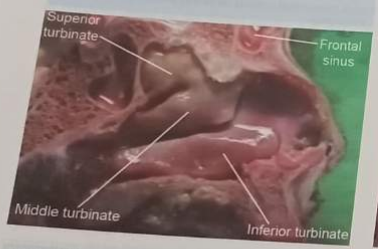
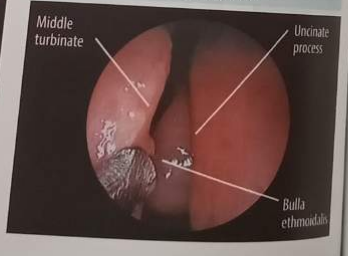


Fig. 17.8: Lateral wall of the nose in a cadaver after removal of the middle turbinate showing the osteomeatal complex.

Fig. 17.7: Endoscopic view of the nasal cavity showing the inferior turbinate, middle turbinate and nasal septum.

Fig. 17.9: Endoscopic view of the middle meatus showing the osteomeatal complex.



shaped space called the *'ethmoidal infundibulum'*. Above and behind the bulla ethmoidalis, there is a two dimensional passage called *'hiatus semilunaris superior'* which leads into a three dimensional recess called *'lateral sinus'*. The lateral sinus is again divided into *'suprabullar recess'* (above the bulla ethmoidalis) and *'retrobullar recess'* (behind the bulla ethmoidalis). The *'uncinate process'* is a thin hook shaped bone which forms the floor and medial wall of ethmoidal infundibulum. *Frontal recess* is situated in the anterior third of the ethmoidal labyrinth and frontal sinus ostium opens at its superior aspect. Inferior meatus receives the nasal opening of the nasolacrimal duct. Above the superior turbinate is a recess called the *'sphenoethmoidal recess'* which receives the opening of the sphenoid sinus.

Blood Supply of the Nasal Cavity

The blood supply of the nasal cavity is derived from the branches of both external and internal carotid arteries. The main supply from the external carotid artery is through the *sphenopalatine* artery, *greater palatine* artery and superior *labial* artery. Branches of the internal carotid artery include anterior and posterior ethmoidal arteries (Fig. 17.10 and 17.11).

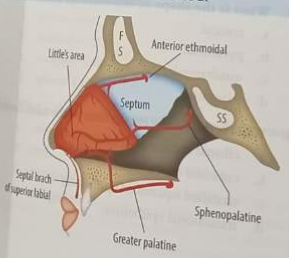
In the anteroinferior part of the nasal septum, an anastomosis of arteries is present called the *'Kiesselbach's plexus'* and the area is called *'Little's area'*. The arteries taking part in this anastomosis include sphenopalatine, greater palatine, superior labial and anterior ethmoidal arteries (Fig. 17.10).

The veins form a plexus beneath the mucous membrane and drain through the *sphenopalatine, anterior facial and ethmoidal* veins.

Blood Supply of the Nose

- From external carotid artery.
  - Sphenopalatine artery.
  - Greater palatine artery.
  - Superior labial artery.
- From internal carotid artery:
  - Anterior ethmoidal artery.
  - Posterior ethmoidal artery.

Fig. 17.10: Blood supply of the nasal septum showing anastomosis of arteries at Little's area.



Lymphatic Drainage of the Nasal Cavity

The lymphatic drainage from the anterior part goes to the *submandibular* and *upper deep cervical* lymph nodes. The lymphatic drainage from the posterior part of the nose goes to the upper deep cervical lymph nodes either directly or through the *retropharyngeal* lymph nodes.

Nerve Supply of the Nasal Cavity

The nerve supply for general sensation in the nasal cavity is derived from the following:

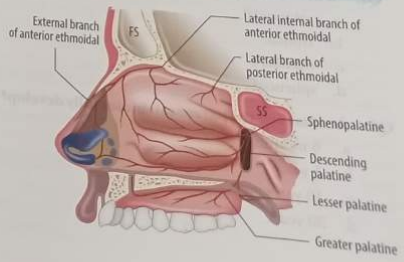
1. *Anterior ethmoidal nerve:* It is a branch of the ophthalmic division of trigeminal nerve and supplies the anterior part of the nasal septum and lateral wall of the nose.
2. *Greater palatine nerve:* It is a branch of maxillary division of the trigeminal nerve through the sphenopalatine ganglion. It supplies the inferior turbinate and the middle and inferior meatus.
3. *Short sphenopalatine (posterosuperior lateral nasal) nerve:* It is a branch of the sphenopalatine ganglion and supplies the posterior part of superior and middle turbinate.
4. *Long sphenopalatine (nasopalatine) nerve:* A branch from the sphenopalatine ganglion and supplies the nasal septum.

Olfactory or first cranial nerve is the nerve for special sense of olfaction or smell. Fibers arise from the bipolar cells in the olfactory mucosa and pass through the cribriform plate to end in an olfactory bulb.

ANATOMY OF THE PARANASAL SINUSES

These are air spaces within certain bones of the skull related with the nose and following are the different paranasal sinuses:

Fig. 17.11: Blood supply of the lateral wall of the nose.



1. Maxillary sinus.
2. Frontal sinus.
3. Sphenoid sinus.
4. Ethmoid sinuses.

Maxillary Sinus

It is also called the *Antrum of Highmore'*. It is pyramidal in shape and is present in the body of the maxillary bone. It has a *medial, posterior* and *anterior wall, roof, floor* and an *apex*. The medial wall is the partition between the nose and the antrum. The anterior wall separates the sinus from the skin of the cheek. The roof is thin and is formed by the floor of the orbit. The floor is formed by the alveolar process and hard palate. The ostium is situated high in the medial wall of the sinus. It has an average capacity of 15 to 20 ml in adults.

Frontal Sinus

This is situated in the frontal bone and regarded as an upward extension of the anterior ethmoidal cells. It has an average capacity of 7 to 10 ml in adults. The right and left sinuses are often asymmetrical and are separated by a thin bony septum, which may be deficient in parts. The frontal sinus ostium opens in the frontal recess, which further opens in the middle meatus.

Sphenoid Sinus

Sphenoid sinus is present in the body of the sphenoid bone and lies behind the upper part of the nasal cavity. The average capacity in adults is about 7 ml. It is unevenly divided by a vertical septum into two halves, which vary considerably in size. The ostium is situated anteriorly and drains into the sphenoethmoidal recess.

Ethmoidal Sinuses

It consists of approximately 7 to 15 thin walled cavities within the lateral mass of the ethmoid bone, grouped into *anterior* and *posterior* ethmoidal cells. Sometimes it extends in the agar nasi and the middle turbinate. They are relatively larger at birth and grow distinctly slowly. Anterior group cells open in the middle meatus while the posterior ethmoidal cells open in the superior meatus.

The *Agger nasi* cells are the most anterior ethmoidal air cells lying anterolateral and inferior to the fronto-ethmoidal recess, and anterior and above the attachment of the middle turbinate. They are located within the lacrimal bone and have lateral relation with the orbit, lacrimal sac and nasolacrimal duct. The *Onodi* cell or Spheno-ethmoidal air cell is the most posterior ethmoidal air cell, which extends posteriorly to lie superolateral to the sphenoid sinus and thus in close proximity to the optic nerve and internal carotid artery. Rarely, it may lie superior to the sphenoid sinus and is then called a Central Onodi air cell. The *Haller* cells, also known as infraorbital ethmoidal air cells or maxillo-ethmoidal cells are extramural ethmoidal air cells that extend into the inferomedial orbital floor.

Chapter Summary and Key Points

Nasal cavity is bounded by the roof, floor, medial and lateral wall. Medial wall is formed by the nasal septum, which separates the nasal cavity of the two sides. Little's area is present at the anteroinferior part of the nasal septum, where the anastomosis of the arteries is present. Frontal sinus is absent at birth and starts developing during childhood between the seventh and eighth year.

Best Choice Questions

Q1. Which of the paranasal sinus is absent at birth?
a. ethmoidal.
b. frontal.
c. maxillary.
d. sphenoid.

Q2. At what age the paranasal sinuses fully develop?
a. 6 months.
b. 1 year.
c. 10 years.
d. 20 years.

Q3. What is the shape of the external nose?
a. conical.
b. pyramidal.
c. quadrangular.
d. triangular.

Q4. What is the lining epithelium of the nasal cavity?
a. ciliated columnar epithelium.
b. cuboidal epithelium.
c. stratified squamous epithelium.
d. transitional epithelium.

Q5. Roof of the nose is mainly formed by:
a. body of the sphenoid bone.
b. cribriform plate of ethmoid bone.
c. frontal process of the maxillary bone.
d. maxillary process of the frontal bone.

Q6. Posterosuperior part of the nasal septum is mainly formed by:
a. body of the sphenoid.
b. perpendicular plate of the ethmoid.
c. septal cartilage.
d. vomer bone.

Q7. Which is the largest turbinate in lateral wall of the nose?
a. inferior.
b. middle.
c. superior.
d. supreme.

Q8. Where is the osteomeatal complex situated in the nose?
a. inferior meatus.
b. middle meatus.
c. superior meatus.
d. sphenoethmoidal recess.

Q9. Which of the following arteries take part in the formation of Kiesselbach's plexus?
a. greater palatine, sphenopalatine, anterior ethmoidal and posterior ethmoidal.
b. greater palatine, sphenopalatine, anterior ethmoidal and superior labial.
c. greater palatine, sphenopalatine, posterior ethmoidal and superior labial.
d. lesser palatine, sphenopalatine, anterior ethmoidal and ascending pharyngeal.

Q10. Which of the following structure is called the 'Antrum of Highmore'?
a. frontal sinus.
b. mastoid antrum.
c. maxillary sinus.
d. sphenoid sinus.

Q11. What is the rough shape of the maxillary sinus?
a. cuboidal.
b. oval.
c. pyramidal.
d. triangular.

Q12. What is the average capacity of the maxillary sinus?
a. 3–5 ml.
b. 6–10 ml.
c. 15–20 ml.
d. 30–35 ml.

Q13. Where is the opening of the frontal sinus situated in the nose?
a. inferior meatus.
b. middle meatus.
c. sphenoethmoidal recess.
d. superior meatus.

Q14. Where is the opening of the sphenoid sinus present in the nose?
a. inferior meatus.
b. middle meatus.
c. sphenoethmoidal recess.
d. superior meatus.

Answers with Explanations

1. b starts developing later.
2. d till growth of the facial bones is complete.
3. b base is directed downwards.
4. a respiratory type epithelium.
5. b.
6. b.
7. a along the whole length of the nasal cavity.
8. b final common pathway for drainage.
9. b.
10. c.
11. c.
12. c.
13. b through the frontonasal duct.
14. c.

CHAPTER 18 Physiology of the Nose and Paranasal Sinuses (PNS)

- Functions of the nose
  - Nasal respiration
  - Air conditioning
    - Change in temperature
    - Humidification
    - Filtration and purification
  - Protective function
  - Smell
  - Resonance to speech
  - Nasal reflexes
- Functions of the paranasal sinuses
  - Resonance of sound
  - Air conditioning
  - Lightening of the skull
  - Thermal insulator
  - Facial development

FUNCTIONS OF THE NOSE

Following are functions of the nose:

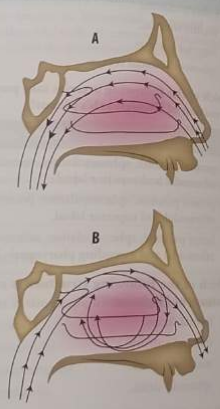
1. Nasal respiration.
2. Air conditioning.
3. Protective function.
4. Smell.
5. Resonance to speech.
6. Nasal reflexes.

Nasal Respiration

The nose forms the upper most part of the respiratory tract and is the natural pathway for breathing. Mouth breathing is not a natural pathway and has to be learned. A newborn baby is not able to breathe through his/her mouth if there is a nasal obstruction. Furthermore, during mastication of food, nasal breathing remains uninterrupted.

During quiet respiration, most of the air goes through the middle part of the nasal cavity. Airflow along the inferior meatus and upper olfactory region is minimal during quiet respiration. During expiration, same route is followed by air but due to resistance, eddies currents are formed (Fig. 18.1). The amount of air passed during breathing is controlled through resistance offered by the anterior ends of the inferior turbinates. The anterior ends of inferior turbinates can undergo changes in size, to increase or decrease the resistance to air flow. Nasal cycle is a normal phenomenon present in all individuals, where there are alternative changes in the resistance of nasal passage on two sides. At one time, one nasal passage is more patent and working more while the other is resting.

Fig. 18.1: Flow of air during breathing through the nasal cavity. A = flow during quiet respiration; B = flow during quiet expiration.



Air Conditioning

Air conditioning of the inspired air is one of the important functions of the nose. 'Air conditioning' means to make the air suitable for the lungs so it doesn't damage the lung tissues. Three important tasks are done by the nose during air conditioning:

1. Change in Temperature

The temperature of the atmospheric air may not be the same as body temperature. Nose brings change in temperature of the inspired air so that when it reaches the alveoli, its temperature becomes equal to that of the body. The mucosa of the nose especially over the turbinates is very vascular and contains venous sinuses. When inspired air is cold, blood flow is increased, which warms the air as it passes through the nose. Similarly, if the inspired air is hot, it is cooled down to body temperature.

2. Humidification

Humidity of the air varies considerably depending on the environment. Nose provides moisture to the respired air and makes it almost completely saturated with moisture as it passes through the nose. The moisture is provided by secretions of the glands and transudation of fluid through the epithelial surfaces.

3. Filtration and Purification

As air passes through the nose, it is filtered. Hair present in the nasal vestibule block the entrance of larger particles. In addition, the mucous film over the surface also filters the fine particles. As air passes through the nose, fine particles like dust and pollen adhere to this mucous film and air is filtered.

Protective Function

Nose protects the lower respiratory tract by preventing entry of any damaging substance or particle in the lungs. The protective function of hair and the mucous film is already discussed above. In addition cilia are present in the epithelium, which clear the mucous film. Due to the ciliary movement, the mucous film over it is transported continuously from the nose to the pharynx, where it is swallowed. The complete sheet of mucous is cleared into the pharynx about twice an hour.

Nasal secretion also contains enzymes and immunoglobulins. An enzyme called lysozyme is present which kills bacteria and viruses. Different types of immunoglobulins including IgA and IgE provide immunity against microorganisms.

Sneezing, which is a reflex phenomenon is also protective in nature. Any inhaled foreign particle causes irritation of the nasal mucosa and as a result, sneezing expels these particles. Olfaction sense is also protective at times when any noxious smell causes temporary cessation of breathing.

Smell

Olfaction or sense of smell is one of the important functions of nose but it is not as well developed in human beings as lower animals. The process by which olfactory epithelium is stimulated in response to odour is still not entirely understood. The odour of a substance is somehow related to the shape of the molecule. Some workers have described the presence of different olfactory cells for some primary odours like musty, pungent, putrid etc. Other odours are perceived due to stimulation of varying degree of different primary odour receptors.

Resonance to Speech

Nose along with the paranasal sinuses provide resonating chambers. These resonating chambers produce resonance to speech.

Nasal Reflexes

Several nasal reflexes are initiated in the nasal mucosa. Protective reflexes like sneezing and holding of breath due to noxious smells are already discussed above. Smell of any palatable food causes a reflexed increase in flow of saliva and even gastric juices. In addition, nasobronchial and nasopulmonary reflexes are also described. Increased resistance in the nasal cavity also causes a rise in pulmonary resistance and vice versa.

FUNCTIONS OF THE PARANASAL SINUSES

Functions of paranasal sinuses are still uncertain and poorly understood. Some of the probable functions are described below:

Resonance of Sound

Along with the nose, paranasal sinuses provide resonating chambers for consonant sound.

Air Conditioning

Paranasal sinuses may help the nose in air conditioning of the inspired air. They increase the overall surface area of the mucous membrane for warming, moistening and filtering.

Lightening of the Skull

The weight of skull bones is reduced due to the presence of air filled spaces in them. This function is probably insignificant.

Thermal Insulator

Paranasal sinuses may act as thermal insulators for the surrounding structures like eyes and brain.

Facial Development

Some of the facial bones grow as a result of expansion of air filled sinuses within them. Its significance is still unknown.

Chapter Summary and Key Points

Nose is the natural pathway for breathing and mouth breathing has to be learned. During mastication, breathing remains normal and uninterrupted. During quiet breathing, most air passes through the middle part of the nasal cavity. Air conditioning function of the nose is very important, it includes change in air temperature equal to that of the body, humidification and filtration. Nose also protects the lower respiratory tract in different ways. Sense of smell is not well developed in human beings as compared to lower animals e.g. dogs. Functions of the paranasal sinuses are poorly understood and are still uncertain.

Best Choice Questions

Q1. Which of the following structure is responsible for maintaining nasal resistance in an adult male?

a. anterior end of the inferior turbinate.
b. anterior end of the middle turbinate.
c. posterior end of the inferior turbinate.
d. posterior end of the middle turbinate.

Q2. Nasal cycle is present in:

a. all normal persons.
b. patients with allergic rhinitis.
c. patients with deviated nasal septum.
d. patients with rhinosinusitis.

Answers with Explanations

1. a thus controls the amount of air passing.
2. a normal physiologic phenomenon.

Symptoms of Nasal Diseases

CHAPTER 19

- Nasal obstruction
- Rhinorrhea
- Sneezing
- Epistaxis
- Postnasal dripping
- Headache and facial pain
- Change in voice tone (rhinolalia)
- Disturbances of smell
- Snoring
- Swelling and nasal mass
- Nasal deformity
- Eye symptoms
- Trauma and Foreign body

Patients with diseases of the nose, nasopharynx or paranasal sinuses may present one or more of the following symptoms:

1. Nasal obstruction.
2. Rhinorrhea or nasal discharge.
3. Sneezing and Itching.
4. Epistaxis.
5. Postnasal dripping.
6. Headache or facial pain.
7. Change in voice tone (rhinolalia).
8. Disturbances of smell.
9. Foul smell from the nose and crusting.
10. Snoring.
11. Swelling and nasal mass.
12. Nasal deformity.
13. Eye symptoms.
14. Trauma and Foreign body.
15. Others like fever, hearing impairment, neck mass and cough etc.

NASAL OBSTRUCTION

This is the most important symptom of nasal and paranasal sinus disease. Nasal obstruction may be intermittent or constant, unilateral or bilateral, congenital or acquired and acute or chronic in nature. Any nasal or paranasal sinus disease can give rise to nasal obstruction. Following are the common causes of nasal obstruction:

1. Congenital
   a. Choanal atresia.
   b. Congenital tumors.
   c. Atresia or stenosis of the anterior nares.
2. Acquired
   a. Acute:
      - Viral rhinosinusitis.
      - Bacterial rhinosinusitis.
      - Foreign body.
      - Septal hematoma.
      - Septal abscess.
      - Trauma to nose.
   b. Chronic:
      - Deviated nasal septum.
      - Nasal polyp.
      - Chronic rhinosinusitis.
      - Nasal allergy.
      - Vasomotor rhinitis.
      - Enlarged adenoids.
      - Tumors of nose and PNS.
      - Chronic granulomatous inflammations.
      - Rhinolith.
      - Hypertrophic turbinate.
      - Nasal synechia or adhesion.
      - Atrophic rhinitis.

A detailed history is taken from the patient with nasal obstruction regarding its:

- Duration.
- Onset.
- Progression.
- Severity.
- Frequency.
- Unilateral or bilateral. Nasal cycle is a normal phenomenon present in all individuals, where there is alternative change in the resistance of nasal passage on each side. At one time, one nasal passage is more

patent and working while the other is resting. This cycle is under autonomic control and most people are unaware of it but a patient with nasal obstruction on both sides becomes aware and complains of alternate blockage on each side.

- Effect of posture. While sleeping on one side, the part of nose which is under side becomes blocked. This is because of venous stasis and engorment of cavernous tissues of the inferior turbinate on the underside nose.
- Aggravating and relieving factors.
- Associated factors.

RHINORRHEA

Rhinorrhea is discharge from the nose. It may be watery, mucoid, mucopurulent or blood stained in nature. Nasal discharge may be unilateral or bilateral. Common causes of nasal discharge according to its nature are as of below:

1. Watery:
   a. Allergic rhinitis. Bilateral episodic watery rhinorrhea with sneezing and itching of the nose is characteristic of allergic rhinitis.
   b. Vasomotor rhinitis.
   c. Acute viral rhinosinusitis or common cold.
   d. CSF rhinorrhea.
2. Mucopurulent:
   a. Acute bacterial rhinosinusitis.
   b. Chronic rhinosinusitis.
   c. Enlarged adenoids.
   d. Choanal atresia.
3. Blood Stained:
   a. Malignant tumor. Unilateral and blood stained nasal discharge in an old age man is mostly suggestive of malignancy.
   b. Foreign body or rhinolith. Unilateral foul smelling and blood stained nasal discharge in a child is almost diagnostic of a foreign body or rhinolith.
   c. Nasal trauma.
   d. Severe rhinosinusitis.

During history taking from a patient with nasal discharge, following must be noted:

- Duration.
- Onset.
- Course and progression of the discharge.
- Amount of discharge.
- Character of the discharge.
- Unilateral or bilateral.
- Aggravating and relieving factors.
- Associated symptoms.

SNEEZING AND ITCHING

Sneezing is a normal, reflex and protective phenomenon to prevent entry of any noxious and harmful material into the nose. However excessive (more than 10 at a time) and frequent sneezing is always because of some pathology. It is mostly associated with itching in the nose. It occurs whenever the nasal mucosa is irritated, and it is particularly significant in patients of:

- Allergic rhinitis
- Vasomotor rhinitis
- Common cold or acute viral rhinosinusitis

EPISTAXIS

See chapter 26 for details.

POSTNASAL DRIPPING

A thin film of mucous is present over the nasal mucosa and due to the ciliary movement, this film is transported continuously towards the pharynx posteriorly. Normally this transportation of mucous is not noted by a person. Whenever there is an increase in the production of nasal secretion, this transportation of mucous becomes noticeable as *postnasal dripping*. Production of nasal secretion is increased whenever there is irritation of the nasal mucosa. Postnasal dripping is particularly prominent in acute and chronic rhinosinusitis. Because of postnasal dripping, there is irritation in the pharynx and the patient has to clear his pharynx or throat repeatedly.

HEADACHE AND FACIAL PAIN

Headache and *facial* pain may occur due to pathology in the nose and paranasal sinuses. Sinusitis is one of the important causes of headache and facial pain. Headache may also occur due to pressure effects of a lesion on the anterior ethmoidal nerve (anterior ethmoidal nerve syndrome).

In acute frontal sinusitis, patient presents severe headache in the frontal region, which may be localized over the affected sinus. Headache is characteristically periodic in nature which starts from waking up in the morning, gradually increases and reaches its peak after some time. It then subsides in the afternoon as the frontal sinus ostium gradually opens due to gravity (often known as office headache). In acute maxillary sinusitis, the patient presents pain in the cheek and maxillary region which may radiate to upper teeth, gums and the temporal region. Patient with ethmoidal sinusitis presents pain which is localized over the bridge of nose, between and deep towards the eyes, accompanied with frontal headache. Patient with sphenoidal sinusitis, presents headache in the frontal, occipital or central vertex region.

In chronic rhinosinusitis, pain is often described as a heavy feeling in the head or a dull ache over the sinuses.

During history taking of a patient with headache or facial pain, the following must be asked:

- Duration.
- Onset.
- Continuous or intermittent: if intermittent then its frequency, timings etc.
- Progression: whether it is increasing, decreasing or constant.
- Severity of the pain and its effect on normal routine.
- Character of the pain.
- Site and radiation of the pain.
- Effect of posture on pain.
- Aggravating and relieving factors.
- Associated symptoms.

CHANGE IN VOICE TONE (RHINOLALIA)

See chapter 32 for details.

DISTURBANCES OF SMELL

The following disturbances of smell can be present:

1. Anosmia
2. Hyposmia
3. Hyperosmia
4. Parosmia
5. Cacosmia

Anosmia is a total loss of sense of smell while *Hyposmia* is the partial loss of smell. Anosmia and hyposmia may occur in any obstructive lesion, which prevents the air to reach the olfactory area. In addition, it may also be caused by a pathology, which causes degeneration of olfactory mucosa and the olfactory nerves. The common causes are:

1. Nasal polyp.
2. Enlarged turbinates.
3. Edema of the mucous membrane e.g. rhinosinusitis, nasal allergy and vasomotor rhinitis.
4. Deviated nasal septum.
5. Atrophic rhinitis.
6. Trauma causing damage to the olfactory area and nerves in the anterior cranial fossa.
7. Intracranial lesions affecting the olfactory nerves, bulb and its central connections.
8. Tumors of the nose and paranasal sinuses.
9. Foreign body.
10. Nasal adhesions.
11. Enlarged adenoids.
12. Nasopharyngeal tumors.
13. Choanal atresia.
14. Functional anosmia: it is not due to any organic lesion rather is due to a psychogenic origin.

Parosmia is a condition where there is alteration or perversion in the perception of smell and the patient interprets the odor incorrectly. The pathophysiology of parosmia is exactly not known but could be due to misdirected regeneration of the nerve fibers. *Hyperosmia* is a condition where the patient has a heightened sense of smell which can be uncomfortable. It could be due to functional or central lesions. *Cacosmia* is a condition where the patient perceives every smell as bad or foul. It may be present in patients with atrophic rhinitis, chronic rhinosinusitis and suppurative conditions of the nose.

FOUL SMELL FROM THE NOSE AND CRUSTING

Foul smell from the nose which is perceived by others is typically associated with crusting in the nasal cavity. Drying of the nasal secretion occurs and the crusts are formed in the nasal cavities. Crusting is typically seen in patients with:

- Atrophic rhinitis
- Rhinitis sicca
- Nasal scleroma

SNORING

Whenever a nasal obstruction is present, the patient will have to breathe through his/her mouth. During sleep when the muscles are relaxed, the soft palate vibrates to produce a sound called *'snoring'*. The vibration of soft palate is especially prominent where there is turbulence of airflow in the mouth and pharynx. The obstruction causing snoring could lie in the nose, nasopharynx or oropharynx. Common causes of snoring are:

- Obesity leading to bulky oropharyngeal tissues.
- Enlarged palatine tonsils.
- Enlarged adenoids.
- Marked nasal obstruction due to a deviated nasal septum or nasal polypi etc.
- Macroglossia.
- Elongated uvula.

Snoring is often associated with 'sleep apnea syndrome'. In this condition, there are more than 30 apneic attacks lasting for at least 10 seconds during a 7 hour sleep. The causes of sleep apnea syndrome could be 'obstructive', 'central' or 'mixed'. In obstructive sleep apnea, there is respiratory obstruction and the patient continues to make respiratory efforts to overcome this obstruction. In central sleep apnea, respiratory effort and consequently air flow ceases mainly because of some defect in the central control of respiration.

SWELLING AND NASAL MASS

Swelling of the external nose may occur due to a skin lesion like boil, neoplasm or trauma. Widening of the nasal bridge due to splaying of the nasal bone occurs due

to pressure of the intranasal mass like polyp or tumor. Swelling of the face and surrounding area of the nose can occur because of the pathology in the paranasal sinuses like tumors or extension of the underlying inflammation.

Any abnormal tissue in the nasal cavity may be visible from outside by the patient or others and the patient can refer to a physician. Sometimes, even the normal nasal turbinates are visible in the nose and patients are worried about this mass. The common causes for a nasal mass are:

- Nasal polyp.
- Hypertrophied inferior turbinate.
- Marked deviated nasal septum.
- Angiofibroma.
- Other tumors of the nose and nasopharynx.

NASAL DEFORMITY

Deformity of the external nose occurs because of trauma, leading to an osteocartilaginous deformity. A deviated nasal septum may also cause deformity of the external nose. Any mass occupying lesion of the nasal cavity on one side may cause an external deformity with deviation of the nasal septum.

EYE SYMPTOMS

Many diseases of the nose and paranasal sinuses can produce different symptoms in the eyes because of their close proximity and include:

- Epiphora or watery eyes. The nasolacrimal duct opens in the inferior meatus of the nasal cavity and any obstruction in the flow of tears can results in watery eyes.
- Proptosis or displacement of the eye ball: Patients may complain of change in the shape or displacement of the eye ball. It can occur in diseases of the nose and paranasal sinuses where the disease enters the orbit through the ethmoidal or maxillary sinus. The displacement or proptosis of the eye can lead to increased intercanthal distance (telecanthus).
- Impaired visual acuity or color vision.

TRAUMA AND FOREIGN BODY

Trauma to the nose is very common. Nose is the most prominent part of the face and is at more risk to any facial injury. It is said that, fracture of the nasal bone is the most common occurring fracture in humans. Patients may come with a history of trauma to the nose or face. Depending on the extent of trauma, patient may be bleeding, have a deformity or pain etc (see chapter 22 for details).

Foreign body in the nose is also very common especially in children and mentally restarted persons. It may enter through the anterior nares, posterior nares or by penetrating injuries (see chapter 22 for details).

Chapter Summary and Key Points

Nasal obstruction and rhinorrhea are common symptoms. Any nasal disease can produce nasal obstruction. Nature of the nasal discharge is important for differential diagnosis. In watery nasal discharge, CSF rhinorrhea must be considered for differential diagnosis. Postnasal dripping is noticeable when there is increased production of nasal secretions. Sinusitis is one of the important cause of headaches and facial pain. The causes of sleep apnea syndrome could be obstructive, central or mixed.

Best Choice Questions

Q1. What is meant by 'rhinorrhea'?
a. any discharge from the nose.
b. CSF discharge from the nose.
c. mucopurulent discharge from the nose.
d. watery discharge from the nose.

Q2. A 20-year-old girl came in with recurrent watery rhinorrhea and sneezing. What is the most likely cause for it?
a. allergic fungal sinusitis.
b. allergic rhinitis.
c. chronic rhinosinusitis.
d. foreign body in the nose.

Q3. A 58-year-old man came in with blood stained discharge from the nose for last two months. What is the most likely condition that should be considered first in this patient?
a. bleeding or clotting disorders.
b. CSF rhinorrhea.
c. malignant tumor of the nose.
d. raised blood pressure.

Q4. Which of the following condition is often associated with snoring?
a. cardiac diseases.
b. pulmonary tuberculosis.
c. renal failure.
d. sleep apnea syndrome.

Q5. What are the minimum number of apneic attacks that occur during a 7 hours sleep in a patient with 'sleep apnea syndrome'?
a. 5.
b. 12.
c. 30.
d. 50.

Answers with Explanations

1. a.
2. b watery rhinorrhea and sneezing.
3. c.
4. d.
5. c.

CHAPTER

20 Clinical Examination of the Nose and PNS

- Inspection
- Palpation
- Anterior rhinoscopy
- Posterior rhinoscopy
- Functional examination
- Nasal endoscopy

The examination of the nose and paranasal sinuses include:

1. Inspection.
2. Palpation.
3. Anterior rhinoscopy.
4. Posterior rhinoscopy.
5. Functional examination.
6. Nasal endoscopy.

INSPECTION

External Nose

Inspection or external examination of the nose and paranasal sinuses require no special instrument except for good illumination of a head light or head mirror. External nose is inspected first from the front then laterally (Fig. 20.1) and then from above by standing behind the patient for any obvious deformity. While examining from behind any straight object like ring probe or pen is placed in the midline to assess lateral deviation of the external nose (Fig. 20.2). Osteocartilaginous framework of the external nose is examined for any deformity including deviation, hump or depression. The skin is examined for any sign of inflammation, scars, sinuses, color change, swelling or any other abnormality.

Fig. 20.1: Front and lateral examination of the external nose.

Fig. 20.2: Examination of the external nose from above and behind.

Paranasal Sinuses and Eyes

External aspect of the paranasal sinuses is inspected for signs of inflammation, swelling and deformity. Diseases involving the ethmoidal sinuses may cause expansion of the sinuses, which results in an increase in distance between the inner canthus of the eye and the bridge of nose (Fig. 20.3). Any mass-occupying lesion of the nasal cavity may result in splaying of the nasal bone and widening of the nasal bridge. Both eyes are also inspected for any proptosis and displacement (Fig. 20.4). Intercanthal distances, both inner (medial) and outer (lateral) and interpupillary distance are measured for assessing telecanthus and hypertelorism (Fig. 20.5). Telecanthus is the condition where distance between the two medial canthi (inner or medial intercanthal distance) is increased but the interpupillary distance as well as outer or lateral intercanthal distance remains the same (Fig. 20.6). Hypertelorism is the condition where distance between the two paired body organs is increased and usually refers to increased distance between the two eyes (orbital

Fig. 20.3: Patient with telecanthus and widening of eye nose bridge due to bilateral nasal polyposis.

Fig. 20.4: Patient with right sided nasal mass causing proptosis of the right eye.

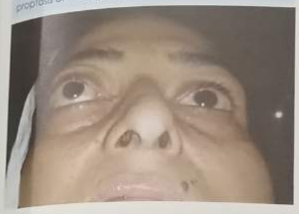


Fig. 20.5: Measurement of inner and outer intercanthal distance and interpupillary distance.

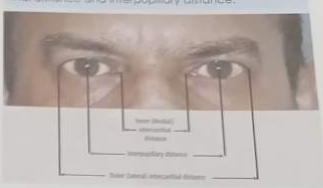
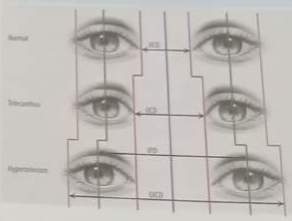


Fig. 20.6: Eye positions in normal, telecanthus and hypertelorism.



hypertelorism). In hypertelorism, intercanthal distances (both inner and outer) as well as interpupillary distance are increased (Fig. 10.8). Proptosis of the eye can occur due to diseases of the paranasal sinuses and if present, is also measured (Fig. 20.7). Visual acuity and color vision of each eye is assessed individually on each side.

Anterior Nares and Nasal Vestibule

The patient is asked to elevate the head, so the anterior nares and visible part of the nasal vestibule is examined. Both the anterior nares are compared for any asymmetry or irregularity (Fig. 20.8). The columella should be in midline. In anterior septal dislocation, most anteroinferior part of the septum in deviated from midline (Fig. 23.3). Anterior nares are also examined for any discharge or smell coming out of them.

The tip of the nose is then elevated with the thumb of left hand to examine the nasal vestibule (Fig. 20.9). Nasal vestibule is inspected for boils, fissures, crusting, color change or swelling. The anteroinferior part of the nasal septum is also inspected for any deviation or deformity.

PALPATION

External Nose

Palpation of the external part of nose is done for:

1. Tenderness: The tip of the nose or the ala on either side is tender in case of a nasal boil. Tenderness over the nasal bone is present in case of a fracture and associated soft tissue injury.
2. Crepitus over the nasal bone is present in cases of nasal bone fracture. It is checked by holding the upper part of the external nose with a thumb and index finger and moving it from side to side. The fractured fragments of the nasal bone will move and a crackling sensation will be felt.
3. Continuity of the nasal bridge is examined by placing the thumb over the bridge of the nose at its upper part and moving it towards the tip. Normally, it is smooth but a small hump or a depression can be felt which is otherwise not visible on inspection.
4. If any swelling or ulcer is present over the external nose, it should be palpated (see chapter 33 for details).

Fig. 20.7: Measurement of eye proptosis.

Fig. 20.8: Examination of the anterior nares and columella.

Fig. 20.9: Inspection of the nasal vestibule.

Fig. 20.10: Palpation over the frontal sinus for tenderness.

Paranasal Sinuses

The palpation over the paranasal sinuses is done for tenderness. Tenderness over the frontal sinus is tested by pressing the thumb over the floor of the frontal sinus just below the medial end of supraorbital ridge (Fig. 20.10). Tenderness appears first over the floor as it is thinner than the anterior wall of the sinus. Tenderness over the maxillary sinus is tested by pressing the thumb on the anterior wall of the sinus (Fig. 20.11). Tenderness can be elicited on the anterior group of the ethmoidal sinuses by pressing over the medial wall of the orbit just behind the root of nose (Fig. 20.12). Palpation of the sphenoid sinus cannot be done.

Transillumination

Transillumination of the paranasal sinuses is a quick and reliable method of testing presence of secretions within the sinuses. It is done in the dark room with the help of a pencil torch. In the frontal sinuses, the torch is placed on the floor of the sinus, while in the maxillary sinus, the torch is placed inside the mouth. Sinuses are brilliantly transilluminated when they are normal and contain air. Presence of fluid or secretion and thickening of the mucous membrane causes a decrease or absence of transillumination. Due to the need of a dark room, transillumination test is not done routinely in clinical practice.

Cervical Lymph Nodes

The cervical lymph nodes are then palpated for enlargement and tenderness (see chapter 33 for details). Some of the lymphatic drainage from the posterior part of the nasal cavity, nasopharynx and posterior group of paranasal sinuses is to the retropharyngeal lymph nodes, which are not possible to palpate.

ANTERIOR RHINOSCOPY

Anterior rhinoscopy is the method of examination for the anterior part of the nasal cavity with a nasal speculum.

Method of Anterior Rhinoscopy

Nasal vestibule is opened with the help of Thudicum's nasal speculum. Nasal speculum is held in the left hand (Fig. 20.13) and is introduced on one side with the lids

Fig. 20.11: Palpation over the maxillary sinus for tenderness.

Fig. 20.12: Palpation over the ethmoidal sinuses for tenderness.

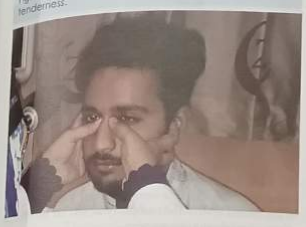


Fig. 20.13: Method of holding Thudicum's nasal speculum.

Fig. 20.14: Method of performing anterior rhinoscopy.

closed. After introduction of the speculum, the blades are opened by releasing the pressure very slowly and gently. Light is introduced in the nasal cavity with a head light or mirror to examine the walls and lumen of the cavity serially (Fig. 20.14). Patient's head may need to be tilted in different directions to examine various parts of the nasal cavity.

Structures Visible on Anterior Rhinoscopy:

Medial wall formed by the nasal septum is examined for any deviation, spur, perforation, hematoma, abscess, ulcer, bleeding point or growth. Condition of the nasal mucosa is also examined for color, congestion, edema and atrophy. Lateral wall is examined for the turbinates. The anterior part of the inferior turbinate and sometimes anterior end of the middle turbinate is visible while the superior turbinate cannot be seen in anterior rhinoscopy. Part of the middle meatus is also visible but inferior meatus is very difficult to assess in anterior rhinoscopy. Superior meatus and sphenoethmoidal recess are not visible. Turbinates are examined for size, color, edema and condition of the overlying mucosa. Floor of the nasal cavity is then inspected, while the roof of the nose is not possible to examine with anterior rhinoscopy. The lumen of the nasal cavity is examined for the presence of any secretion, foreign body, rhinolith, polyp or any other mass.

Probe Test

Probe test is done in cases where a mass is seen in the nasal cavity. This test can differentiate between a polyp and an enlarged turbinate since a probe can move all around a polyp but not in cases of an enlarged turbinate. In addition, consistency, mobility, attachment of a pedicle, sensations and bleeding on touch can also be examined using a probe test. For this purpose, Jobson Horne probe is used. First, a piece of cotton is wrapped around the pointed end of the probe (Fig. 20.15). The probe is held in the right hand and is moved all around the swelling present in the nose (Fig. 20.16).

POSTERIOR RHINOSCOPY

This is the examination of the posterior part of nasal cavity and the nasopharynx. The area is visualized indirectly through a mirror called a 'posterior rhinoscopy mirror'.

Fig. 20.15: Method of wrapping a probe with cotton.

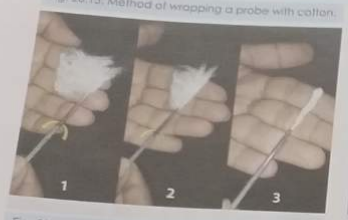
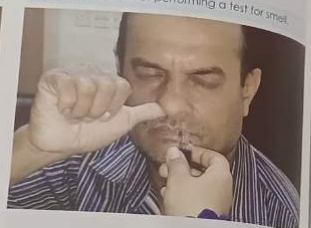


Fig. 20.16: Method of performing a probe test.

Fig. 20.17: Method of performing a posterior rhinoscopy.

Fig. 20.18: Method of performing a test for smell.



Method of Posterior Rhinoscopy

The patient sits in front of the examiner and is asked to open the mouth. With the help of a tongue depressor, held in the left hand, the tongue is depressed (Fig. 20.17). A posterior rhinoscopy mirror is held in the right hand like a pen and warmed from its mirror surface to prevent misting. The warmed mirror is checked for its temperature on the back of the left palm. The mirror is then introduced, facing upwards sliding over the tongue depressor and is passed behind the uvula. The patient is asked to breathe through his nose, which opens the nasopharynx by bringing the soft palate down and forward. Various parts of the nasopharynx and the posterior end of nasal cavity are examined by tilting the mirror in different directions. Some patients have extremely sensitive pharynx so a posterior rhinoscopy is very difficult. In such cases, a spray of 10% xylocaine in the oropharynx helps to retracts the gag reflex and the examination may become easy.

Structures Visible on Posterior Rhinoscopy

Structures which are visible on a posterior rhinoscopy are the posterior border of nasal septum, the posterior nares, posterior ends of the turbinates and the nasopharynx. In the roof of the nasopharynx, adenoids may be seen while in the lateral wall of the nasopharynx, slits like the opening of the eustachian tube are seen.

FUNCTIONAL EXAMINATION

Two essential functions of the nose, smell and nasal patency for respiration must be checked.

Smell

The sense of smell can be tested by asking the patient to identify the smell of a solution or a substance held below the nostrils while keeping the eyes closed. Each side of the nose is tested individually by closing the nostril of the other side (Fig. 20.18).

Nasal Patency

Patency of the nasal passage is checked by holding a cold metallic tongue depressor below the nostrils (Fig. 20.19). The patient is asked to breathe normally through the nose. During expiration, misting will occur on the cold tongue depressor. Patency of both sides can be checked simultaneously and compared by observing the mist below each nostril. A mirror can be used in place of a tongue depressor.

Another way of checking nasal patency is to hold a small piece of cotton wool below a nostril and closure of the other nostril with a finger (Fig. 20.20). Movement of the cotton wool is noted during breathing. Nasal patency is tested individually on each side by this method.

Cottle's Test:

Cottle's test is performed to assess the resistance at the nasal valve area. Place the fingers on the cheek, lateral to the nasal ala on one side and draw the skin laterally and upwards (Fig. 20.21). This movement causes traction on the nasal valve and opening of the valve area. Patient is asked to breathe and compare air entry before and after the traction. If there is improvement in air entry by this maneuverer, it means cause of nasal obstruction is at the nasal valve area. If there is no improvement, then the cause of nasal obstruction is lying more posteriorly.

NASAL ENDOSCOPY

Most of the ENT clinics are now equipped with the facility of a nasal endoscopy. It evaluates the nasal mucosa, sinonasal anatomy and nasal pathology with direct vision under magnification. It can be done with either a flexible fiber-optic endoscope or a rigid nasal endoscope, but a rigid endoscope is preferable and superior. Rigid nasal endoscopes have the diameter ranging from 2.7 to 4.0 mm, with tip angles ranging from 0 to 70°. Nasal endoscopy plays an important role in pre-operative, post-operative and medical management of sinonasal pathologies.

It is done under local anesthesia by using either 10% xylocaine spray or using a cotton soaked with xylocaine. Topical nasal decongestant in the form of xylometazoline spray is also used before the procedure. It is mostly done in a sitting position on an examination chair with patient's head adjusted according to the need but it can also be done in a supine position. The examiner usually performs three separated passes of the endoscope through each nasal cavity.

First Pass

During the first pass, a 0-degree endoscope is passed along the floor of the nasal cavity till the nasopharynx. The nasal cavity along the floor and inferior turbinate (Fig. 17.7), the entire nasopharynx along with the eustachian tube opening and fossa of Rosenmuller are examined in detail.

Second Pass

During the second pass, same endoscope is passed between the middle and inferior turbinate to examine the inferior portion of the middle meatus along with the frontanelles and accessory ostia. The scope is then passed medially and posteriorly to the middle turbinate for examining the sphenoethmoidal recess and opening of the sphenoid sinus. The scope is then rotated laterally under the middle turbinate to examine the uncinate process, bulla ethmoidalis and the infundibulum (Fig. 17.9).

Fig. 20.19: Method of checking nasal patency.

Fig. 20.20: Method of checking nasal patency with a piece of cotton.

Fig. 20.21: Method of performing a Cottle's test.

Third Pass

Third pass is usually performed with a 30-degree endoscope to examine other difficult areas like the olfactory cleft.

Checklist for Clinical Examination of the Ear

1. Introduce yourself.
2. Explain the procedure.
3. Take appropriate consent.
4. Sit in proper position.
5. Expose the examining part properly.
6. Illuminate the part properly with a head light or head mirror.
7. Begin by inspection of:
   a. External nose.
   b. Frontal region.
   c. Maxillary region.
   d. Ethmoidal region and eyes.
   e. Anterior nares vestibule of the nose.
8. Examine the nose by elevating the tip with a thumb.
9. Palpate the following regions:
   a. Bridge of the nose.
   b. Nasal bone.
   c. Frontal sinus.
   d. Maxillary sinus.
   e. Ethmoidal sinus.
   f. Cervical lymph nodes.
10. Perform anterior rhinoscopy.
    a. Hold the nasal speculum in a proper way.
    b. Introduce the nasal speculum correctly.
    c. Perform a probe test (if growth is present).
11. Perform a transillumination test.
12. Perform a posterior rhinoscopy:
    a. Explain the procedure.
    b. Hold the mirror precisely in the correct hand.
    c. Warm the mirror.
    d. Check the heated mirror for its temperature on the back of your palm.
    e. Ask the patient to breathe through his/her nose.
    f. Introduce the mirror correctly.
13. Perform functional examination of the nose:
    a. Check the nasal patency.
    b. Check for sense of smell.
    c. Perform Cottle's test
14. Perform a nasal endoscopy (in selected cases, if this facility is available).
15. Record the findings adequately.
16. Rewrap the exposed part and say thanks.

Best Choice Questions

Q1. A 20-year-old male patient came in the OPD with the complaint of a nasal deformity. On clinical examination, the external nose of this patient should be inspected from:

a. above and below.
b. front, above and below.
c. front, lateral and above.
d. right and left lateral.

Q2. Septal surgery was performed on a 21-year-old female patient who later on developed a saddle nose deformity. Which part of the external nose is involved in such deformity?

a. lower one-third of the external nose.
b. middle one-third of the external nose.
c. upper one-third of the external nose.
d. upper two-thirds of the external nose.

Q3. An 18-year-old female patient came in with a boil in the nose. What is the best method of examination of the nasal vestibule for this patient?

a. by asking the patient to lower her head.
b. by elevating tip of the nose with a thumb.
c. by Killian's nasal speculum.
d. by Thudicum's nasal speculum.

Q4. Anterior rhinoscopy was performed on a 25-year-old male patient in OPD. Which of the following structure is not visible on this examination?

a. floor of the nose.
b. inferior turbinate.
c. middle turbinate.
d. superior turbinate.

Q5. Anterior rhinoscopy was performed on a 30-year-old male patient which showed a smooth, round and shiny mass in the right nasal cavity. Which of the following clinical test is now mandatory to perform?

a. patency test.
b. probe test.
c. swab for culture and sensitivity.
d. test for sense of smell.

Q6. Which of the following two structures are differentiated on a 'probe test' during clinical examination of the nose?

a. antrochoanal and ethmoidal polyp.
b. enlarged inferior and middle turbinate.
c. polyp and enlarged adenoid.
d. polyp and enlarged inferior turbinate.

Q7. Palpation of the paranasal sinuses was done on a 28-year-old male patient during clinical examination of the nose. What important information will we get from this examination?

a. firmness in the wall of the sinuses.
b. pulsation in the sinuses.
c. softness of wall of the sinuses.
d. tenderness over the sinuses.

Q8. While performing a clinical examination of the nose on a 22-year-old female patient, palpation of the paranasal sinuses was done. Which of the paranasal sinus is not possible to palpate?

a. anterior ethmoidal.
b. frontal.
c. maxillary.
d. sphenoid.

Q9. A nasopharyngeal mass was suspected in a 26-year-old male patient who had a nasal obstruction. Which of the following clinical method is used for examination of the nasopharynx?

a. examination with Killian's nasal speculum.
b. examination with Thudicum's nasal speculum.
c. patency test.
d. posterior rhinoscopy.

Answers with Explanations

1. c examine from all sides for shape.
2. b that is why, it is called a saddle deformity.
3. b nasal speculum will hide this area.
4. d.
5. b to know its attachment.
6. d by assessing its attachment.
7. d seen in cases of sinusitis.
8. d.
9. d.

CHAPTER 21 Congenital Malformations of the Nose and PNS

- Congenital choanal atresia
- Atresia and stenosis of the anterior nares
- Dermoid cyst and sinus
- Other congenital anomalies of the nose
  - Aplasia of the sinuses
  - Bifid nose
  - Hypoplasia of the maxilla
  - Hyperplasia of the maxilla

CONGENITAL CHOANAL ATRESIA

Congenital choanal atresia is said to be due to persistence of the *primitive* bucconasal *membrane*. Atresia may be *bony* in type but could be *membranous* or partly membranous and partly bony. It may vary in its degree of severity. It could be complete or incomplete and may occur unilaterally or bilaterally. Complete unilateral atresia is the most common type seen. Its thickness may vary from 1 mm to 10 mm and is covered with epithelium on both sides. It occurs in about 1/7000 births and if there is a family tendency. Females are more commonly affected than males.

Clinical Features

It depends on the degree of severity and involvement of one or both sides of the nose. Unilateral atresia causes unilateral nasal obstruction which may not be noticed for many years. Many a times, a unilateral atresia is diagnosed accidentally. Excessive unilateral discharge from the nose is present in these cases as the nasal secretions can not be transported to the pharynx. This nasal discharge is mostly thick and glue like in consistency. In bilateral cases, at or soon after birth, the child asphyxiates as he/she cannot breathe through the mouth. In complete bilateral atresia, death may occur immediately after birth. Asphyxia is relieved when the mouth is opened and recurs again when the mouth is closed. A child has difficulty in sucking as during sucking the mouth is closed which causes asphyxia. Bilateral nasal discharge which is characteristically glue like is present. If the child survives, mouth breathing develops and in such cases, the child remains symptom free but has problem during feeding. Later on, failure to develop sense of smell and taste occurs.

Diagnosis

The diagnosis of choanal atresia can be made and confirmed by:

1. *Nasal patency test:* A cold metallic spatula (tongue depressor) or a mirror is placed below the nostril which shows reduced or no condensation over the surface.
2. *Catheter test:* A soft catheter is passed through the nose which will not pass beyond the posterior part of the nose in case of complete atresia.
3. *Dye test:* Few drops of color dye like methylene blue is put into the nose and the pharynx is examined for the presence of that dye. In complete choanal atresia, the dye will not reach into the nasopharynx.
4. *Nasal endoscopy:* Endoscopic examination of the nose will confirm the presence and extent of choanal atresia (Fig. 21.1).
5. *Imaging studies:* A radiopaque dye is instilled into the nose and plain X-ray is taken with a lateral view of the nose. This will show presence of choanal atresia. CT scan is now a preferred method to delineate nature and thickness of the obstruction (Fig. 21.2).

Treatment

In emergency cases immediately after birth, a tracheostomy may be needed in bilateral complete choanal atresia, but it should be avoided if possible. A mouth gag may provide a good oral airway. Use of *McGovern nipple* or endotracheal intubation are other options in emergency situation with bilateral complete choanal atresia. Atresia is treated by surgical or laser excision through endoscopic transnasal or sometimes through transpalatal approach.

ATRESIA AND STENOSIS OF THE ANTERIOR NARES

These are much more rare conditions compared to choanal atresia. Atresia is caused by the non-canalization of an epithelial plug between the median and lateral nasal processes. Stenosis is the narrowing of the anterior nares. In atresia, a web like partition is present between the nasal vestibule and nasal cavity proper. It may be unilateral or bilateral. The main presenting complaint is nasal

Fig. 21.1: Nasal endoscopy showing complete choanal atresia

Fig. 21.2: CT scan of the nose and nasopharynx showing thick complete choanal atresia on the left side

Fig. 21.3: Midline dermoid cyst

Fig. 21.4: Bifid nose

obstruction and in bilateral cases, loss of sense of smell is noted. The condition is treated by surgery with excision of the web.

DERMOID CYST AND SINUS

Dermoid cyst is formed in the line of fusion of the two processes in the developing embryo while a sinus is formed due to incomplete fusion. These are usually found in the midline of the nasal region but rarely, it may occur at other sites of fusion (Fig. 21.3). In a dermoid cyst, swelling is present on the bridge of the nose which may be very small. In a larger dermoid cyst, gross deformity of the nose may occur. A sinus opening is present in cases of dermoid sinus. Rarely, a sinus may communicate inside the nasal cavity forming a fistula. The condition is treated by complete surgical excision of the cyst or sinus.

OTHER CONGENITAL ANOMALIES OF THE NOSE

A number of other congenital anomalies may occur in the nose and paranasal sinuses. All are extremely rare and only the names are mentioned here.

Aplasia of the Sinuses

This occurs due to failure of pneumatization. Frontal sinus is mostly affected but sphenoid and maxillary sinus may be involved. No treatment is required in these cases.

Bifid Nose

A deep cleft or groove is present in the midline of the nose giving an appearance of a bifid nose (Fig. 21.4).

Hypoplasia of the Maxilla

Hyperplasia of the Maxilla

Chapter Summary and Key Points

Bilateral complete choanal atresia causes asphyxia soon after birth. It is an emergency situation. Asphyxia can be relieved by just opening the mouth. Tracheostomy is needed in some cases but it should be avoided as much as possible. Atresia is treated by surgical excision.

Best Choice Questions

Q1. A new born baby boy was brought in with a bilateral nasal obstruction with mouth breathing. A soft rubber catheter was tried to pass through the nose but it failed on both the sides. What is the structure, whose persistence results in this condition?

a. frontonasal process.
b. median nasal process.
c. primitive bucconasal membrane.
d. primitive nasal membrane.

Q2. According to the structures, what is the most common type of congenital choanal atresia?

a. cartilaginous.
b. bony.
c. membranous.
d. partly bony and partly membranous.

Q3. What is the most common type of congenital choanal atresia?

a. bilateral complete atresia.
b. bilateral incomplete atresia.
c. unilateral complete atresia.
d. unilateral incomplete atresia.

Answers

1. c.
2. b.
3. c.

Injuries Involving the Nose and PNS

CHAPTER 22

- Nasal bone fracture
- Fracture of the midface
- Foreign bodies (F.B.) in the nose
- Rhinolith
- Cerebrospinal Fluid (CSF) Rhinorrhea
- Oro-antral fistula

NASAL BONE FRACTURE

Nose is the most prominent feature of the face and is at more risk in any kind of facial injury. It is said that fracture of the nasal bone is the most common fracture in humans. It is often associated with fractures of other bones of the face and base of skull. Nose alone is usually involved in low velocity trauma while in a high velocity trauma, other facial bones are also involved along with the nose. Following are the common causes of nasal trauma and fractures:

1. Personal assault.
2. Sport injury.
3. Road traffic and other accidents.

Nasal bone fracture is classified into three types:

1. *Class I fracture:* In this type, the distal thin part of the nasal bone is fractured, which may be depressed or displaced. This type of fracture occurs due to trauma from the front and is associated with vertical fracture of the nasal septum *(Chevallet fracture)* (Fig. 22.1).
2. *Class II fracture:* In this type, along with fracture of the nasal bone, fracture of the frontal process of maxilla also occurs. This type of fracture is due to a medium velocity trauma from the lateral side (Fig. 22.2). It is associated with horizontal *(Jarjavay fracture)* or 'C' shaped fracture of the nasal septum along with perpendicular plate of ethmoid (Fig. 22.3).
3. *Class III fracture:* In this type, the ethmoid labyrinth is also fractured. There is marked depression of the nasal bones which are pushed under the frontal bones and there is an apparent widening of space between the two eyes (telecanthus).

Fig. 22.1: Class I nasal bone fracture.

Fig. 22.2: Class II nasal bone fracture.

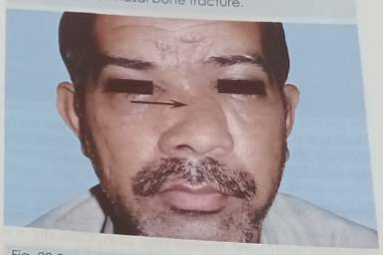


Fig. 22.3: A: Chevallet fracture, B: Jarjavay fracture.

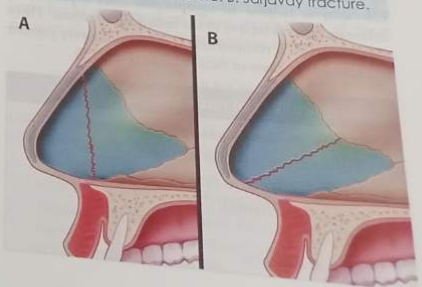


Fig. 22.4: Plain X-ray of nasal bone (lateral view) showing nasal bone fracture.

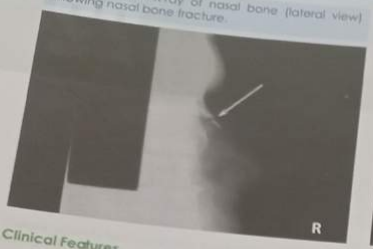


Fig. 22.5: 3D CT reconstruction in case of nasal trauma.

Clinical Features

Patient may present immediately after trauma especially if trauma, is severe enough. In minor degrees of trauma, patient may ignore the initial injury and may come later with some deformity of the nose and nasal septum. Deformity of the nose may occur immediately after trauma, which is soon followed by swelling and ecchymosis of the nose and surrounding region. Pain may not be very severe but tenderness is marked. Bleeding from the nose or epistaxis of varying severity may occur immediately after trauma. Nasal obstruction will develop when there is trauma to the nasal septum causing its fracture, dislocation and hematoma formation. When other injuries on the face are also present along with nasal trauma, signs and symptoms related to that injury would be present. In some cases of nasal trauma, a cerebrospinal fluid leak *(CSF rhinorrhea)* may occur due to a dural tear in the roof of the nose. On clinical examination, crepitus over the nasal bone will be present in case of a fracture.

Investigations

Radiology: Plain X-ray of the nasal bone in lateral view will show nasal bone fracture (Fig. 22.4). Clinically, it is of little value but has a great medico-legal significance. CT scan is helpful in complicated cases especially to delineate other fractures in the maxillofacial region. Three dimensional CT reconstruction is becoming very popular and valuable in cases of facial trauma (Fig. 22.5).

Clinical features of nasal trauma

- Maybe present immediately or after sometime.
- Deformity of the external nose.
- Edema, ecchymosis or bruises.
- Pain and tenderness.
- Bleeding.
- Nasal obstruction.
- CSF rhinorrhea.
- Crepitus over the nasal bone.
- Other associated injuries.

Treatment

Reduction of the nasal bone fracture is possible if the patient reports the fracture immediately after trauma, before local swelling. If the patient reports it after a period of time, when the edema and swelling is marked, reduction of fracture is difficult and it should not be attempted. Correction of the nasal bone fracture in these cases is then tried later on when the swelling and edema subsides, suitably after 10 to 14 days. Reduction of the displaced nasal bone fracture is done by mobilization of the fragments with the help of Walsham's forceps. Sometimes it is also possible to correct nasal septal fractures at this stage with Ashe's forceps. If the septal fracture is not possible to replace, then a septoplasty will be required. After reduction POP cast is applied over the external nose for 10–14 days (Fig. 22.6).

Prophylactic antibiotic is required especially in cases of an external open wound. Anti-inflammatory and analgesics are also required to relieve edema and pain. In cases of malunion, when the patient reports the problem at later stages with nasal deformity, a *rhinoplasty* is required to correct the deformity by doing lateral and medial osteotomies (see chapter 23).

FRACTURE OF THE MIDFACE

The midface is the part which lies between the supraorbital ridge and the upper teeth. It consists of the central naso-maxillary complex and lateral malar-maxillary complex. Fractures of the central midface are conventionally classified into *alveolar* and *Le Fort's* fracture. In the alveolar fracture, fracture line passes through the upper alveolar process. Le Fort's fractures are again divided into three types (Fig. 22.7):

Fig. 22.6: POP cast after reduction of a nasal bone fracture.

Fig. 22.7: Three types of Le Fort's fractures.

1. *Le Fort's I (Guerine fracture):* The fracture line runs above the floor of the nasal cavity and the maxillary sinus. Fracture line involves the lower part of the nasal septum, maxillary antrum and the pterygoid plates.
2. *Le Fort's II:* In this type, the fracture line runs from the floor of the maxillary sinus to the infraorbital margin up to the roof of the nose. Fracture line involves the root of the nose, lacrimal bone, floor of the orbit, maxillary sinus and pterygoid plates.
3. *Le Fort's III:* In this type of fracture, there is complete disconnection of the facial skeleton from the base of skull. Fracture line runs at the level of the base of skull involving the root of the nose, the ethmo-frontal junction, the superior orbital fissure, lateral wall of the orbit, fronto-zygomatic and temporo-zygomatic sutures and pterygoid plates.

Fracture of the orbital floor may occur along with fracture of the zygomatic bone or Lefort's type II or type III fracture, typically known as the *"blow out fracture"*. The orbital contents may herniate into the maxillary sinus which results in enophthalmos. Inferior rectus muscle or other orbital content get entrapped within the fracture resulting in teething and restriction of gaze and diplopia. Typical *"tear drop sign"* is observed on plain X-ray or CT scan due to this herniation of the orbital content (Fig. 22.8 and 22.9).

Fig. 22.8: Tear drop sign on plain X-ray PNS (Water's view).

Fig. 22.9: Tear drop sign on CT scan of the nose & PNS (coronal view).

The body and processes of the zygomatic bone constitute the lateral midface. Depressed fracture of the zygomatic bone is called the *'Tripod fracture'* because the bone breaks at three places. Basic treatment of all these fractures is reduction and fixation of the bony fragments.

FOREIGN BODIES (F.B.) IN THE NOSE

Foreign bodies in the nose are much more common in children and mentally retarded persons. It may enter the nose through one of the following routes:

1. Through the anterior nares: This is the most common route for introduction of foreign bodies.
2. Through the posterior nares: Foreign body may enter through the posterior nares rarely like entering of food or vomitus during vomiting.

3. Through penetration of its walls: e.g. bullet.

Foreign bodies of the nose are classified into *animate* and *inanimate*. Inanimate foreign bodies are further classified into *vegetative (hygroscopic)* and *non-vegetative (non-hygroscopic)*. Non-vegetative foreign bodies may be *metallic* or *non-metallic* in nature.

Type of Foreign Bodies in the Nose

Animate: flies, maggots etc.
Inanimate:
- Vegetative: seed, peanut, *chalia* etc.
- Non-vegetative:
  - metallic: metal pieces, screw, battery cell.
  - non-metallic: rubber piece, bead, chalk piece.

Clinical Features

Patient may come in immediately with a history of introduction of foreign body. Often, patient reports no history of foreign body introduction, rather reports unilateral, foul smelling and often blood stained discharge with unilateral nasal obstruction. If a child reports unilateral foul smelling discharge, presence of a foreign body must be excluded first. On examination, a foreign body may be seen in the nasal cavity. Sometimes, foreign body may not be visible due to the nasal discharge, congestion and edema of the nasal mucosa. Most of the foreign bodies are impacted near the floor between the nasal septum and inferior turbinate.

Investigations

Radiology: Plain X-ray of the nose in lateral and anteroposterior view may show presence of a radiopaque foreign body (Fig. 22.10). Soft tissue shadow may be seen in cases of radiolucent foreign bodies.

Treatment

In very young and noncooperative children with deep-seated foreign bodies, general anesthesia is suitable for the removal. Method of removal depends on the nature of the foreign body. Flattened foreign body like a piece of paper can be removed by a pair of crocodile forceps. Irregular and round foreign body removal must not be tried with forceps, as they will push the foreign body further deep inside. These types of foreign bodies are removed by a round hook or probe (as in ear, Fig. 7.4). The instrument is passed behind the foreign body and dragged forward along the floor. Rarely, a larger foreign body lying deep in the nasal cavity can be pushed into the nasopharynx and removed through the mouth.

Fig. 22.10: Plain X-ray nasal cavity (lateral view) showing radiopaque foreign body (battery cell)

Complications

If the foreign body is not removed and remains unnoticed for few days, it will give rise to local reaction, edema with superadded infection. If the foreign body remains there for a long time, calcium deposition will occur over it leading to rhinolith formation. Rarely, a foreign body in the nose may slip into the nasopharynx spontaneously and gets impacted lower in the aerodigestive tract.

RHINOLITH

Rhinolith is stone formation in the nasal cavity. A rhinolith is formed by deposition of calcium and magnesium salts over a nucleus of foreign material. The nucleus could be *exogenous* like an unnoticed foreign body which has been present for a long time or *endogenous* like a blood clot or inspissated nasal secretion. Over a period of time, the rhinolith increases in size due to continuous deposition of salts. A large rhinolith exerts pressure over the nasal septum and lateral wall of the nose and may cause its necrosis. Rhinolith is usually hard and grayish brown/black in color and sometimes may be multiple.

Clinical Features

Patient presents a unilateral obstruction and unilateral discharge from the nose. The discharge is mucoid or mucopurulent, mostly foul smelling and sometimes blood stained. On examination, rhinolith will be visible in the nasal cavity. When touched with a probe, it appears hard and gritty in consistency.

Investigations

Radiology: Plain X-ray of the nose (lateral view or Water's view) will show presence of the radiopaque irregular mass in the nasal cavity (Fig. 22.11). Radiopacity of the rhinolith is due to presence of calcium salts.

Fig. 22.11: Plain X-ray of the nose and PNS (Water's view) showing radiopaque shadow in the left nasal cavity (black arrow). Inset = rhinolith after removal.

Treatment

Removal of the rhinolith is done under general anesthesia. In cases of a large rhinolith, it may not be possible to remove and would have to be broken down into smaller pieces before removal. Rarely, when it is not possible to break, a large rhinolith is removed through a *lateral rhinotomy* approach.

CEREBROSPINAL FLUID (CSF) RHINORRHEA

This is the flow of cerebrospinal fluid from the nose.

The following are the causes of CSF rhinorrhea:

1. *Trauma:* This is the most common cause of CSF rhinorrhea. It is caused by the fracture of base of skull involving the anterior cranial fossa with tearing of the dura mater. Surgical trauma to the cribriform plate is an important cause like in a SMR operation, septoplasty, nasal polypectomy and Functional Endoscopic Sinus Surgery (FESS).
2. *Neoplasia:* Destructive lesions of the nose involving the floor of anterior cranial fossa may cause a CSF rhinorrhea.
3. *Congenital defect:* Congenital malformation in the anterior cranial fossa associated with encephalocoele or meningocoele may cause CSF rhinorrhea.
4. *Spontaneous:* This is a rare cause, where CSF rhinorrhea occurs spontaneously without any known pathology.

Clinical Features

Patient presents dribbling of clear watery fluid from the nose, which is increased by bending or straining (Fig. 22.12). This is sometimes the only presenting complaint. It is sometimes confused with watery rhinorrhea of an allergic or viral origin. Other associated symptoms of nasal diseases like sneezing, nasal obstruction, postnasal dripping etc, are absent in this condition. Sometimes, meningitis may supervene and patient presents signs and symptoms of meningitis.

Fig. 22.12: Dribbling of clear watery fluid due to CSF rhinorrhea.

When this fluid is collected on a handkerchief, after drying, the handkerchief will remain soft (*handkerchief test*). In contrast, nasal secretion which contains mucous and albumin causes stiffening of the handkerchief. If this discharge is collected in a test tube and allowed to stand for sometime, it remains clear while in nasal secretions, sedimentation will occur on standing. CSF has high glucose content in contrast to nasal secretion, which can be tested by a glucose paper strip.

Investigations

1. *Biochemical tests:* These tests are done to confirm the presence of CSF. The nasal discharge is checked for glucose and B-2 transferrin array (a protein present in CSF, perilymph, aqueous and vitreous humor), its presence will confirm the diagnosis of CSF rhinorrhea.
2. *CT scan:* High resolution CT scan is done in both axial and coronal view to demonstrate site and size of the defect.
3. *Nasal endoscopy:* It is very helpful in localizing the site of leak. The localization of CSF leak is done by injecting a colored dye (fluorescein) through a lumbar puncture intrathecally and checking its leak into the nose through a nasal endoscopy.

Treatment

Initially, medical treatment can be tried and many of the leaks stop spontaneously. Medical treatment includes prophylactic antibiotics to prevent meningitis, putting the patient in a semi-sitting position and avoiding blowing of the nose and straining. Nasal packing must be avoided in these cases, as it will lead to meningitis. If the leak persists for few weeks, surgical treatment is employed. Previously, repair of the dura mater was done by placing a fascia graft through intracranial approach. But now endoscopic endonasal approach is used for treating CSF rhinorrhea. Site of the leakage is identified by injecting a colored dye

and it is repaired by placing fat or fascia, sealed with local mucosal flap and human fibrin glue.

ORO-ANTRAL FISTULA

Oro-antral fistula is a communication between the oral cavity and the maxillary antrum. The causes of an oro-antral fistula are:

1. *Dental extraction:* This is the most common cause of oro-antral fistula. The fistula is formed through the alveolar border of upper jaw after tooth extraction (Fig. 22.13). This occurs mostly after extraction of the first upper molar tooth, the roof of which may penetrate the bony floor of the antrum. Fistula may occur when removal of broken tooth root is attempted.
2. *Caldwell Luc's operation:* This operation is done through sublabial incision. The line of incision may break down and form a fistula.
3. *Malignant tumors:* Erosion of bone by a malignant tumor of the oral cavity and maxillary antrum may form an abnormal communication.
4. *Penetrating injuries:* Penetrating injuries like from a bullet may form a fistula between the oral cavity and the maxillary antrum.

Clinical Features

Regurgitation of fluid occurs through the nose during drinking. Discharge may occur from the opening in the oral cavity, which may be purulent or mucopurulent in

Fig. 22.13: Oro-antral fistula after tooth extraction

nature. Fistula will cause infection in the maxillary sinus and signs and symptoms of sinusitis will be present.

On examination, opening in the oral cavity is seen. A probe can be passed through this opening into the maxillary antrum. The signs of sinusitis will be present in the nose.

Treatment

A small fistula may heal spontaneously when the mucosa over it is stitched after tooth extraction. In the same way, a sublabial fistula after Caldwell Luc's operation may heal by restitching of the mucosa. Larger fistulae may need other surgical procedures for closure by use of different flaps.

Chapter Summary and Key Points

Fracture of the nasal bone is most common among all fractures of the body. Foreign bodies in the nose are common in children and mentally retarded persons. Vegetative or a hygroscopic foreign body swells by absorbing moisture and gets impacted. A child with unilateral, foul smelling and blood stained discharge, indicates the possibility of a foreign body or rhinolith and must be considered first. Sometimes a large rhinolith is difficult to remove through the nostril and in such cases, open surgical approach by lateral rhinotomy is needed. In cases of clear watery discharge from the nose, CSF leak must be excluded first. On a handkerchief test, nasal discharge after drying causes stiffening of the handkerchief while in CSF leak, it remains soft after drying. Nasal packing must be avoided in CSF leaks as they may lead to meningitis.

Best Choice Questions

Q1. After a road traffic accident, a 22-year-old male patient presented fracture of the nasal bone. How will you classify such a fracture?

a. class I and II fracture.
b. class I, II and III fracture.
c. Lefort's I and II fracture.
d. Lefort's I, II and III fracture.

Q2. A 3-year-old child was brought in with the complaint of unilateral foul smelling and blood stained discharge from the nose for last 2 weeks. Which important condition should be suspected first?

a. congenital choanal atresia.
b. foreign body in the nose.
c. fracture of the nasal bone.
d. nasopharyngeal angiofibroma.

Q3. A 4-year-old boy was admitted in the hospital with the complaint of foreign body entry in his nose 4 hours ago. The child was very aggressive and was crying continuously, so it was decided to remove the foreign body under anesthesia. What is the most suitable anesthesia in this case?

a. general.
b. local.
c. regional.
d. spinal.

Q4. A 16-year-old boy was diagnosed with a large and impacted rhinolith in his right nasal cavity. He had a history of removal of a rhinolith under general anesthesia that was not successful. Now, what option is available for removal of this rhinolith?

a. lateral maxillectomy.
b. lateral rhinotomy.
c. medial maxillectomy.
d. medial rhinotomy.

Q5. A 26-year-old man came in the OPD with complaint of clear watery rhinorrhea from his right nose for last 5 days, which increased with bending and straining. What is the most common cause of such condition?

a. congenital defect in the anterior cranial fossa.
b. malignancy of the nose, extending intracranially.
c. spontaneous or without any cause.
d. trauma to the anterior skull base.

Q6. A 22-year-old male patient was diagnosed with oro-antral fistula. What is the most common cause of this condition in such a patient?

a. Caldwell Luc's operation.
b. malignant tumor of the oral cavity.
c. penetrating injuries.
d. extraction of first upper molar tooth.

Answers with Explanations

1. b three varieties.
2. b.
3. a to avoid trauma to other structures.
4. b though rarely required.
5. d fractures and nasal surgical trauma.
6. d its root projects into the floor of the sinus.

CHAPTER

23 Nasal Septal Diseases

- Deviated nasal septum
  - Etiology
  - Types of DNS
  - Effects of deviation
  - Clinical features
  - Treatment
- Septal surgery
  - Indications
  - Contraindications
  - Procedure of SMR
  - Procedure of septoplasty
  - Post-operative care
  - Complications
- Rhinoplasty
- Septal hematoma
- Septal abscess
- Septal perforation

DEVIATED NASAL SEPTUM

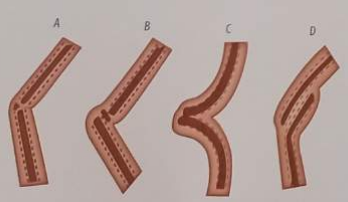
Deviation of the nasal septum (DNS) is extremely common but in most cases, it is not severe enough. Symptoms are produced only in some cases.

Etiology

The important etiological factors responsible for development of deviated nasal septum are:

1. *Trauma:* Many cases of deviated nasal septum are due to direct trauma to the nose resulting in fracture of the nasal septum (Fig. 23.1). This trauma is frequently associated with damage and fracture to other parts of the nose.
2. *Developmental disturbance:* There are many factors which can disturb the development of the nasal septum and result in its deviation. Abnormal intrauterine posture results in compression of the nose and upper jaw. When the compression forces are unequal on the two sides, it may cause deviation. Furthermore, during parturition, trauma may occur to the nose, as it is the most exposed part of the face. Subsequent growth of the child will further accentuate this deviation or dislocation. During primary and secondary dentition, further growth of the palate occurs. When there is unequal growth between the palate and base of skull, buckling of the nasal septum may occur. For the same reason, DNS is common in cases of a high arched palate.
3. *Race and hereditary:* The incidence of a deviated nasal septum is more common among races like the Caucasians. In addition, many members of the same family may be affected by this condition.
4. *Space occupying lesion:* Any growth or spaceoccupying lesion in one nasal cavity may push the septum resulting in its deviation e.g. nasal polyp.

Fig. 23.1: Types of nasal cartilage fractures. A = edge to edge angulation; B = angulation with overlap; C = bowing of edges; D = duplication of edges.

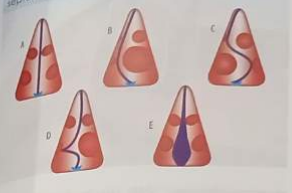


Types of DNS

Deviation or deflection may involve only the cartilage, bone or both. Deviation may be:

1. *Simple or 'C' shaped:* Where the septum is curved on one side. This is usually present in the cartilaginous part on that side. Where the septum is concave, the nasal cavity is wider which leads to compensatory hypertrophy of the inferior turbinate on that side (Fig. 23.2 B).
2. *Sigmoid or 'S' shaped:* A double bend is present in a 'S' shaped manner. 'S' shaped curve may be present in the vertical or anteroposterior plane (Fig. 23.2 C).
3. *Spur:* It is an isolated and sharp angulated shelf like projection of the nasal septum mostly found at the junction of cartilage and bone along the floor of the nose (Fig. 23.2 D).

Fig. 23.2: Types of deviated nasal septum: A = normal straight septum; B = 'C' shaped septum; C = 'S' shaped septum D = septal spur; E = thickened nasal septum.



4. *Thickening:* It is present in cases of trauma where overriding of the fractured segments results in duplication of the cartilage. It may also occur due to organization of the septal hematoma (Fig. 23.2 E).
5. *Anterior or caudal septal dislocation:* The lower border of the septal cartilage is displaced from its median position and projects into one of the nostril (Fig. 23.3).

Effects of Deviation

Deviation of the nasal septum affects functions of the nose and it depends upon the severity of the deviation. Nasal obstruction is present either due to deviation of the nasal septum or due to compensatory hypertrophy of the inferior turbinate on the other side. Due to deviation of the septum, normal flow of air current through the nose is disturbed. As a result of this, drying of the localized mucosa may occur which leads to crusting. Separation of the crust causes mucosal ulceration and bleeding. Drying of the mucosa may occur over a large area and this loss of protective mucous film results in reduced resistance to infection. Deviation may also cause localized constriction in the nasal cavity. According to *Bernoulli's phenomenon*, when air passes through a constriction, there is a creation of negative pressure distal to constriction. This negative pressure causes an edema of the mucosa and leads to further nasal obstruction. Deviation of the septum may produce pressure effects on the lateral wall of the nose and result in pain.

Clinical Features

Nasal obstruction is the prime presenting complaint in patients having a deviated nasal septum. Nasal obstruction may be unilateral or bilateral depending on type and severity of the deviation. As mentioned earlier, deviated nasal septum reduces the resistance to infection and recurrent rhinosinusitis may occur. Epistaxis is present due to drying and crusting. Bleeding from the nose may also occur from vessels over the septal spur. Headache may occur as a result of sinusitis or due to pressure effects on the lateral wall. Loss of smell may occur in cases where deviation prevents the air to reach the olfactory area. Severe and marked nasal septum deviation may be associated with external deformity of the nose. Recurrent infections of the nose and sinuses may spread to cause infection in the pharynx, larynx and middle ear.

Fig. 23.3: Anterior or caudal dislocation of nasal septum on the left side.

On examination, septal deviation is quite obvious during anterior rhinoscopy (Fig. 23.4). Septal deviation in the region of nasal valve causes the greatest obstruction because this is the narrowest area of the nasal cavity. Hypertrophy of inferior turbinate is also visible on the other side of deviation in anterior rhinoscopy. Mucosal changes including drying, edema, congestion and crusting are also visible.

Clinical Features of Deviated Nasal Septum

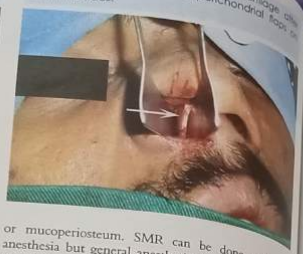
- Nasal obstruction.
- Rhinosinusitis.
- Epistaxis.
- Headache.
- Loss of smell.
- External deformity.
- Infections of neighbouring area.
- Inferior turbinate hypertrophy.
- Mucosal changes.

Treatment

Minor degrees of deviated nasal septum, producing no symptoms require no treatment. Surgery is required in cases where deviated nasal septum produces symptoms.

Fig. 23.4: Anterior rhinoscopy showing deviated nasal septum with convexity on the left side.

Fig. 23.5: SMR operation showing cartilage after elevation of the the mucoperichondrial flaps on both the sides.



SEPTAL SURGERY

Two surgical procedures are described for the treatment of DNS.

1. *Submucous Resection* (SMR).
2. *Septoplasty*.

SMR was the classical operation for DNS in adults at one time but now septoplasty is the preferred choice. Septoplasty can be performed in children having a deviated nasal septum producing marked symptoms.

Indications

1. SMR or septoplasty is indicated in cases of deviated nasal septum producing symptoms including nasal obstruction, recurrent infection, pressure, headache and epistaxis.
2. When DNS is causing external deformity of the nose, a septoplasty can be done alone or in combination with rhinoplasty (septo-rhinoplasty).
3. As an approach to pituitary fossa for hypophysectomy (transseptal transsphenoidal hypophysectomy).
4. When DNS is causing obstruction in viewing other structures of the nose during a nasal endoscopy and approach to these structures is difficult without removing the deflected septum.

Contraindications

Both operations are contraindicated during acute upper respiratory tract infection. Other relative contraindications are uncontrolled diabetes, hypertension, bleeding disorders and other systemic infections. SMR is contraindicated in patients below 17 years of age.

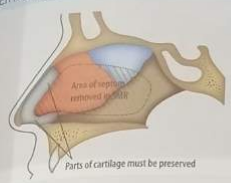
Procedure of SMR

It is only performed in adults. It consists of removal of the deflected part and spur of either bone or cartilage between the two coverings of mucoperichondrium or mucoperiosteum. SMR can be done under local anesthesia but general anesthesia is preferable, especially in anxious patients, females and noncooperative patients. Local anesthesia is applied by packing the nose with 4% xylocaine with adrenaline for 20 to 30 minutes. Adrenaline causes local vasoconstriction, which minimizes bleeding during surgery, and prolongs the action of xylocaine by reducing its absorption. The patient is kept in a supine position with the head end of the table raised. 1% or 2% xylocaine with adrenaline is infiltrated in the mucosa which produces a plane of cleavage between the cartilage and mucoperichondrium and further prevents bleeding during surgery. 'C' or 'L' shaped incision is done on the mucous membrane of the convex side of deviation, few millimetres behind the mucocutaneous junction (*Killian's incision*). Mucoperichondrium is elevated as a single layer on that side. Incision is done on the cartilage just deep to the first incision and mucoperichondrial flap is elevated on the other side (Fig. 23.5). Mucoperiosteal flap is also elevated over the bone posteriorly and inferiorly. The deviated portion of the cartilage and bone along with the spur is removed. A strip of cartilage is preserved along the caudal and dorsal border of the septum to maintain the shape of the external nose (Fig. 23.6). Excessive cartilage removed along the dorsal border will result in *saddle shape deformity* of the external nose. In the same way, if the cartilage is removed along the caudal border, *retraction of the columella* will occur. After removal of the cartilage and bone, both the mucoperichondrial flaps are united with each other. Stitching with catgut is done over the mucosal incision. Nose is packed for 24 to 48 hours with a ribbon gauze soaked in antiseptic ointment, glove finger pack or other nasal packing materials (Fig. 23.7).

Procedure of Septoplasty

Septoplasty is a conservational septal surgery where most of the cartilage is retained and the nasal septum is repositioned in the midline. Septoplasty can be done in

Fig. 23.6: Schematic diagram of nasal septum showing the part which is removed in SMR and part which must be preserved.



patients below the age of 17 years, where SMR operation is contraindicated due to interference with the growth of a nasal skeleton. Septoplasty is also done in adults in place of SMR nowadays because of lesser complications.

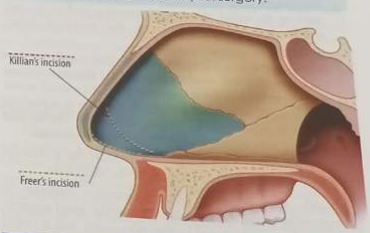
Procedure of a septoplasty is similar to SMR with only few differences. It is mostly done under general anesthesia but can be done under local anesthesia. The incision of septoplasty is different, which is done along the caudal border of the septal cartilage and is called *'Freer's'* or *'hemi-hemitransfixation'* incision (Fig. 23.8). The mucoperichondrial flap is raised only on one side. This flap on the other side remains intact so that the nutrition of the cartilage (which is dependent on perichondrium) is not affected. Attachment of the septal cartilage with vomer and perpendicular plate of ethmoid is separated. Mucoperiosteal flap over these bones on the other side is elevated and correction of the bony septum is done by removing the maxillary crest and other deflected parts. Septal cartilage is then maneuvererd in such a way to reposition in the midline. In septoplasty, many of the complications of SMR can be prevented like septal perforation, saddle nose deformity, columellar retraction etc.

Post-Operative Care

Patient is given Nothing Per Orally (NPO) for 4 to 6 hours if surgery is done under general anesthesia. Shorter NPO is required if surgery is done under local anesthesia. Patient is kept supine with his head in an upward position after he is fully conscious and recovers from the effects of general anesthesia. A soft diet is advised for few days to minimize active mastication. Antibiotics and analgesics are given for about a week. Nasal pack is removed after 24 to 48 hours. After pack removal, regular cleaning of the nose is done by nasal irrigation with a warm saline solution. Lubricants like liquid paraffin or ointments are used to prevent drying of the nasal mucosa. Splints if used are removed after 10 to 14 days.

Fig. 23.7: Two types of nasal packing after septal surgery.

Fig. 23.8: Incisions for nasal septal surgery.



Post-operative care after Septal Surgery

- NPO: 4 to 6 hours in cases of G/A.
- Position: supine with the head end up.
- Soft diet.
- Antibiotic and analgesic.
- Removal of pack: after 24 to 48 hours.
- Cleaning of the nose: nasal douching.
- Application of topical lubricant in the nose.
- Removal of splints: if placed after 10 to 14 days.

Complications

1. *Anesthetic complications*. Complications both for local and general anesthesia can occur like, xylocaine toxicity, cardiac failure, cerebral hypoxia etc.
2. *Bleeding:* Profuse bleeding may occur during surgery or post-operatively after removal of pack. Repacking of the nose is needed if the bleeding is profuse and does not stop by other measures.

Fig. 23.9: Saddle nose deformity after SMR operation.

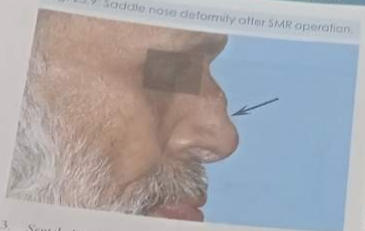


Fig. 23.10: Nasal adhesion after septal surgery.

3. *Septal hematoma:* Blood may collect between the two mucoperichondrial flaps leading to hematoma formation. Infection may follow hematoma formation leading to septal abscess. Hematoma and/or abscess needs drainage by reopening the previous septal incision.
4. *Septal perforation:* Perforation of the nasal septum occurs when the mucoperichondrial damage or tear occurs on both sides at the same level. In a small septal perforation, when air passes through it a whistling sound is produced. In larger perforation drying and crusting may occur, leading to recurrent epistaxis.
5. *CSF rhinorrhea:* This complication occurs due to damage to the cribriform plate or the anterior skull base.
6. *Saddle nose deformity:* When excessive cartilage is removed along the dorsal border of the nasal septum, depression of the nasal bridge may occur, this is called a saddle nose deformity (Fig. 23.9). It is treated by augmentation rhinoplasty.
7. *Adhesion formation:* Fibrous bands or adhesions may form between the nasal septum and the lateral wall (Fig. 23.10). Chances of adhesion formation are increased when surgery is performed on the lateral wall with SMR (e.g. electric cautery). It is treated by excision of the adhesions and keeping the splints for few days.
8. *Retraction of columella:* It occurs when cartilage along the caudal border is not preserved.
9. *Persistence of deviation:* It usually occurs due to inadequate surgery. It is treated by a revision surgery.
10. *Flapping nasal septum:* Sometimes, due to removal of cartilage, the remaining mucoperichondrial flaps vibrate during respiration.

Complications of Septal Surgery

- Anesthetic: G/A or L/A
- Bleeding.
- Septal hematoma/abscess.
- Septal perforation.
- CSF rhinorrhea.
- Saddle nose deformity.
- Adhesion formation.
- Retraction of columella.
- Persistent deviation.
- Flapping septum.

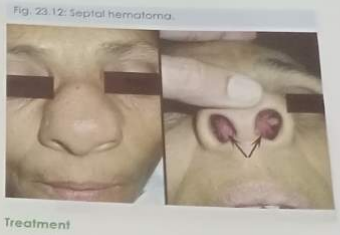
RHINOPLASTY

Rhinoplasty is the operation to correct cosmetic deformities of the external nose. This operation is performed either alone or combined with a septoplasty (septo-rhinoplasty). Nowadays, the preferred technique of rhinoplasty is open or external. Rhinoplasty is commonly performed for the following types of nasal deformities:

1. Deviated nose: If the bony vault is deviated, medial and lateral osteotomies are done to mobilize the nasal bones so that they can be repositioned (Fig. 23.11). If the cartilage is also deviated, rhinoplasty is combined with a septoplasty.
2. *Nasal hump:* Rhinoplasty performed to correct a nasal hump is called, 'reduction rhinoplasty'.
3. *Saddle nose deformity:* Rhinoplasty performed to correct saddle nose deformity is called 'augmentation rhinoplasty'. Saddle nose deformity can involve only the cartilaginous part or both cartilaginous and bony parts of the external nose. A graft is placed to augment the nose, which may be a cartilage graft (costal, septal or conchal cartilage) or a free bone graft (iliac crest).
4. *Nasal tip deformity:* Operation to lengthen or heighten the nasal tip is required to correct deformities left by a cleft lip or palate.
5. *Alar collapse:* In this condition, the alae nasi collapse inward on inspiration in a valve like pattern causing nasal obstruction. This type of deformity is corrected by prosthetic devices or by cartilage grafts.

Fig. 23.11: Rhinoplasty. A: Before, B: After.

Fig. 23.12: Septal hematoma.



SEPTAL HEMATOMA

It is collection of blood under the mucoperichondrium or mucoperiosteum of the nasal septum. In most of the cases, it results from trauma to the nasal septum but sometimes, may occur spontaneously. Trauma to the nasal septum may be accidental, e.g. road traffic accident, blow or fall on the nose or surgical, e.g. after SMR and septoplasty operation. Spontaneous hematoma formation may occur in bleeding or clotting disorders like hemophilia, purpura, leukemia etc.

Causes of Septal Hematoma

- Trauma:
  - Accidental: RTA, blow or fall.
  - Surgical: septoplasty.
- Spontaneous:
  - Bleeding or clotting disorders.

Clinical Features

Nasal obstruction, which is bilateral, is the most common presenting symptom. It is associated with swelling of the anterior part of the nose. Pain in the nose with frontal headache and sense of pressure over the nasal bridge may be present. On an anterior rhinoscopy, smooth and rounded swelling over the nasal septum is present on both sides (Fig. 23.12). The swelling is deep red or bluish in color and soft in consistency, which is fluctuant. Nasal patency is reduced or absent on both sides.

Clinical Features of Septal Hematoma

- Nasal obstruction: bilateral.
- Swelling over nose.
- Pain in the nose.
- Bilateral swelling over nasal septum: smooth, round, soft, fluctuant, red or bluish in color.
- Reduced nasal patency.

Treatment

Incision and drainage of the hematoma is required under aseptic conditions. Incision is given on one side only and the blood is evacuated. A small drain is placed to prevent reaccumulation and the nasal cavity is packed on both sides to exert pressure on the nasal septum. Prophylactic systemic antibiotic is given. Nasal pack is usually removed after 48 hours.

Complications

Organization of the septal hematoma may occur if it is not drained, leading to permanent thickening of the nasal septum. Infection usually follows the septal hematoma leading to septal abscess formation. Larger hematoma and septal abscess causes necrosis of the septal cartilage because nutrition of the cartilage is affected due to the separation of mucoperichondrium. Necrosis of the septal cartilage may result in supratip depression or saddle nose deformity.

SEPTAL ABSCESS

It is the collection of pus under the mucoperichondrium of the nasal septum. In majority of cases, septal abscess occurs as a result of a secondary infection of septal hematoma. Spontaneous septal abscess may sometimes form due to extension of infection in the nasal furunculosis and may follow measles, scarlet fever and typhoid fever.

Clinical Features

Nasal obstruction, which is bilateral and often complete, is present with severe and throbbing pain in the nose. Fever is also present and distinguish abscess from septal hematoma.

On examination, skin of the external nose may be red and swollen. Anterior rhinoscopy will show smooth, bilateral swelling of the nasal septum. The swelling is dull, purplish in color, soft and fluctuation can be elicited. The draining lymph nodes (submandibular) may also be enlarged and tender.

Fig. 23.13: Septal perforation after SMR operation.

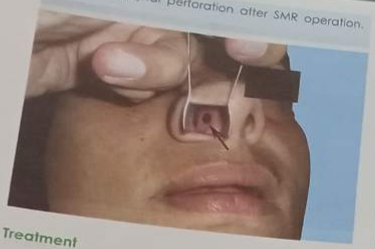
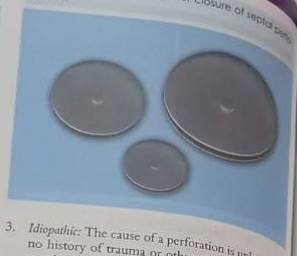


Fig. 23.14: Silastic buttons for closure of septal perforation.



Treatment

Incision and drainage of the pus should be done as early as possible. Incision is given over the most dependent part of the abscess and pus is evacuated. Any necrosed cartilage, if present, should also be removed. If abscess occurs after a septal surgery, it is drained by reopening the previous surgical incision. A small drain is placed and the nasal cavity is packed. Pus is sent for culture and sensitivity. Systemic antibiotic must be started immediately which can be changed after a report of culture and sensitivity. Pack is removed daily and any reaccumulation of pus is drained for few days.

Complications

Necrosis of the septal cartilage occurs often if an abscess is not drained early. Necrosis of the septal cartilage may lead to supratip depression, saddle nose deformity or septal perforation. Extension of the infection may lead to meningitis and cavernous sinus thrombosis, but these complications are rare nowadays because of better antibiotics.

SEPTAL PERFORATION

Etiology

1. *Traumatic perforation:* This is the most common type of septal perforation. Operations of the nasal septum like SMR's may lead to septal perforation (Fig. 23.13), if there is a mucoperichondrial tear on both sides opposite to each other. Repeated cautery of the nasal septum, tight anterior nasal packing and penetrating injuries of the nose can also lead to septal perforation. Nose picking to remove crusts from the nose is another cause of septal perforation. Traumatic perforation is also seen in snuff takers and chromium platters. Occasionally, the septum is deliberately perforated to wear ornaments.
2. *Pathological perforation:* Many diseases affecting the nose may cause septal perforation. It includes septal hematoma, abscess, syphilis, tuberculosis, leprosy, Wegener's granulomatosis, foreign bodies, rhinolith and occasionally a na[illegible].
3. *Idiopathic:* The cause of a perforation is unknown with no history of trauma or other nasal diseases. Patient may be unaware of this perforation.

Clinical Features

Clinical features depend on the size and sometimes the site of perforation. In small perforations when air passes through, a whistling sound is produced during breathing. Larger perforations cause drying and crusting of the nasal secretions. When the crusts are removed, they cause epistaxis. Drying and crusting also predispose to recurrent nasal infections. In syphilis, the perforations are characteristically present in the bony part of the nasal septum.

Clinical Features of Septal Perforation

- Depends on size and site.
- Whistling sound in small perforation.
- Drying and crusting.
- Epistaxis.
- Recurrent infection.

Investigations

Investigations required to find out the cause of perforation include test for tuberculosis, leprosy, syphilis etc. Biopsy around the margins may be diagnostic.

Treatment

The specific diseases causing pathological perforation should be treated accordingly. Septal perforation causing no symptom needs no treatment. Smaller perforations can be closed surgically by putting mucosal flaps. Larger perforations are difficult to close surgically. In these cases symptoms are produced due to crusting which can be prevented by instilling 25% glucose in glycerin drops or applying antiseptic ointment. Use of silastic buttons is another option for treating symptomatic septal perforation (Fig. 23.14).

Chapter Summary and Key Points

Deviation of the nasal septum is very common in adults but it produces symptoms in few cases. Deviation of the nasal septum disturbs the normal physiological flow of air currents through the nose and produces various symptoms. Surgical treatment is required only in cases where symptoms are present. SMR and septoplasty are two surgical operations for deviated nasal septum. SMR is contraindicated in patients below the age of 17 years as it will lead to facial asymmetry later on, during growth of facial bones. In septoplasty, only a small part of the septum is removed and rest of the nasal septum is repositioned in midline. Many complications of SMR can be avoided by a septoplasty. Septal hematoma and abscess must be drained as early as possible to avoid necrosis of the septal cartilage, which results in saddle nose deformity and septal perforation.

Difficult words

- *Buckling:* Bending of nasal septum due to pressure.
- *Nasal hump:* Hump like projection on the dorsum of the nose which could either be bony or cartilaginous.
- *Splints:* These are silastic or plastic sheets placed in the nasal cavity after surgery to prevent adhesion formation between raw surface on the nasal septum and lateral wall.

Best Choice Questions

Q1. A 24-year-old male patient has a deviated nasal septum. What is the most common etiological factor of this condition?

a. nose picking.
b. thumb sucking.
c. trauma to the nose.
d. unilateral nasal mass.

Q2. On clinical examination of the nose in a 26-year-old male patient, there was a marked 'C' shaped deviation of the nasal septum on the left side. Which turbinate will show compensatory hypertrophy in this patient?

a. inferior turbinate on the left side.
b. inferior turbinate on the right side.
c. middle turbinate on the left side.
d. middle turbinate on the right side.

Q3. A 35-year-old male patient came in OPD with complaint of fever, pain and swelling of the nose. On examination, there was bilateral smooth bulging on the nasal septum and it was very tender on touch. What is the most common cause for this?

a. septal adhesion.
b. septal deviation.
c. septal hematoma.
d. septal spur.

Q4. A 30-year-old male patient had a planned SMR operation. Which incision will be used for surgery in this patient?

a. Freer's incision.
b. hemi-transfixation incision.
c. Killian's incision.
d. Weber Fergouson's incision.

Q5. SMR was planned for a 28-year-old female patient who had a deviated nasal septum. Which part of the septum will be left behind in this case?

a. central part of septal cartilage.
b. lower part of the perpendicular plate of ethmoid.
c. strip of septal cartilage along the dorsal border.
d. the entire vomer bone.

Q6. Septoplasty was planned for a patient with deviated nasal septum. Which strength solution of Xylocaine will be used for infiltration during surgery?

a. 2% solution.
b. 5% solution.
c. 7% solution.
d. 10% solution.

Q7. Septoplasty was done on a 30-year-old male patient. After how long, will the nasal packing be removed for this patient?

a. 4–6 hours.
b. 24–48 hours.
c. 3–4 days.
d. 5–6 days.

Q8. A 30-year-old male patient was shifted from operation theatre after septoplasty operation. After how long, will he be allowed to take some food orally?

a. 2 hours.
b. 6 hours.
c. 12 hours.
d. 24 hours.

Q9. Nasal pack was removed for a 27-year-old female patient after 48 hours of a septoplasty operation. After removal of pack, she started having profused bleeding from both the nasal cavities. What is the most appropriate treatment for this patient?

a. chemical cautery.
b. electric cautery.
c. ligation of the maxillary artery.
d. repacking of the nose.

Q10. A 28-year-old female patient was undergoing SMR operation. During surgery, she developed a CSF rhinorrhea. What is the most common site for a CSF leak in such patients?

a. cribriform plate of the ethmoid.
b. floor of the frontal sinus.
c. roof of the sphenoid sinus.
d. upper part of the lamina papyracea.

Q11. A 26-year-old female patient developed saddle nose deformity after the SMR operation. From which area of the septum, excessive removal of bone or cartilage had been done that resulted in this type of deformity?

a. central part of the septal cartilage.
b. perpendicular plate of the ethmoid.
c. septal cartilage along the dorsal border.
d. vomer bone along the floor.

Q12. A 35-year-old lady developed septal adhesions after a septal surgery 6 months ago. What measures or procedures have to be taken at that time to prevent such complication?

a. doing surgery under general anesthesia.
b. giving NSAID's drugs post-operatively.
c. giving prophylactic antibiotics after surgery.
d. putting splints after surgery.

Q13. A 26-year-old female patient was diagnosed with a deviated nasal septum and given the choice of SMR or septoplasty operation. She was suggested to go for a septoplasty operation. What is the most important point in favor of septoplasty over SMR operation?

a. it can be done under local anesthesia.
b. less bleeding during surgery.
c. less chances of recurrence.
d. less surgical complications.

Q14. A 22-year-old male patient came with a nasal obstruction, pain and fever for last 24 hours. On clinical examination he had bilateral septal swelling which was very tender on touch. What complication can occur in this patient if the condition is not treated early?

a. CSF rhinorrhea.
b. nasal adhesion formation.
c. nasal hump.
d. supratip depression.

Answers with Explanations

1. c all sort of trauma.
2. b because of a wider nasal cavity.
3. c blood provides culture media.
4. c behind mucocutaneous junction.
5. c to prevent saddle nose deformity.
6. a with or without adrenaline.
7. b.
8. b also in most other ENT surgeries.
9. d again for 24–48 hours.
10. a forming the roof.
11. c.
12. d splints are kept for 10–14 days usually.
13. d conservation surgery.
14. d.

Acute Inflammatory Diseases of the Nose and PNS

CHAPTER 24

- Nasal boil
- Vestibulitis
- Acute rhinosinusitis
- Viral rhinosinusitis
- Acute rhinosinusitis associated with influenza
- Acute bacterial rhinosinusitis

NASAL BOIL

Nasal boil or furuncle is the staphylococcal infection of the hair follicle. In the nose, hair follicles are present in the vestibule of the nasal cavity. Nasal vestibule is present in a dangerous area of the face and its inflammation may spread to cause intracranial complications. Boils in the nose are usually *single* but *multiple* may occur. Like boils in the ear, a nasal boil is also very painful as skin of the nasal vestibule is tightly adhered to the underlining structures. Recurrence of a nasal boil is common. The predisposing factors are diabetes mellitus, general debilitating diseases, scratching and nose picking.

Clinical Features

Pain in the nose is usually the first presenting symptom. As inflammation spreads into the subcutaneous tissues, an intense painful, indurated swelling develops in the vestibule and tip of the nose. The swelling is usually tender, red, nodular and firm (Fig. 24.1). Headache may be present along with these symptoms. Spontaneous rupture of the boil with evacuation of pus may occur. Spreading thrombophlebitis of the angular and superior ophthalmic vein may occur leading to *cavernous sinus thrombosis*. Local spread of infection may occur leading to *cellulitis* of the upper lip and sometimes *septal abscess*.

Fig. 24.1: Nasal boil or furuncle.

Treatment

An appropriate systemic antibiotic against staphylococcus is required. Analgesics and hot fomentation is given to relieve pain. If fluctuation is present, incision and drainage is required.

VESTIBULITIS

Vestibulitis is diffused dermatitis of the skin of nasal vestibule. It may occur in an *acute* or chronic form. Predisposing factors are nasal discharge due to any cause, irritation and trauma caused by handkerchiefs and fingers while cleaning nasal discharge.

Clinical Features

In the acute form, induration, excoriation and painful fissures are present in the nasal vestibule. Vestibular skin is red, swollen and tender with crusting and scaling. In chronic cases, painful fissures persist with induration and crusting. The upper lip may be similarly affected.

Treatment

Treatment is directed towards the primary cause of nasal discharge. The crusts in the nasal vestibule are gently removed. Simple ointment containing antibiotics with or without steroids is applied to form a protective barrier. Chronic form where the fissures persist can be treated by chemical cautery with silver nitrate solution.

ACUTE RHINOSINUSITIS

Formerly, the term rhinitis and sinusitis were described separately. Owing to the continuity of the lining mucosa of the nasal cavity with the sinuses, inflammation of the nose is often associated with inflammation of the sinuses. So the term 'rhinosinusitis' is now used in clinical practice. Depending on the duration of inflammation, rhinosinusitis

is classified into acute, subacute and chronic. Acute rhinosinusitis is of less than 4 weeks duration, subacute is between 4 to 12 weeks duration and chronic rhinosinusitis is of more than 12 weeks duration. Depending on the causative organism, acute rhinosinusitis may be:

- Viral rhinosinusitis.
- Acute bacterial rhinosonusitis.

VIRAL RHINOSINUSITIS

It is also called common cold or coryza. It is an acute viral infection of the lining nasal mucosa. This is conveyed by contacts or as an air borne droplet infection. Several different types of viruses can cause this infection including *adenovirus, rhinovirus, coxsackie virus,* ECHO *virus* etc. Secondary bacterial infection is common especially in our region. Incubation period is usually 1 to 4 days and resolution of the disease usually occurs within 7 to 10 days. The predisposing factors include poor general resistance, exposure to cold and local nasal diseases like DNS and nasal polyps.

Pathology

1. *Prodromal or ischemic stage:* This is the first stage of common cold and it lasts for few hours. Local blood supply of the mucosa is reduced and the mucosa appears pale. There is severe irritation in the nose with burning sensation and sneezing. The sense of smell is altered or may be lost during this stage.
2. *Hyperaemic or vasodilatation stage:* Few hours after the ischemic stage, local vasodilatation occurs in the nasal mucosa. The nasal mucosa appears red, congested and swollen. There is profuse rhinorrhea with varying degree of nasal obstruction and fever. This stage lasts for few hours to few days.
3. *Stage of resolution:* The symptoms and signs gradually diminish and after about 5 to 10 days complete recovery takes place.

Clinical Features

Clinical features depend on the stage of disease. During the prodromal stage, there is irritation and burning sensation in the nose with nasal obstruction, sneezing and rhinorrhea. Shivering may occur during this stage followed by fever. The patient may also complain of headache, malaise and bodyache. Nasal discharge is initially thin and profuse which becomes thick and green or yellow in color later on. Resolution occurs in 5 to 10 days.

Clinical Features of Viral Rhinosinusitis

- Irritation and burning in the nose.
- Sneezing.
- Rhinorrhea: watery.
- Nasal obstruction.
- Fever.
- Headache.
- Malaise and bodyache.

Differential Diagnosis

The condition is to be differentiated from allergic rhinitis, vasomotor rhinitis and other forms of non-infective rhinitis. In allergic and vasomotor rhinitis, the symptoms appear paroxysmal in attacks and fever is absent.

Treatment

As a prophylaxis, contact with a person who has the common cold must be avoided. Bed rest is essential to shorten the illness. Antihistamine and nasal decongestants are given to relieve nasal irritation and blockage. Analgesic and antipyretic are useful to relieve fever, headache and bodyache. When there is a secondary bacterial infection antibiotics are given. Steam inhalation has a soothing and comforting effect.

Treatment of Viral Rhinosinusitis

- Mainly symptomatic.
- Bed rest.
- Antihistamine: for rhinorrhea and irritation.
- Nasal decongestant: for nasal obstruction.
- Analgesic and antipyretic.
- Steam inhalation.
- Antibiotic: if secondary bacterial infection is present.

Complications

Common cold is a self-limiting disease and the patient recovers in 1 to 2 week. Sometimes, the infection may spread to the other regions and give rise to complications. It includes pharyngitis, tonsillitis, otitis media, bronchitis and pneumonia.

ACUTE RHINOSINUSITIS ASSOCIATED WITH INFLUENZA

Influenzal rhinosinusitis occurs in association with infection by one of the influenza viruses. There are three types of influenza viruses, A, B and C. Human influenza A and B viruses cause seasonal epidemics of disease with influenza type C infections cause a mild respiratory illness and are not believed to cause epidemics. The emergence of a new and very different influenza virus to infect people can cause an influenza pandemic. Influenza A viruses are divided into subtypes based on two proteins on the surface of the virus, the hemagglutinin (H) and the neuraminidase (N). There are 18 different hemagglutinin subtypes (H1 through H18) and 11 different neuraminidase subtypes (N1 through N11). The characteristic lesion is a varying

degree of necrosis of the ciliated epithelium of upper respiratory tract.

The sign and symptoms are much similar to those of common cold but all are exaggerated. Preventive treatment of influenza by giving vaccines is available now. Immunizing vaccines are generally given to those with higher risk of infection such as elderly persons, diabetics and persons with renal, pulmonary or cardiac diseases. Treatment of the established cases is same as that of common cold.

ACUTE BACTERIAL RHINOSINUSITIS

Acute inflammation in the paranasal sinuses may be limited to one, more than one (multi sinusitis) or may involve all the sinuses (pansinusitis).

Etiology

Acute bacterial rhinosinusitis generally results from viral rhinosinusitis. Infection in the sinuses reaches either *directly* through the surface mucosa or through the *submucosal lymphatics*. Swimming and diving, similarly causes direct spread of infection to the sinuses through the ostium where infected water reaches the sinuses. Dental root abscess and dental extraction may also results in spread of infection to the maxillary sinuses. Fractures involving the walls of the sinuses and baro-traumatic changes in the sinuses may sometime predispose to a sinus infection. Any factor which interferes with the ventilation of the sinuses can cause sinusitis due to stasis of secretion. It includes packing of the nose, deviated nasal septum, swollen turbinate, nasal polypi and the neoplasms. Other factors causing stasis of secretion in the nose, also predispose to sinusitis, which include enlarged adenoids, choanal atresia, cystic fibrosis etc.

Etiology of Acute Bacterial Rhinosinusitis

Exciting Factors

- Common cold and influenza.
- Swimming and diving.
- Dental infections and extraction.
- Fractures.
- Baro trauma.

Predisposing Factors

- Nasal packing.
- Swollen turbinate.
- Deviated nasal septum.
- Nasal polypi.
- Neoplasia.
- Enlarged adenoids.
- Choanal atresia.
- Cystic fibrosis.

Pathology

Nose and sinuses are mostly affected initially by the *virus* which is soon followed by *bacterial* invasion. The causative organisms in acute bacterial rhinosinusitis are pneumococci, streptococci, hemophilus influenza, moraxella catarrhalis staphylococci and klebsiella pneumoniae. The infections of dental origin are usually caused by E. coli and anaerobic streptococci and sometime mixed infection.

Acute inflammatory process sets in the mucosa of the nose and sinuses. It results in hyperemia, edema, cellular infiltration and glandular hyperactivity. Exudation occurs, which is initially serous in nature but later on becomes purulent or mucopurulent. If the ostium of the sinuses are blocked due to edema or other pathology, the secretions of the sinuses will not drain. This results in collection of purulent or mucopurulent secretion under pressure. The inflammatory process and infection may spread beyond the limit of mucosa to involve the bony wall of the sinuses and give rise to complications.

Clinical Features

The clinical features of acute bacterial rhinosinusitis depends on the severity and number of sinuses involved in the disease. They usually follow the viral rhinosinusitis where the secondary bacterial infection occurs. Instead of improving after 5–10 days, the symptoms of viral rhinosinusitis aggravate. The initial watery rhinorrhea becomes thick and mucopurulent and post-nasal dripping of thick secretion becomes prominent. Other signs and symptoms related with the sinuses varies with the involvement of the sinus.

Maxillary Sinusitis

In acute maxillary sinusitis, the patient reports pain in the cheek and maxillary region which may radiate to upper teeth, gums and the temporal region. Headache may be present along with other constitutional symptoms like fever, malaise and bodyache.

On examination, tenderness is present over the maxillary region when pressed or tapped. Sometimes, redness and edema of the cheek may be present especially in children with puffy lower eye lids. On anterior rhinoscopy, pus may be seen in the middle meatus with congested and swollen turbinates. Transillumination of the maxillary sinus may show dullness in the affected sinus.

Frontal Sinusitis

In acute frontal sinusitis, patient reports severe headache in the frontal region, which may be localized only over the affected sinus. Headache is characteristically periodic in nature which starts on waking up in the morning, gradually increases and reaches at peak within few hours. It then subsides in late afternoon as the frontal sinus ostium gradually opens by gravity.

On examination, tenderness is present on pressing over the floor of the frontal sinus just above the medial canthus. Percussion over the frontal sinus is also painful. Edema of the upper eyelid is present in many cases. On an anterior rhinoscopy, mucopurulent discharge may be seen in the middle meatus but is absent when the frontal sinus ostium is blocked.

Ethmoidal Sinusitis

Ethmoid sinusitis is often associated with involvement of other sinuses as well. It is common in young children. Patient reports pain which is localized over the bridge of nose, between and deep into the eyes, accompanied with frontal headache. Edema of both the eyelids may be also present. On anterior rhinoscopy, pus may be seen in the middle meatus with edema and congestion of the middle turbinate.

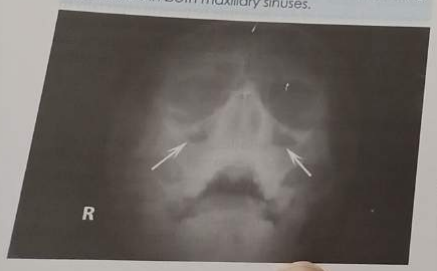
Sphenoidal Sinusitis

Isolated involvement of the sphenoid sinus is uncommon and mostly occurs as a part of pansinusitis. Patient reports headache in the frontal, occipital or central vertex region. Pus is usually not visible on anterior rhinoscopy but can be seen on posterior rhinoscopy.

Investigations

1. *Plain X-ray* of the paranasal sinuses (Water's view) is helpful and show haziness or opacity in the affected sinus with or without fluid level in it (Fig. 24.2). By this view, we can assess condition of the maxillary and frontal sinuses. Condition of the sphenoid sinus can be assessed if this view is taken with an open mouth. This view is not an ideal view to assess the ethmoidal sinuses.
2. *CT scan:* It is much superior and better to assess the condition of the paranasal sinuses and all groups are clearly and undoubtedly evaluated.

Fig. 24.2: Plain X-ray of PNS (Water's view) showing fluid levels in both maxillary sinuses.



Treatment

Medical treatment of acute bacterial rhinosinusitis includes broad spectrum antibiotics. Nasal decongestants in the form of topical drops or sprays e.g. 0.1% xylometazoline is helpful to open the blocked ostium and encourages drainage. Steam inhalation with tincture benzoin co. encourages opening of sinuses and drainage with a soothing effect. Analgesics and anti-inflammatory drugs are given to relieve pain and edema.

Most of the cases of acute bacterial rhinosinusitis are resolved by the above mentioned medical treatment. Cases not responding to medical treatment need surgical intervention to drain mucopus from the affected sinus. The type of surgical procedure depends on the involvement of a particular sinus. Previously, *'proof puncture'* or *'sinus lavage'* was used to drain the secretion from the frontal sinus (see chapter 25 for details). In the frontal sinusitis *'trephination'* of the sinus was done to evacuate the pus in the floor of the frontal sinus and drainage of the sinus was done. In involvement of ethmoidal sinuses, *ethmoidectomy* was needed sometimes. Very rarely, puncture of the sphenoid sinus was needed to evacuate the pus within it. Now Functional Endoscopic Sinus Surgery (FESS) is used where these sinuses are approached and treated endoscopically (see chapter 25 for details).

Treatment of Acute Bacterial Rhinosinusitis

- **Medical**
  - Appropriate antibiotic.
  - Nasal decongestant.
  - Steam inhalation.
  - Analgesics and anti inflammatory drugs.
- **Surgical**
  - Drainage from the affected sinus.
  - Functional endoscopic sinus surgery.

Complications

Spread of infection into and beyond the bony wall of the sinuses is uncommon nowadays because of improved antibiotics. The infection from the sinuses may spread through one or more of the following routes:

1. Direct spread.
2. Venous spread.
3. Lymphatic spread.

Following complications may occur:

1. *Osteitis* or *osteomyelitis* of the surrounding bones. *Pott's Puffy* tumor is one of the most dangerous complications of frontal sinusitis, which is characterised by osteomyelitis of the frontal bone with an associated subperiosteal abscess.

2. *Orbital complications:* Infection may spread to the orbit and cause preseptal edema of the lids, orbital cellulitis, subperiosteal abscess and orbital abscess. *Chandler classification* is the most commonly used system for staging such infection into:
   stage I: preseptal orbital cellulitis with inflammation and edema anterior to the orbital septum.
   stage II: orbital cellulitis with extension of the inflammation and edema beyond the orbital septum.
   stage III: subperiosteal abscess beneath the periosteum of lamina papyracea.
   stage IV: orbital abscess and purulent collection within the orbit.
   stage V: cavernous sinus thrombosis after posterior extension of the infection through the superior ophthalmic veins.
3. *Intracranial complications:* infection may spread into the cranium and lead to meningitis, extra dural abscess, subdural abscess, brain abscess cavernous sinus thrombosis and thrombophlebitis of the longitudinal sinus and frontal cortical veins.
4. *Chronic infection:* acute infection of the sinuses may convert into sub acute or chronic infection of the sinuses.

Chapter Summary and Key Points

A nasal boil is a localized infection of hair follicle in the vestibule while a vestibulitis is a diffused infection. Owing to the continuous mucosa of the nasal cavity and the sinuses, inflammations of the nasal cavity may extend into the sinuses. So in clinical practice, the term 'rhinosinusitis' is used. Acute rhinosinusitis is mostly viral in origin where secondary bacterial infection is common in our region. Acute sinusitis may occur either in one sinus, multiple sinuses or all the sinuses, giving the name 'pansinusitis'. In an isolated infection of one or more sinuses, clinical features depend on the site and severity of the infection. Maxillary sinuses are involved in most of the cases. Complications of acute bacterial rhinosinusitis are uncommon nowadays because of the availability of good antibiotics.

Best Choice Questions

Q1. A 20-year-old male patient reported severe pain at the tip of the nose since the previous day. On examination, the tip of the nose was swollen and red with marked tenderness. Which microorganism is responsible for this condition?

a. haemophilus.
b. pneumococci.
c. staphylococci.
d. streptococci.

Q2. A 16-year-old female patient was diagnosed with a boil in the nose. What is the most common site of origin of this condition?

a. floor of the nasal cavity.
b. nasal cavity.
c. nasal septum.
d. nasal vestibule.

Q3. What are the two most important predisposing factors for a nasal boil?

a. asthma and nasal allergy.
b. diabetes mellitus and scratching of the nose.
c. hypertension and nasal allergy.
d. renal disease and swimming in dirty water.

Q4. A 52-year-old male patient with uncontrolled diabetes mellitus came into the ENT OPD and was diagnosed with a boil in the nose. Which of the following intracranial venous sinus thrombosis can occur as a complication in this patient?

a. cavernous sinus.
b. inferior sagittal sinus.
c. sigmoid sinus.
d. superior sagittal sinus.

Q5. A 22-year-old male patient came with complaints of sneezing, rhinorrhea, nasal obstruction, fever, headache and bodyache for last two days. What is the most likely diagnosis for this patient?

a. acute bacterial rhinosinusitis.
b. allergic rhinitis.
c. viral rhinosinusitis.
d. atrophic rhinitis.

Q6. A 23-year-old female patient came in OPD with nasal obstruction, sneezing, rhinorrhea, fever and bodyache for last two days. Which of the following virus is the most likely cause of such illness?

a. adenovirus.

b. cytomegalovirus.
c. Epstein Barr virus.
d. human immunodeficiency virus.

Q7. An 18-year-old female patient was diagnosed with common cold. What is the characteristic nasal discharge in such condition?
a. profuse and blood stained.
b. scanty and yellow.
c. thick and foul smelling.
d. watery and thin.

Q8. Plain X-ray PNS was ordered for a 25-year-old male patient who had nasal obstruction, nasal discharge and postnasal dripping. Which of the following view, will be most helpful in this patient?
a. anteroposterior view.
b. occipitofrontal view.
c. occipitomental view.
d. submentovertical view.

Q9. Plain X-ray PNS (Water's view) was advised to a 20-year-old male patient for assessing the paranasal sinuses. Which of the following sinus is most difficult to assess on this view?
a. ethmoidal sinus
b. frontal sinus.
c. maxillary sinus.
d. sphenoidal sinus.

Q10. A 30-year-old female patient came into the ENT OPD with complaints of thick mucopurulent nasal discharge, postnasal dripping, nasal obstruction and headache for last 8 to 10 days. What are the common bacteria causing this illness?
a. moraxella and pseudomonas.
b. proteus and hemophilus.
c. staphylococci and streptococci.
d. streptococci and pneumococci.

Q11. Proof puncture or antral washout was planned for a 25-year-old male patient. Which of the following structure is drained in this operation?
a. ethmoidal sinus.
b. frontal sinus.
c. maxillary sinus.
d. sphenoid sinus.

Q12. Trephination was planned for a 22-year-old male patient to drain retained pus. Which of the following structure is drained in this operation?
a. ethmoidal sinus.
b. frontal sinus.
c. maxillary sinus.
d. sphenoid sinus.

Answers with Explanations

1. c.
2. d hair follicles are only present here.
3. b.
4. a causes cavernous sinus thrombosis.
5. c also called coryza or common cold.
6. a along with rhinovirus, coxsackie and ECHO virus.
7. d.
8. c shows maxillary, frontal and sphenoid sinuses.
9. a.
10. d.
11. c.
12. b.

Chronic Inflammatory Diseases of the Nose and PNS

CHAPTER 25

- Chronic rhinosinusitis
  - Proof puncture or antral washout
  - Caldwell luc's operation
  - Functional Endoscopic Sinus Surgery (FESS)
  - Fungal sinusitis
    - Acute fulminant invasive fungal sinusitis
    - Chronic invasive or non-granulomatous invasive fungal sinusitis
    - Granulomatous invasive fungal sinusitis
    - Fungal ball or mycetoma
    - Allergic Fungal Sinusitis (AFS)
  - Atrophic rhinitis
    - Primary atrophic rhinitis
    - Secondary atrophic rhinitis
  - Rhinitis sicca
  - Rhinitis caseosa
- Tuberculosis
- Syphilis
- Leprosy
- Lupus vulgaris
- Rhinoscleroma
- Wegener's granulomatosis
- Midline lethal granuloma

CHRONIC RHINOSINUSITIS

Chronic rhinosinusitis is the chronic inflammation of the nose and paranasal sinuses which lasts for more than 12 weeks duration. The features of chronic infection of the various sinuses are similar to those of the acute forms but of a lesser degree. Acute exacerbation is common and in between the intervals, symptoms may be reduced.

Pathology

Most of the cases of chronic rhinosinusitis are due to failure of the acute infection to resolve. It may follow single or repeated attacks of acute rhinosinusitis. In chronic infections the process of destruction and healing occurs simultaneously. Every stage from a hypertrophic change to one of an atrophic change may be found in the sinus mucosa. Edema of the sinus mucosa is present ranging from slight thickening to gross polyposis. On the basis of presence and absence of nasal polypi, chronic rhinosinusitis is now classified as:

1. Chronic rhinosinusitis without polyposis.
2. Chronic rhinosinusitis with polyposis.

Chronic inflammatory cellular infiltration is present with glandular hypertrophy. The surface epithelium may show desquamation, regeneration, ulceration or metaplasia. The organisms are usually mixed and include *streptococci, pneumococci, B. proteus* and *anaerobes*.

Clinical Features

The clinical features of chronic rhinosinusitis are similar to acute rhinosinusitis but of lesser degree. Nasal discharge and post nasal dripping is usually present in most of the cases. Nasal obstruction of varying degree is also present. Headache is present when there is obstruction to the drainage or during acute exacerbation of the infection. It is often described as a heavy feeling in the head or a dull ache over the sinuses. Hyposmia, anosmia or sometimes cacosmia may occur. Constitutional disturbances are usually mild and include malaise, mental apathy and anorexia.

Investigations

1. *Nasal endoscopy:* Detailed examination of the nasal cavity especially middle meatus under local anesthesia is very important in a patient of chronic rhinosinusitis.
2. *Plain X-ray* of the paranasal sinuses will show mucosal thickening, polyposis or opacity in the affected sinus.
3. *CT scan:* It is now considered as a mandatory investigation in a patient of chronic rhinosinusitis with thin cuts preferably in all three planes (axial, coronal and sagittal). It will clearly show condition of all the paranasal sinuses and nasal cavity (Fig. 25.1).
4. *Nasal secretions for culture and sensitivity:* Purulent or mucopurulent secretion collected from the middle meatus through nasal endoscopy, should be sent for culture and sensitivity.

Treatment

Medical treatment of chronic rhinosinusitis is the same as for acute sinusitis. It includes appropriate antibiotic, nasal decongestant, antihistamine, mucolytic agents

Fig. 25.1: CT scan nose and PNS (coronal view) of a patient of chronic rhinosinusitis.

Fig. 25.2: Method of submucosal diathermy of the inferior turbinate.

and steam inhalation. Any underlying etiological factor, if present, should be treated accordingly. Surgery is required in more severe cases and where no response is obtained by medical treatment. The basic aim of surgery in these cases is to provide free drainage of the sinuses. Choice of surgical procedure depends upon the site and severity of the disease. With the advent of endoscopic sinus surgery, all the paranasal sinuses are approached and treated endoscopically. Conventional surgical procedures to approach different paranasal sinuses are rarely used now.

Surgical Treatment for Maxillary Sinusitis

Conventionally in cases of chronic maxillary sinusitis, not responding to medical treatment, repeated *antral washout* was done. Removal of pus and retained secretions from the maxillary antrum helps the mucosa to revert to normal. *Caldwell luc's* operation is a more radical surgery where maxillary antrum is reached through its anterolateral wall by a sublabial incision. In this operation pus or retained secretion is drained, diseased mucosa is removed and an opening is made in the inferior meatus for the drainage of secretion. Endoscopic sinus surgery is now the treatment of choice in chronic maxillary sinus. Uncinate process is removed first (*uncinectomy*), natural ostium of the maxillary sinus is visualized and then it widened to drain secretions from the sinus. Maxillary sinus can be examined through the ostium by using 30°, 45° or 70° telescope.

Surgical Treatment for Frontal Sinusitis

Conventionally in cases of frontal sinusitis *trephination* of the sinus through its floor was done to drain pus and retained secretion, as in cases of acute frontal sinusitis. In severe cases a more radical approach was required by performing *Howarth's operation*, where floor of the frontal sinus was opened and the disease was cleared from the frontal sinus. The frontal sinus can also be approached by *osteoplastic flap operation*, where anterior wall of the frontal sinus is opened by reflecting it as an osteoplastic flap. All these radical operations on the frontal sinus are rarely used now and endoscopic sinus surgery is the preferred choice. Frontal sinus can be approached endoscopically through the middle meatus and clearance of the disease is possible from the sinus and frontonasal duct. After performing uncinectomy, frontal recess is approached and ostium of the frontal sinus is seen. All the disease from this area is cleared endoscopically.

Surgical Treatment for Ethmoidal Sinusitis

In cases of ethmoidal sinusitis, *ethmoidectomy* is required to clear the disease from ethmoidal air cells. Previously three approaches for ethmoidectomy were used.

1. Intranasal ethmoidectomy.
2. Trans-antral ethmoidectomy.
3. External ethmoidectomy.

Clearance of the disease from the ethmoid sinuses (ethmoidectomy) is now possible through endoscopic sinus surgery, where all the ethmoidal air cells can be approached endoscopically through the nose.

Surgical Treatment for Sphenoidal Sinusitis

Sphenoidectomy is done to clear the disease from sphenoid sinus. Sphenoid sinus is reached through its anterior wall by transseptal or external ethmoidectomy approach. With the advent of endoscopic sinus surgery, sphenoid sinus is now approached and disease is cleared endoscopically through the nasal route.

Surgical Treatment Hypertrophied Inferior Turbinate

Inferior turbinate reduction can be performed by various techniques that resect, displace or decrease the volume of the turbinate. Following are the various techniques or procedures:

1. *Electric cautery:* Multiple linear surface burns are produced, parallel to the length of inferior turbinate by monopolar or bipolar diathermy or thermal electric cautery.
2. *Submucous diathermy (SMD):* Multiple linear submucosal burns are made by monopolar diathermy (Fig. 25.2)
3. *LASER:* CO_2 laser is very effective for reducing the size of hypertrophied inferior turbinate through induction of scarring and actual tissue removal.
4. *Cryosurgery:* Freezing at -85°C is done with cryo-probe on the surface of inferior turbinate.
5. *Submucosal resection with microdebrider:* It removes the stromal tissue from inside the turbinate while the overlying mucosa is completely preserved.
6. *Submucous resection of turbinate bone:* This is very effective in cases with conchal bone hypertrophy.
7. *Turbinectomy:* Partial or complete surgical removal of the inferior turbinate is done in severe or recurrent cases. The major complications of this procedure are severe hemorrhage, post-operative crusting and atrophic rhinitis.
8. *Radio-frequency turbinate reduction:* Radio-frequency heat is used to induce submucosal tissue destruction and scarring later on, thus reducing the size of the turbinate.

Fig. 25.3: Antral washout showing site of puncture and flow of saline.

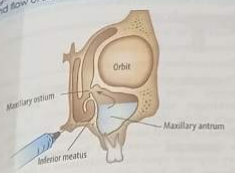


Fig. 25.4: Method of performing antral washout under local anesthesia in an adult patient.

PROOF PUNCTURE OR ANTRAL WASHOUT

This is a surgical procedure for irrigation or wash out of the maxillary antrum. Maxillary sinus is punctured through its medial wall in the inferior meatus and the sinus is drained.

In adults antral wash out is mostly done under local anesthesia. General anesthesia is reserve for children and nervous patients. 4% xylocaine pack with adrenaline is applied in the inferior meatus for 15 to 20 minutes. Sitting position is preferred in adults when it is done under local anesthesia whereas patient lies supine with head end raised when general anesthesia is used. Inferior meatus and inferior turbinate is visualized with head light and nasal speculum. *Lichwitz's* trocar and cannula is used for puncturing the maxillary antrum. The medial wall of the maxillary antrum is punctured in the inferior meatus at a point 1.5 to 2 cm behind the anterior end of inferior turbinate. The trocar and cannula is directed towards the ipsilateral tragus or outer canthus of the eye. After piercing the trocar is removed and cannula is advanced further. The sinus is irrigated with normal saline at body temperature with a 20 ml syringe or *Haggenson's* syringe (Fig. 25.3 and 25.4). Irrigation is continued till the returned fluid is cleared. In the end the cannula is removed and nose is packed for few hours if there is significant bleeding.

Complications

1. *Anesthetic complications:* It depends upon the type of anesthesia used.
2. *Bleeding:* Profuse bleeding may occur due to trauma to nasal mucosa and turbinate.
3. *Orbital injury:* The trocar and cannula may enter into the orbit through the roof of the sinus, if it is entered with a great force. Sometimes roof of the sinus is dehiscent and fluid may enter into the orbit leading to orbital cellulitis.
4. *Cheek injury:* Trocar and cannula may enter into soft tissues of the cheek and leads to the swelling of cheek.
5. *Damage to pterygopalatine fossa:* Trocar and cannula may enter into the pterygopalatine fossa through its posterior wall and can damage the internal maxillary artery or the ganglion.
6. *Air embolism:* This is a rare complication but may be fatal.

CALDWELL LUC'S OPERATION

This is the operation of opening the maxillary antrum through its anterolateral wall. After cleaning the disease from the sinus, an opening is made in the medial wall of the sinus into the inferior meatus *(antrostomy)*.

Fig. 25.5: Caldwell Luc's operation showing opening of maxillary sinus.

This operation is done mostly in general anesthesia with cuffed endotracheal tube. The position of the patient is same as in other nasal surgeries i.e. the patient is kept supine with head end raised. A sublabial, horizontal incision is given few millimetres below the gingivo-labial sulcus. The incision extends from the lateral incisor to the second molar tooth. Mucoperiosteum flap is raised from the canine fossa. Opening is made in the canine fossa by using gauge and hammer or a drill machine (Fig. 25.5). Disease is cleared from the maxillary antrum. At the end antrostomy is made in its medial wall. Antrum and the nasal cavity is packed for 24 to 48 hours. Sublabial incision is stitched with catgut.

Complications

1. Anesthetic complications.
2. Profuse bleeding.
3. Damage to the infraorbital nerve leading to anesthesia of the cheek.
4. Damage to the dental nerves.
5. Damage to the inferior turbinate.
6. Damage to the nasolacrimal duct.
7. Oro-antral sublabial fistula due to non-healing of the wound.

FUNCTIONAL ENDOSCOPIC SINUS SURGERY (FESS)

Endoscopic nasal and sinus surgery is the result of development in many aspects of medicine. Most important is understanding of the natural sinus clearance by mucociliary transport system. Functional endoscopic sinus surgery has gain popularity in the management of sinonasal disease because of its minimal invasiveness.

Without damaging the normal tissues one can remove diseased mucosa, polyp, or a growth from the nose and sinuses. The natural ostium of the sinuses can be enlarged to improve drainage. The instruments for FESS include rigid fiber-optic endoscopes with telescopic lenses (0°, 30°, 45°, 70°), microdebrider and micro-surgical instruments for precise and limited surgery (Fig. 25.6 and 25.7). The advantages of functional endoscopic sinus surgery are:

1. It is minimally invasive.
2. Hospital stay is short.
3. Normal physiology is not disturbed.
4. Gives excellent view of the deep and concealed cavities.

The most widely used technique for functional endoscopic sinus surgery (FESS) is advocated by Messerklinger which employs anterior to posterior approach of the sinuses. FESS can be done under local anesthesia or general anesthesia depending upon the extent of the disease and condition of the patient. The extent of surgery depends upon the involvement of the sinuses by the disease. The basic philosophy of FESS is to remove only the diseased mucosa leaving behind all the normal and healthy mucosa from the nose and sinuses. After local infiltration of xylocaine with adrenaline, first step is the removal of uncinate process (uncinectomy) and exposure of the infundibulum. Natural ostium of the maxillary sinus is identified and it is widened to improve drainage. Anterior ethmoidal cells are cleared (anterior ethmoidectomy) by opening the bulla ethmoidalis (bullectomy). Posterior ethmoidectomy (clearance of the posterior ethmoidal cells) is then performed by opening the basal lamella. Exposure and cleaning of the frontal sinus ostium is done next (frontal sinusotomy). Opening and cleaning of the sphenoidal sinus is usually done at the end (sphenoid sinusotomy).

Indications

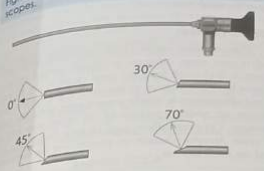
Endoscopic sinus surgery is used for treatment of the following conditions:

1. Chronic sinusitis.
2. Nasal polyp.
3. Small growth of the nose or nasopharynx.
4. Nasal adhesions.
5. CSF rhinorrhea.
6. Fungal sinusitis.
7. Mucocoele.
8. Foreign body removal.
9. Control of epistaxis.
10. Deviated nasal septum.
11. Hypertrophied inferior or middle turbinate.
12. Enlarged adenoids.
13. Choanal atresia.
14. Dacryocystitis.

Complications

Beside anesthetic complications following are the important and common complications of endoscopic sinus surgery:

Fig. 25.6: Functional endoscopic sinus surgery telescopes.



1. Orbital complications. It includes:
   a. orbital hemorrhage and hematoma.
   b. orbital cellulitis and abscess.
   c. damage to the optic nerve.
   d. damage to medial rectus muscle and diplopia.
   e. periorbital ecchymosis.
2. Intracranial complications. It includes:
   a. CSF leak.
   b. meningitis.
   c. brain abscess.
   d. intracranial hemorrhage.
   e. trauma to brain tissues.
   f. injury to internal carotid artery.
3. Nasal complications. It includes:
   a. nasal adhesion formation.
   b. bleeding especially from anterior and posterior ethmoidal arteries.
   c. injury to nasolacrimal duct.
   d. anosmia or hyposmia.

FUNGAL SINUSITIS

By far the greatest advances in the last decade as well as the great topic of controversy in head and neck mycosis have revolved around fungal sinusitis. Although fungal infection of the nose and paranasal sinuses is observed uncommonly but its incidence is increasing. Previously these infections are usually seen in individuals who are immunocompromised but recently the occurrence of fungal sinusitis has increased in the immunocompetent population as well. Many different species of fungi are found to involve the paranasal sinuses, common among them are *aspergillus, mucor, alternaria, curvularia* and *rhizopus*.

The fungal infections of the nose and paranasal sinuses are broadly classified into two distinct entities; *'invasive'* and *'non-invasive'* fungal sinusitis. Invasive fungal sinusitis is commonly seen in individuals who are diabetics or immunocompromised and is characterized by its invasiveness, rapid onset and tissue destruction. Non-invasive fungal sinusitis is commonly seen in immunocompetent individuals where fungus remains on the surface. Each of this variety is further subclassified as follows, so that there are five recognized forms, each with its own pathophysiology and clinical presentation:

Fig. 25.7: Method of performing functional endoscopic sinus surgery.

I. Invasive fungal sinusitis:
   1. Acute fulminant invasive fungal sinusitis.
   2. Chronic invasive or non-granulomatous invasive fungal sinusitis.
   3. Granulomatous invasive fungal sinusitis.

II. Non-invasive fungal sinusitis:
   4. Allergic Fungal Sinusitis (AFS).
   5. Fungal ball or mycetoma.

1. Acute Fulminant Invasive Fungal Sinusitis

It is less than four weeks in duration and occurs in immunocompromised patients. Common causative fungal species are aspergillus, mucor and rhizopus. It has a very high mortality if not recognized early and treated aggressively by radical surgical debridement and systemic intravenous antifungal medications (amphotericin-B).

2. Chronic Invasive or Non-Granulomatous Invasive Fungal Sinusitis

It is commonly found in patients with diabetes mellitus, as in diabetes, cell mediated immune response is deficient and granuloma formation requires an intact cell mediated response. These fungi invade mucosa of the sinuses and involve the underlying bones to cause its erosion. Aspergillus is the most common organism responsible for this condition. Treatment is radical surgical debridement with removal of all debris from the sinuses along with systemic antifungal therapy.

3. Granulomatous Invasive Fungal Sinusitis

It is seen in patients with intact cell mediated immune response. Usually surgical debridement is effective alone and prognosis is better than non-granulomatous form.

4. Fungal Ball or Mycetoma

It is composed of tightly packed hyphae of fungus mostly aspergillus. It commonly affects maxillary and sphenoid sinuses. Patients are typically immunocompetent and non-atopic. Surgical removal of the debris is enough with no systemic use of antifungal drugs.

5. Allergic Fungal Sinusitis (AFS)

Over the past three decades *allergic fungal sinusitis (AFS)* has become increasingly defined. It is believed to be an allergic reaction to aerosolized environmental fungi in an immuno-competent host. The diagnostic criteria for AFS include presence of the following five characteristics:

1. Type I (IgE mediated) hypersensitivity to fungi.
2. Nasal polyposis.
3. Characteristic radiographic findings.
4. Eosinophillic mucin or allergic mucin, without fungal invasion into sinus tissue, remains the most reliable indicator of AFS.
5. Positive fungal stain on culture of sinus content, removed at the time of surgery.

Causative fungi are aspergillus, bipolaris and curvularia. This condition is mostly associated with nasal polypi and asthma. There is no invasion of sinus mucosa by the fungus. The mainstay of treatment is polypectomy and aeration of the sinuses either by conventional surgery or endoscopic sinus surgery. Systemic steroids are helpful especially in the post-operative period.

ATROPHIC RHINITIS

It is a chronic inflammation with atrophy and thinning of the nasal mucosa. It occurs as a result of *periarterial fibrosis* and *endarteritis* of the terminal arterioles. Two clinical types of atrophic rhinitis are described.

a. Primary atrophic rhinitis.
b. Secondary atrophic rhinitis.

Primary Atrophic Rhinitis

The exact cause is unknown but several factors have been described. It may be the advanced stage of chronic rhinosinusitis after a long interval. Various organisms have been isolated from the patients with atrophic rhinitis. These organisms are also presumed to be the causative agents. It includes *Klebsiella ozaenae* (Perez bacillus), *diphtheroid* and *P. vulgaris*. Autoimmune process may also be a cause of atrophic rhinitis.

Degeneration of the ciliated epithelium and seromucinous gland of the nasal cavity occurs. This leads to the formation of thick adherent crusts in the nose. The lining of the turbinates also undergo re-sorption causing widening of the nasal cavity.

Clinical Features

This condition involves both sides of the nasal cavity and is seen more common in females around puberty. There is foul smell from the nasal cavity of the patient. Patient herself is unaware of this smell as she has anosmia. Nasal obstruction is usually present even when the nasal cavities are wide. Separation of the crusts may lead to epistaxis. On examination, nasal cavity is found to be filled of crust. Atrophic changes are present over the turbinates and the nasal mucosa.

Treatment

Removal of the crust is best achieved by nasal alkaline douches. It loosens the crust and removes thick tenacious nasal secretions. 25% glucose in glycerine drops is instilled into the nose to prevent new crust formation and it also inhibits saprophytic infections. Local or systemic antibiotics may be prescribed to control infection. Several measures have been used in an attempt to increase granular activity and blood supply. It includes potassium iodide by mouth, hormonal therapy (estradiol or stilbestrol locally or systemically), placental extract and systemic use of streptomycin (against Klebsiella organism).

Surgical treatment is indicated for cases not responding to medical treatment. Different surgical procedures are described. In *Young's operation* both the nostrils are closed for 6 months which reverts the mucosal changes. Wide nasal cavities can be narrowed by injection of teflon paste submucosally. Moistening of the nasal mucosa has been attempted by diverting parotid or Stenson's duct into the antrum.

Secondary Atrophic Rhinitis

Destruction of the nasal mucosa and atrophic changes in the nasal cavity occurs secondary to some disease or surgery in the nose like syphilis, leprosy, lupus, excessive surgical removal of the inferior turbinates, deviated nasal septum, long-standing sinusitis and radiotherapy to the nose. The clinical features and management are the same as for primary atrophic rhinitis.

RHINITIS MEDICAMENTOSA

Rhinitis medicamentosa is subset of drug-induced rhinitis, characterized by nasal congestion that is triggered mainly due to the overuse of topical vasoconstrictive medications like an intranasal decongestant and recreational use of intranasal cocaine. Cessation of the intranasal decongestant is followed by rebound congestion that is quite profound, leading to more use of the decongestant. Symptoms are confined to the nose and consist of chronic nasal congestion as the most prominent symptom which does not change with season or environment. On examination, typically nasal mucous membrane appears 'beefy-red', inflamed, may show areas of punctate bleeding and scant mucus. There may be areas of increased tissue friability and profuse stringy mucoid discharge. Diagnosis is usually made on careful history and clinical examination. Investigations are needed to exclude other causes like chronic rhinosinusitis, nasal polyposis etc. For treatment, use of topical decongestant must be discouraged and discontinued gradually but as soon as possible. During weaning period of topical decongestant, symptomatic treatment with topical or systemic steroids can be used.

RHINITIS SICCA

This condition affects the anterior third of the nasal cavities only. It occurs in people who work in hot, dry and dusty environment. There is *peri-glandular fibrosis* and *metaplasia* of chronic the ciliated epithelium. It results in a viscid and stagnant mucous blanket which forms crusts. These crusts are not foul smelling as in atrophic rhinitis. It is treated by correction of the occupational surrounding and application of lubricants in the nose.

RHINITIS CASEOSA

This is a rare condition which mostly affect males. In this condition, a cheesy material enters the nose from the maxillary antrum. It probably results from failure of the evolution of sinusitis when its secretion inspissates and a foul cheesy debris is excluded into the nose. This condition is treated by removal of the debris and granulation tissues.

TUBERCULOSIS

Primary tuberculosis in the nose is very rare. Nasal involvement may occur in miliary tuberculosis or by finger nail inoculation in a tuberculous patient. The anterior part of the nasal cavity especially the anterior ends of the inferior turbinates and anteroinferior part of the nasal septum are commonly involved. In the initial stages, a localized tuberculoma is present. Ulceration may follow and finally perforation of the nasal septum may occur. Along with other tests for tuberculosis, biopsy of the lesion is diagnostic. This condition is treated by antituberculous therapy as in other cases of tuberculosis.

SYPHILIS

Nasal involvement can occur in both *congenital* and *acquired* forms of syphilis. The nasal septum is most commonly involved but lateral wall of the nose may also be affected. Ulceration and destruction of the soft tissues occurs. In the nasal septum, perforation usually occurs which may involve the bony or cartilaginous part of the septum. As a result of nasal septum destruction, sinking of the nasal bridge may occur leading to saddle nose deformity. Serological tests for syphilis like VDRL, TPHA and FTA are positive depending on the stage of the disease. Biopsy of the nasal lesion will confirm the diagnosis, which may demonstrate the presence of *Treponema palladium* by special stains. Treatment is the same as for syphilis in other parts of the body.

LEPROSY

It is a chronic granulomatous inflammation caused by *mycobacterium leprae*. Mycobacteria are conveyed to the nose by the finger nail inoculation in most of the cases. Destruction of the nasal septum occurs in late cases which results in *septal perforation* and *external nasal deformity*. This condition is treated by anti-leprosy therapy including dapsone, rifampicin, isoniazid etc.

LUPUS VULGARIS

This is caused by inoculation of tubercle bacilli of low virulence, probably as a result of nose picking. Treatment is the same as for tuberculosis of the nose.

RHINOSCLEROMA

It is a chronic granulomatous inflammation caused by the gram negative 'bacillus of Frisch' or *Klebsiella rhinoscleromatis*. This disease is prevalent in certain endemic areas of the world. Three stages of the disease are distinguished:

1. Atrophic stage.
2. Tumefective or granulomatous stage.
3. Cicatrizing stage.

WEGENER'S GRANULOMATOSIS

Wegener's granulomatosis or *Granulomatosis with polyangiitis* (GPA) a multisystem autoimmune disease of unknown etiology. It is one of the antineutrophil cytoplasmic antibody (ANCA) associated vasculitic disorders. Primarily, it involves the upper and lower respiratory tracts and kidneys. The patient often presents persistent nasal obstruction and sometimes blood stained nasal discharge. Nasal examination will show thickening of the nasal mucosa with ulceration and crust formation. The clinical features are similar to atrophic rhinitis. Cytoplasmic antineutrophil cytoplasmic antibody (c-ANCA) directed against PR3 is the most specific diagnostic test while some patients express perinuclear-staining ANCA (p-ANCA) specific for myeloperoxidase. Biopsy of the nasal granulation will show the presence of epithelioid necrotizing granulomata, fibrinoid necrosis and focal vasculitis. The condition is treated by giving high doses of systemic steroids which results in a rapid clinical improvement. Cytotoxic drugs may bring long term control.

MIDLINE LETHAL GRANULOMA

It is a chronic granulomatous disease of the nose, resulting in slow and progressive destruction of the nose

and midfacial region. There is remarkably little systemic disturbance with no evidence of pulmonary or renal involvement. More recently, this condition is considered as a malignant lymphoma. The condition responds well with local radiotherapy.

Chapter Summary and Key Points

Most of the cases of chronic rhinosinusitis are due to failure of an acute infection to resolve, leading to chronicity. It is classified into two types, with polyposis or without polyposis. Surgical treatment is required in cases not responding to medical treatment. Functional endoscopic sinus surgery is now considered as the treatment of choice. All conventional surgeries of the sinuses are rarely employed now. Fungal infections of the nose and paranasal sinuses are increasing because of increasing incidence of diabetes mellitus, other immunecompromized states and increasing use of steroids.

Best Choice Questions

Q1. A 15-year-old girl came with the complaint of a nasal obstruction and recurrent epistaxis. On examination, both nasal cavities were full of foul smelling crusts with wide nasal cavities. Which of the following solution will be used for instillation in the nose?

a. 25% glucose in glycerine.
b. 25% potassium iodide in glycerine.
c. 25% soda bicarb in glycerine.
d. 25% sodium chloride in glycerine.

Q2. In which of the following demographic group, primary atrophic rhinitis is most common?

a. infants of both genders.
b. females around puberty.
c. middle aged males.
d. old aged males.

Q3. A 22-year-old female patient, had been taking medications for atrophic rhinitis since last few years, but there was no relief in her symptoms. Which of the following surgical operations can be tried for treatment in this patient?

a. Caldwell Luc's operation.
b. Howarth's operation.
c. lateral rhinotomy.
d. Young's operation.

Q4. Which of the following part of nasal cavity is most commonly affected by rhinitis sicca, where drying and crusting is maximum?

a. anterior third of the nasal cavity.
b. lower third of the nasal cavity.
c. posterior third of the nasal cavity.
d. upper third of the nasal cavity.

Q5. A 28-year-old man, who was recently diagnosed with pulmonary tuberculosis, came with complaints of nasal obstruction and blood stained nasal discharge. On examination, he has granulation tissues and mucosal ulceration on the nasal septum. Which of the following is the most important test for diagnosis?

a. biopsy.
b. Erythrocyte Sedimentation Rate (ESR).
c. Monteux test.
d. nasal endoscopy.

Q6. Antral washout was planned for a 22-year-old male patient. What should be the direction of trocar and cannula while performing this procedure?

a. angle of the mandible.
b. inner canthus of the eye.
c. lobule of the ear.
d. outer canthus of the eye.

Q7. 'FESS' is the abbreviation for:

a. faster endoscopic sinus surgery.
b. field enhanced sinus surgery.
c. frontal endoscopic simple surgery.
d. functional endoscopic sinus surgery.

Q8. Caldwell Luc's operation was planned for a 30-year-old male patient. Which of the following incision will be used for this operation?

a. gingival vertical incision.
b. subgingival horizontal incision.
c. sublabial horizontal incision.
d. sublabial vertical incision.

Q9. Which of the following degree of telescopes are most commonly used in functional endoscopic sinus surgery?

a. 0, 10 and 20.
b. 0, 20 and 50.
c. 0, 30 and 70.
d. 10, 20 and 30.

Q10. In functional endoscopic sinus surgery, which of the following instrument is used for removal of nasal polyp?

a. micro-currette.
b. micro-debrider.
c. micro-scissors.
d. micro-suction.

Answers with Explanations

1. a prevents crust formation.
2. b.
3. d both nostrils are closed for 6 months.
4. a.
5. a for histopathological diagnosis.
6. d or also towards ipsilateral tragus.
7. d.
8. c from lateral incisor to second molar tooth.
9. c.
10. b.

CHAPTER

26 Epistaxis

- Etiology
- Pathology
- Clinical Features
- Treatment
  - First aid measures
  - Hospital management
  - Delayed management

Epistaxis means bleeding from inside the nose. Epistaxis is a symptom and not a disease and is fairly common. It may occur in any age group.

Etiology

The following are common causes of epistaxis:

1. *Idiopathic:* When the cause of epistaxis is unknown.
2. *Local causes:*
   a. Congenital causes: e.g. Osler's disease. In Osler's disease, prominent telangiectasis are present in the nose, face and mouth.
   b. Trauma: This is the most common local cause of epistaxis. It may occur as a result of fingernail trauma, road traffic accidents, injuries to nose, foreign bodies and hard blowing of the nose.
   c. Acute infections: e.g. common cold, diphtheria and acute rhinosinusitis.
   d. Chronic infections: All chronic infections, which lead to drying and crust formation may cause epistaxis e.g. atrophic rhinitis, tuberculosis, granuloma etc.
   e. Septal perforation.
   f. Deviated nasal septum.
   g. Surgical operations of the nose.
   h. Maggots and leaches in the nose.
   i. Neoplasms of the nose and nasopharynx like nasopharyngeal angiofibroma, hemangioma and malignant tumors.
3. *General causes:*
   a. Hypertension.
   b. Bleeding disorders like hemophilia, thrombocytopenia, Christmas disease, leukemia, aplastic anemia etc.
   c. Atmospheric conditions like very hot weather and high altitudes.
   d. Liver diseases e.g. cirrhosis causing clotting factors deficiency.
   e. Chronic nephritis.
   f. Acute infections like measles, chicken pox, typhoid fever etc.
   g. Drugs e.g. anticoagulant drugs, salicylates and quinine.

Pathology

Bleeding may occur from any site but in 90% of cases, epistaxis occurs from the *Little's area*. Little's area is situated in the anteroinferior part of the nasal septum, where the anastomosis of four blood vessels is present, called *'Kiesselbach's plexus'* (Fig. 17.8). These arteries include the anterior ethmoidal, septal branch of superior labial, sphenopalatine and greater palatine arteries. This area is exposed to the drying effects of inspired air and to fingernail trauma. There is another vascular plexus situated posteriorly in the lateral wall of the nose below the inferior turbinate, known as the *Woodruff's plexus*. This area is the most common site for posterior bleeding. The other sites of bleeding include, above the middle turbinate from the ethmoidal vessels, below the middle turbinate from branches of the sphenopalatine artery and the nasopharynx.

Venous bleeding may occur especially from the retrocolumellar vein which runs vertically just behind the columella. Bleeding from small vessels and capillaries can also occur, which is usually diffused.

Sites of Epistaxis

Medial wall or septum:

- Little's area-Kiesselbach's plexus.
- Behind columella-retro columellar vein.

Lateral wall:

- Above the middle turbinate-anterior and posterior ethmoidal arteries.
- Below the middle turbinate-sphenopalatine artery.

Posterior bleeding:

- Posterior part of lateral nasal wall-woodruff's plexus.
- Nasopharynx-sphenopalatine artery.

Diffuse bleeding:

- Small vessels and capillaries-blood dyscrasia.

Clinical Features

Epistaxis may occur in any age group. Bleeding varies greatly in degree from trivial to lethal bleeding. Blood usually flows out from the anterior nares (anterior epistaxis) but may flow backwards into the pharynx (posterior epistaxis) and comes out from the mouth or is swallowed. This swallowed blood may be vomited out later on. In most cases of trivial epistaxis, bleeding stops spontaneously. In cases of severe epistaxis when there is large amount of blood loss, patient may present a hypovolumic shock.

Treatment

First aid Measures

Minor degree of epistaxis, especially from the Little's area is usually controlled by asking the patient to pinch his nose and sit in an upright position with forward inclination for 10 to 15 minutes. The mouth is kept open and patient is instructed to breathe quietly through it. An ice or cold pack may be applied to the bridge of nose and forehead to produce a reflex vasoconstriction (Fig. 26.1). Still if bleeding continues or if it is severe, the patient should be shifted to a hospital.

Hospital Management

The precise method to control bleeding from the nose depends on the severity of bleeding and the site of bleeding. In cases of mild to moderate anterior bleeding where the site of bleeding is visible, chemical cauterization or electric cautery can be employed. The commonly used materials for chemical cauterization are a silver nitrate stick or solution and trichloroacetic acid solution.

In cases of severe bleeding or where no clear bleeding point is visible, anterior nasal packing is done. Patient is admitted in the hospital, the intravenous line is maintained and blood loss during epistaxis should be assessed. In severe loss, blood transfusion may be needed. Vital signs monitoring is essential. Procoagulants like tranaxemic acid may have some role and can be tried. Patient must be sedated and prophylactic antibiotics should be started.

Anterior nasal packing is done with a ribbon gauze soaked in Bismuth Iodoform Paraffin Paste (BIPP) or any antiseptic ointment e.g. polyfax. In an adult patient of average built, approximately about one metre ribbon gauze is required for packing each nasal cavity. The ribbon gauze is inserted and placed in the nasal cavity in layers starting from the floor (Fig. 26.2). The entire nasal cavity is packed tightly on both the sides to exert pressure and stop bleeding. Most of the anterior epistaxis stops by anterior nasal packing. The pack is removed usually after 48 to 72 hours.

Sometimes bleeding is not stopped by anterior nasal packing, especially in posterior epistaxis. In such cases, *posterior nasal packing* is required. In posterior nasal packing, the nasopharynx is packed along with the nasal cavity. There are different methods of posterior nasal packing. The simplest one is with a balloon catheter where a special balloon catheter is passed from each nostril into the nasopharynx and its balloon is inflated with normal saline (Fig. 26.3 A). After inflation of the balloon, anterior nasal packing is done in the usual way with a ribbon gauze as described above. In another method, a double balloon catheter is used (Fig. 26.3 B). First balloon is for the nasopharynx while the second is for nasal cavity, thus anterior nasal packing with ribbon gauze is not required.

Fig. 26.1: First aid measures in epistaxis.

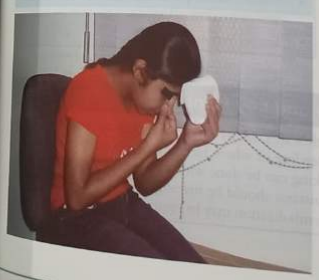


Fig. 26.2: Method of anterior nasal packing. Nasal cavity is packed with a ribbon gauze in layers. Arrow showing the point of start.

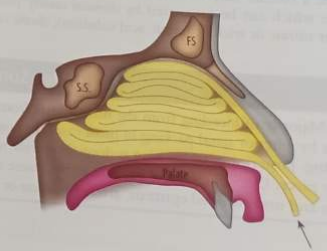


Fig. 26.3: Balloon catheters for posterior nasal packing A = one balloon for the nasopharynx; B = two balloons for nasopharynx and nasal cavity both.

Another method of posterior nasal packing is with a piece of gauze. The gauze is rolled first and three silk threads are tied with it. Then a soft rubber catheter is passed through each nostril and brought out through the mouth. The ends of two threads of the pack are tied with the rubber catheter. The rubber catheter is then withdrawn from the nose, carrying with it the silk threads of the pack. Thus, now two threads of the pack are going through the mouth into the nasopharynx and coming out through the nose. The postnasal pack is then introduced through the mouth into the nasopharynx and both the threads are pulled and tied in front of the columella to keep the postnasal pack in its place. The third silk thread remains in the mouth, which is used later on for removal of the postnasal pack. Anterior nasal packing is then done in the usual way as described above. Most posterior epistaxis are stopped by this method. Pack is removed after 48 to 72 hours.

Delayed Management

After the acute phase is over, the patient must be investigated for the cause of epistaxis and it should be treated accordingly. If hypertension is the cause, blood pressure should be controlled. After removal of the nasal pack, a bleeder may be visible in the anterior part of the nose which can be cauterized by *chemical cautery* (using a silver nitrate or trichloroacetic acid solution), *electric cautery* or *coagulation diathermy*. In some cases, nasal endoscopy or examination under general anesthesia is required where identification of the bleeder and cauterization can be done more effectively.

In severe cases of epistaxis not controlled by above measures, other procedures like an arterial ligation or arterial embolization may be needed. Arterial ligation is done according to the site of bleeding or which artery is responsible for the bleeding. The arteries which can be ligated in cases of epistaxis are external carotid artery, maxillary artery, sphenopalatine artery anterior and posterior ethmoidal arteries. Endoscopic transnasal sphenopalatine artery ligation is a good alternative to ligate this artery endoscopically where it enters in the nose through sphenopalatine foramen. Embolization of the bleeding vessels can be done under fluoroscopic control (angiography), where gelform, polyvinyl alcohol or glass beads are injected into the artery to produce an embolus there, this causes blockage in the artery.

Treatment of Epistaxis

First aid Measures:

- Pinching of the nose.
- Sitting upright with forward inclination.
- Ice packs on forehead.

Hospital Management:

- Chemical or electric cautery.
- Anterior nasal packing.
- Posterior nasal packing.
- Maintain I/V line.
- Blood loss assessment and replacement.
- Coagulant therapy e.g. tranaxemic acid.
- Prophylactic antibiotic.

Delayed Management:

- Investigation to find the cause of bleeding.
- Treatment of the cause.
- Nasal endoscopy or examination under anesthesia and cauterization/ligation.
- Embolization.

Chapter Summary and Key Points

Majority of bleeding from the nose occurs from the Little's area. Many cases of epistaxis are idiopathic. Bleeding stops by anterior nasal packing in most cases. In posterior bleeding or where bleeding does not stop by anterior nasal packing, posterior nasal packing is done. Posterior nasal packing can be done with a balloon catheter or with a rolled gauze piece. Once the patient became stable, cause of the epistaxis should be investigated and treated accordingly. In severe and uncontrolled epistaxis, arterial ligation or arterial embolization may be required.

Best Choice Questions

Q1. What is the most common site for epistaxis?

a. anterior part of the inferior turbinate.
b. anterior part of the middle turbinate.
c. anteroinferior part of the nasal septum.
d. upper part and roof of the nasal cavity.

Q2. A 16-year-old boy presented a complaint of mild to moderate, recurrent epistaxis of an idiopathic etiology. What will you advise him to stop bleeding during an acute episode at home?

a. lie supine with head end 15° up.
b. lie supine with sand bag under the shoulders.
c. sit upright with backward inclination.
d. sit upright with forward inclination.

Q3. Which of the following part is packed in anterior nasal packing?

a. anterior half of the nasopharynx.
b. anterior nares.
c. anterior one-third of the nasal cavity.
d. whole of the nasal cavity.

Q4. A 50-year-old man came to the ER with complaint of severe epistaxis. Anterior nasal packing was done immediately in ER and the bleeding stopped. What is the most appropriate time period after which nasal packing will be removed in this patient?

a. 3–5 hours.
b. 6–24 hours.
c. 2–3 days.
d. 5–7 days.

Q5. Anterior nasal packing was advised to a 20-year-old girl who presented compliant of severe epistaxis in emergency (ER). What material is most suitable for packing in such a patient?

a. cotton.
b. gelfoam.
c. ribbon gauze.
d. sponge stone.

Answers with Explanations

1. c from the Little's area.
2. d.
3. d.
4. c.
5. c for proper pressure in the nasal cavity.

CHAPTER

27 Allergic and Vasomotor Rhinitis

- Allergic rhinitis
  - Etiology
  - Pathogenesis
  - Pathology
  - Clinical features
  - Investigations
  - Treatment
- Vasomotor Rhinitis (VMR)
  - Etiology
  - Pathology
  - Clinical features
  - Treatment

ALLERGIC RHINITIS

Allergy is an abnormal reaction of the tissue to certain substances. It is mediated by Immunoglobulin E (IgE) and is classified as a type-I hypersensitivity reaction. It is similar to allergic asthma but the size of the offending allergen is different.

Etiology

Allergy is produced by substances called *allergens* which are capable of enabling the body to produce antibodies. Allergens may be *exogenous* or *endogenous*. Exogenous allergens are mostly inhalants and include dust, pollen, feathers, house dust mites and fungal spores. Exogenous allergens may also be ingestant such as egg, fish, milk, wheat or drugs. Some exogenous allergens can cause allergy by coming in contact with the nasal mucosa e.g. nasal drops, sprays, face powder, etc. Endogenous allergens come from within the body and include tissue proteins.

There are many predisposing factors for allergic rhinitis. The most important is genetic predisposition of an individual. *'Atopy'* refers to the genetic tendency of an individual to develop allergic diseases and is typically associated with heightened immune responses to common allergens. The chance to develop allergic rhinitis is around 47% if both parents are allergic and 29% if one parent is allergic. The other factors that may predispose an individual to allergic rhinitis are physical factors like the environment, viruses, other infections, endocrinal and psychological factors etc.

Pathogenesis

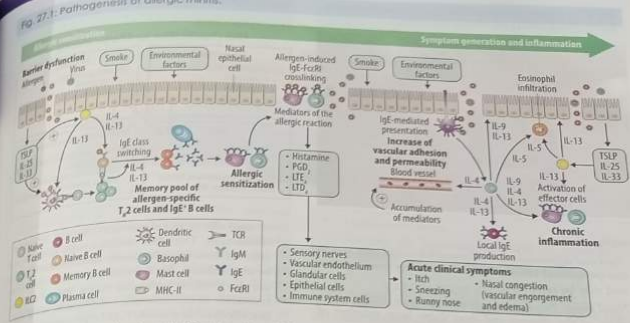
Pathogenesis of allergic rhinitis is a complex process of interaction of an allergen and so many mediators of inflammation (Fig. 27.1). The first process is *'sensitization'*, when inhalation of the allergens for the first time causes production of specific IgE antibodies in the genetically predisposed individual. These IgE antibodies are then fixed to the surface of the mast cells or basophils. Subsequent exposure to these allergens causes them to be attached with these specific IgE antibodies on the mast cell surface. The attachment of allergens with antibodies causes degranulation of the mast cells with the release of several chemical mediators. These mediators are broadly classified into *'preformed'* and *'newly synthesized'*. Among the preformed mediators, important are histamine, interleukins, Eosinophil Chemotactic factor of Anaphylaxis (ECF-A), neutrophil Chemotactic factor, heparin. Among the newly synthesized factors, important are leukotrienes, prostaglandins, Platelet Aggregating Factor (PAF), thromboxane-A. Tumor necrosis factor. These chemical mediators produce several effects including vasodilatation, edema, excessive production of nasal secretion and infiltration of eosinophils. The development of an IgE response is dependent on T-lymphocytes with regulation of IgE synthesis by the number of T-cell derived soluble factors.

Typically, an allergic response occurs in two phases: acute or early phase and late or delayed phase. The early phase occurs immediately within 5 to 30 minutes after exposure to allergens and causes rhinorrhea, sneezing and nasal obstruction due to release of different mediators. Late or delayed phase occurs 2 to 8 hours after exposure and does not require re-exposure to allergens. This phase occurs due to recruitment and infiltration of inflammatory cells eosinophils, basophils, neutrophils, monocytes and T-lymphocytes at the local site.

Pathology

With the naked eye, the nasal mucosa is seen as pale and swollen. These changes are most marked over the inferior and middle turbinate. Later on, the mucosa appears to be bluish in color due to venous stasis. The watery discharge is present in the nasal cavity because of increase activity of the seromucinous glands. The mucin content is reduced, fluid is sterile, contains eosinophils and is more alkaline than normal. The edematous mucosa may grow into polypoidal masses, which also contain

Fig. 27.1: Pathogenesis of allergic rhinitis.



eosinophils. Polyp formation is marked in the ethmoidal air cells. These mucosal changes predispose to infection, so secondary superadded infection is very common. The mucosal changes are also seen in the lining of the sinuses, leading to generalized thickening of the lining mucosa. Fluid effusion into the sinuses may also occur. The fluid is sterile and clear but in some chronic cases, it may become thick and gum like.

Clinical Features

Two clinical forms of allergic rhinitis are well known:

1. Seasonal.
2. Nonseasonal or Perennial.

In *seasonal* form, symptoms appear only during specific season in specific areas of the world for e.g. during pollen season. In *nonseasonal* or *perennial* form, the symptoms are usually not very marked as in the seasonal form but remains throughout the year. Nasal allergy often starts in school going children and is less common after 50 years of age. The symptoms may vary in severity from day to day or even from hour to hour. Patients report rhinorrhea, sneezing, nasal irritation and nasal obstruction. Nasal discharge is clear, watery and usually profuse. Sometimes postnasal dripping may be present but is less often than in the infective rhinitis. Sneezing commonly occurs in paroxysms. Nasal obstruction occurs bilaterally and is because of mucosal edema and venous stasis especially of the inferior turbinate. Nasal irritation or tickling sensation in the nose may be present without sneezing. Partial or complete loss of sense of smell, which may be intermittent or continuous, is often present. Along with symptoms of nasal allergy, symptoms related allergies of other areas like the pharynx, larynx, eyes and ears might be present.

On examination of the nose, nasal mucosa appears to be pale, swollen, and sometimes bluish in color. Nasal cavity may be seen full of watery and thin secretions. Turbinates especially the inferior are swollen and hypertrophied (Fig. 27.2). Sometimes nasal polypi may be present.

ARIA (Allergic Rhinitis and its Impact on Asthma) has classified allergic rhinitis according to its duration (intermittent or persistent) and severity of the symptoms (mild or moderate to severe) for treatment purposes (Fig. 27.3). Thus, there are total four subgroups; mild and intermittent, mild and persistent, moderate to severe and intermittent and moderate to severe and persistent.

Clinical Features of Allergic Rhinitis

- Two forms: seasonal and perennial.
- Watery rhinorrhea.
- Sneezing.
- Nasal irritation.
- Nasal obstruction.
- Hyposmia or anosmia.
- Mucosa: pale, swollen or bluish.
- Inferior turbinate: hypertrophy.
- Polyp formation: sometimes.
- Sign and symptoms of allergy in other parts of the body.

Fig. 27.2: Patient of allergic rhinitis with hypertrophied, edematous and pale inferior turbinate.

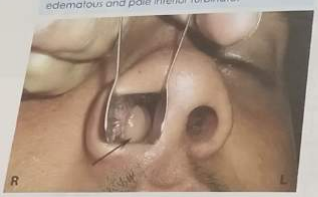
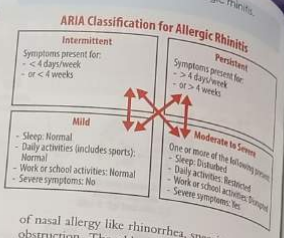


Fig. 27.3: ARIA classification of allergic rhinitis.



Investigations

1. *Total and differential count:* Eosinophil count may rise in the peripheral blood. This is not a very sensitive test and may be normal.
2. *Nasal smear:* Nasal smear should be made during active phase of the disease and may show large number of eosinophils.
3. *Serum IgE level:* A high serum IgE level is present in patients having allergy.
4. *RAST test:* Radio-Allergo-Sorbent test (RAST) measures the specific IgE antibodies concentration in the patient's serum.
5. *Nasal provocation test:* In this test, different allergens are applied on the patient's nasal mucosa and its response is noted. It is similar to skin test with specific allergens.
6. *Skin tests:* Specific allergens are given intradermally and its response is noted.
7. *Imaging studies:* Plain X-ray PNS (water's view) or CT scan nose and PNS without contrast is advised to assess the condition of the paranasal sinuses especially when nasal allergy is associated with chronic rhinosinusitis or nasal polyposis.

Treatment

Following are the treatment options for allergic rhinitis:

1. *Avoidance:* Avoidance of allergens is the optimum treatment but unfortunately this is rarely possible totally. Best results are obtained, if the allergy is against a single allergen. Allergies with multiple allergens are difficult and sometimes impossible to avoid. It may include removal of pets from houses, avoidance of specific foods, removal of carpets and heavy curtains, covering of pillows and mattress with specific anti-allergic sheets, change of work place etc.
2. *Antihistamine:* These have been the main mode of treatment for many years. They control symptoms of nasal allergy like rhinorrhea, sneezing, itching and obstruction. The older antihistamines have the side effect of drowsiness but newer antihistamines claim to be non-sedating. Antihistamines in topical spray forms are also available with good results. Patient to patient responses to antihistamines vary greatly, so if one is not effective then another can be prescribed with good results.
3. *Decongestant:* There is very limited role for oral decongestants because of rebound phenomena. It relieves nasal obstruction but its long term use is not advised. It is very helpful during the acute stage to relieve nasal obstruction but should be used only for a short period. Systemic nasal decongestant (pseudoephedrine) can be used to relieve nasal obstruction in acute cases.
4. *Mast cell stabilizer (Sodium chromoglycate):* It stabilizes mast cells to prevent the release of granules and their chemical mediators. It is a useful product for allergic rhinitis with extremely few side effects and can be used on a long term basis. It is used as 2% solution for nasal drops or sprays.
5. *Leukotriene inhibitors:* As the leukotriene is among one of the most important chemical mediator to cause symptoms of nasal allergy, drugs which inhibit the function of leukotriene may be used to relieve symptoms of nasal allergy. Leukotriene inhibitors are either leukotriene receptor antagonists (like montelukast, zafirlukast) or leukotriene synthesis inhibitors (like zileuton).
6. *Corticosteroids:* Oral and topical use of corticosteroids are very effective in controlling the symptoms of allergic rhinitis. Their use should be limited during severe acute phase of allergy where other measures have failed to relieve the symptoms. Topical steroids have fewer side effects than systemic steroids. Topical steroids may promote the growth of fungus in the nose, pharynx and sinuses.

Fig. 27.4: ARIA treatment guidelines for allergic rhinitis.

7. *Hyposensitization or Immunotherapy:* This involves injection of small amount of allergens subcutaneously (subcutaneous immunotherapy) in gradually increasing doses till the maintenance dose is reached. It suppresses the formation of IgE antibodies and also raises the titer of specific IgG antibodies. It is very effective if the allergy is due to a single allergen. The main problem with this treatment is the possibility of anaphylaxis. Another newer option is sublingual or nasal immunotherapy where allergens are applied to sublingual or nasal mucosa directly.
8. *Anticholinergics:* It blocks the parasympathetic activity which in turn decreases nasal secretions. Topical ipratropium bromide is used as nasal spray to control rhinorrhea in allergic rhinitis.
9. *Anti-IgE antibody:* Omalizumab is a recombinant humanized monoclonal antibody which selectively binds to the IgE and inhibits binding to IgE receptors on the surface of mast cells and basophils. It is administered subcutaneously.
10. *Surgical treatment:* As such surgery has no role to eliminate or treat nasal allergy. Surgery is required for hypertrophied inferior turbinate to relieve nasal obstruction (see chapter 25 for details). Surgical treatment for nasal polypi is indicated when polypi are present.

ARIA (Allergic Rhinitis and its Impact on Asthma) has developed treatment guideline according to subgroups in allergic rhinitis (Fig. 27.4).

Treatment of Allergic Rhinitis

- Avoidance of allergens.
- Antihistamine drugs.
- Nasal decongestant.
- Mast cell stabilizer.
- Leukotriene inhibitor.
- Corticosteroid: topical or systemic.
- Hyposensitization.
- Surgery: for hypertrophied inferior turbinate or polyposis.

VASOMOTOR RHINITIS (VMR)

In *vasomotor rhinitis*, the nasal mucosa is hyper reactive to certain stimuli in the absence of any identifiable allergic cause. It is a *non-allergic rhinitis* but clinically simulates nasal allergy with symptoms of nasal obstruction, rhinorrhea and sneezing. This condition usually persists throughout the year. It does not involve type-I hypersensitivity reaction and most of the tests for nasal allergy are negative.

Etiology

The symptoms appear to derive from an autonomic imbalance in the nasal mucosa. The predisposing and precipitating factors for vasomotor rhinitis are:

1. *Hereditary:* It plays a significant role in this condition.
2. *Psychological and emotional factors:* The symptoms are more prominent during the state of stress.
3. *Endocrine influences:* Endocrine changes in the body may affect the nose. Vasomotor rhinitis is particularly common at puberty, during menstruation, pregnancy, old age and with sexual excitement (Honeymoon rhinitis).
4. *Constitutional make up:* It may influence susceptibility to vasomotor rhinitis.
5. *Atmospheric condition:* Changes in the humidity and temperature of the atmosphere may precipitate an acute attack giving the impression of seasonal allergy.
6. *Fumes, dust and alcohol:* They may provoke a non-allergic hypersensitivity.
7. *Reflex phenomena:* Sneezing on waking or getting out of bed or exposure to cold may be of this nature.

Pathology

Nasal mucosa is under the control of the autonomic nervous system. The blood vessels and venous sinusoids

are controlled by the sympathetic nervous system. Nasal secretions by the glands are under the control of parasympathetic nervous system. Autonomic nervous system is unstable in cases of vasomotor rhinitis. Nasal mucosa is hyperactive to several non specific stimuli, resulting in symptoms of vasomotor rhinitis.

Clinical Features

Clinical features of vasomotor rhinitis are very similar to allergic rhinitis. Paroxysmal sneezing may occur due to any stimuli e.g. getting out of bed in the morning. Rhinorrhea is present, which is usually profuse, clear and watery. Nasal obstruction which alternates from side to side is present, more marked at night. On examination, the nasal mucosa especially over the inferior turbinate is congested and hypertrophic.

Treatment

The physical factors, which provoke vasomotor rhinitis, must be avoided. Antihistamine drugs are helpful in relieving the symptoms of vasomotor rhinitis. In cases of severe nasal obstruction, topical decongestants may be given for short term use. Psychological, emotional and endocrinal factors if present, must be treated accordingly.

Short term use of systemic or topical steroid may be indicated where the symptoms are not relieved by other measures.

In cases of hypertrophied inferior turbinate, causing nasal obstruction, can be treated by surgery like electro cautery and SMD. In severe cases of vasomotor rhinitis not relieved by medical treatment, sectioning of the vidian nerve *(vidian neurectomy)* is indicated which supplies the autonomic nerve fibers to the nose. Cryosurgery was very popular previously but it is now obsolete.

Treatment of Vasomotor Rhinitis

- **Medical**
  - Elimination of the factor causing VMR.
  - Symptomatic treatment.
  - Antihistamine.
  - Nasal decongestant.
  - Corticosteroid.
- **Surgical**
  - Surgery for hypertrophied inferior turbinate.
  - Vidian neurectomy.

Chapter Summary and Key Points

Nasal allergy occurs in two forms, seasonal and perennial. Patient usually reports watery discharge, sneezing, irritation and nasal obstruction. Eosinophil count and total serum IgE level are raised in these patients. The condition is mainly treated by medical treatment which includes antihistamine, corticosteroids, leukotriene inhibitors, mast cell stabilizers etc. Surgery has a role in patients when there is hypertrophy of the inferior turbinate causing nasal obstruction or nasal polyposis.

Vasomotor rhinitis is clinically similar to allergic rhinitis where nasal mucosa is hyper reactive to certain stimuli but is not due to type-I hypersensitivity reaction. Psychological, emotional and endocrinal factors play roles in developing this condition.

Best Choice Questions

Q1. *A 22-year-old girl presented excessive sneezing, watery rhinorrhea, itching and nasal obstruction whenever she come in contact with house dust. Which type of hypersensitivity reaction is occurring in this patient?*

a. *type I hypersensitivity reaction.*
b. *type II hypersensitivity reaction.*
c. *type III hypersensitivity reaction.*
d. *type IV hypersensitivity reaction.*

Q2. *A 12-year-old atopic boy was exposed to an inhalation antigen for the first time in his life. Which type of antibodies will be formed in this boy, that will later produce nasal allergy?*

a. *IgA.*
b. IgE.
c. IgG.
d. IgM.

Q3. A 12-year-old girl was exposed to an inhalation antigen that produced specific IgE type antibody. On which of the following type of cells this IgE antibody will be fixed so that it produces nasal allergy later on?

a. eosinophils.
b. lymphocytes.
c. mast cells.
d. neutrophils.

Q4. A 20-year-old male, known case of seasonal allergic rhinitis with pollen, was exposed to pollen while he was on a trip to Islamabad. Which is the most important preformed mediator released on exposure to pollen in this patient?

a. histamine.
b. leukotriene.
c. prostaglandin.
d. thromboxane A.

Q5. A 30-year-old lady came in OPD with complaint of excessive sneezing, watery rhinorrhea and itching from exposure to dust, pollen etc. On anterior rhinoscopy, what are the most typical findings on nasal mucosa in this case?

a. blue and thin mucosa.
b. pale and swollen mucosa.
c. red and congested mucosa.
d. red and thick mucosa.

Q6. Smear was made from the nasal discharge in an 18-year-old female patient who was a known case of allergic rhinitis. Which of the following type of cells are typically present in nasal discharge of this patient?

a. basophils.
b. eosinophils.
c. lymphocytes.
d. mast cells.

Q7. What are the two common clinical types of allergic rhinitis?

a. acute and chronic.
b. seasonal and nonseasonal.
c. with and without eosinophilia.
d. with or without neutrophilia.

Q8. A 35-year-old male patient presented excessive sneezing, watery rhinorrhea and nasal itching from exposure to house dust. Which of the following turbinate will typically appear enlarged on anterior rhinoscopy in this patient?

a. inferior turbinate.
b. middle turbinate.
c. superior turbinate.
d. supreme turbinate.

Q9. What is the eosinophil count in peripheral blood of a 25-year-old, healthy and normal person?

a. 0–3%.
b. 4–6%.
c. 7–10%.
d. 11–20%.

Q10. Peripheral blood was examined in a 28-year-old female, who was diagnosed with allergic rhinitis. Which type of antibody level will be increased in this patient?

a. IgA.
b. IgE.
c. IgG.
d. IgM.

Q11. A 33-year-old male patient came in OPD with some symptoms and was diagnosed with vasomotor rhinitis. What is the other condition, where symptoms are very similar to this disease?

a. allergic fungal sinusitis.
b. allergic rhinitis.
c. chronic rhinosinusitis.
d. rhinitis sicca.

Q12. A 27-year-old female patient came with complaints of early morning sneezing, rhinorrhea and itching. On laboratory investigations, all tests for nasal allergy were negative. Which of the following drug is used to treat such a patient?

a. antidepressant.
b. antihistamine.
c. anti-inflammatory.
d. mast cell stabilizer.

Answers with Explanations

1. a IgE mediated.
2. b.
3. c subsequently causes mast cell degranulation.
4. a so antihistamine is helpful.
5. b sometimes bluish.
6. b high count in nasal smear.
7. b seasonal or perennial.
8. a causes nasal obstruction.
9. b.
10. b as condition is IgE mediated.
11. b.
12. b reduces secretions and sneezing.

CHAPTER

28 Nasal Polyp

- Ethmoidal polypi
  - Pathology
  - Clinical features
  - Investigations
  - Differential diagnosis
  - Treatment
- Antrochoanal polyp
  - Pathology
  - Clinical features
  - Investigations
  - Differential diagnosis
  - Treatment

Nasal polyp is a pedunculated swelling arising from the sinus and nasal mucosa. It is an easily recognizable clinical entity and results from prolapsed mucosal lining of the sinuses. Two distinctive varieties are described:

1. Ethmoidal polypi.
2. Antrochoanal polyp.

ETHMOIDAL POLYPI

This is the most common type and occurs in more than 70% of cases. Although it is a disease of the ethmoidal sinuses, mucosal changes extend farther into the nose and other paranasal sinuses. The maxillary sinuses are affected more than the frontal and sphenoid sinuses. The polyp may arise from the uncinate process, bulla ethmoidalis, ostium of the sinuses and medial surface of the middle turbinate.

Pathology

Debate continues about the exact pathophysiology of the polyp formation, despite much research in this area. Several studies support the idea of development of polyp as a by-product of sinonasal inflammation, where the source of inflammation may be variable or multiple. *Allergy* and *vasomotor imbalance* are the two most common etiological factors in the formation of nasal polypi. Other etiological factors include *allergic fungal sinusitis, chronic rhinosinusitis* and *cystic fibrosis*. All these may contribute to polyp formation but none can be universally incriminated. Nasal polypi are also associated with aspirin hypersensitivity and asthma.

Etiological Factors for Ethmoidal Polypi

- Nasal allergy.
- Vasomotor rhinitis.
- Chronic rhinosinusitis.
- Allergic fungal sinusitis.
- Cystic fibrosis.
- Aspirin hypersensitivity.
- Asthma.

Mucosa is edematous due to collection of extracellular fluid which leads to polypoidal changes. Polypi are initially sessile but soon becomes pedunculated. Ethmoidal polypi are usually multiple, bilateral, pale and whitish in color. It originates from the lining mucosa and each polyp consists of a pedicle, a body and a fundus. On naked eye examination they are soft, smooth and grape like structures, which move on probing and insensitive to touch. On microscopic examination, it is covered with ciliated columnar epithelium and submucosa shows large intercellular spaces filled with serous fluid. There is marked infiltration of the connective tissue and round cells. The covering epithelium may undergo metaplastic changes to transitional and squamous type when exposed to atmosphere.

Clinical Features

Nasal polypi may arise at any time after the age of 2 years but it is unusual to appear before the age of 10 years. If a polypoidal mass is present below the age of 2 years, possibility of a meningocoele or encephalocoele and cystic fibrosis must be borne in mind. Nasal obstruction is often the first presenting symptom, which may be bilateral, continuous and usually complete. Symptoms of nasal allergy like watery rhinorrhea and sneezing are also present. There may be partial or total loss of sense of smell. Headache is often present due to associated sinusitis. Extension of the disease into the orbit may produce proptosis and hypertelorism. Sometimes widening of the nasal bridge or mass protruding from the nostril may be present (Fig. 28.1 and 28.2).

On anterior rhinoscopic examination, nasal polyps are seen which may be multiple, bilateral, smooth, pale and

Fig. 28.1: Bilateral, multiple nasal polypi.

Fig. 28.2: Widening of the nasal bridge with increase in distance between the inner canthi of two eyes due to extensive, bilateral nasal polypi.

glistening grape like structure. On probing they are mobile, pedunculated and insensitive to touch. Nasal patency is reduced or absent on the affected side. Occasionally, the surface of the polyp may be ulcerated, congested and red in color and may mimic in neoplasm. Patient may have a distinctive hyponasal voice when the obstruction is severe (*Rhinolalia Clausa*).

Clinical Features of Ethmoidal Polypi

- Nasal obstruction.
- Symptoms of allergy: rhinorrhea and sneezing.
- Loss of smell.
- Headache.
- Eye changes: proptosis or telecanthus.
- Widening of nasal bridge.
- Presence of bilateral, multiple, pale, grape like polypi in the nasal cavity on anterior rhinoscopy.

Fig. 28.3: CT scan of the nose and PNS in axial view showing bilateral nasal polypi present in the nasal cavities, maxillary sinuses, ethmoidal sinuses and sphenoid sinus.

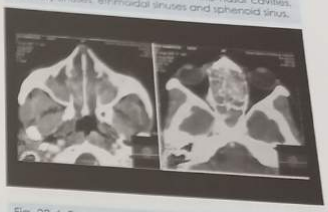


Fig. 28.4: Endoscopic view of left nasal cavity showing grape like polypi.

- Reduced nasal patency.
- Rhinolalia clausa.

Investigations

1. *Imaging studies:* Plain X-rays of the paranasal sinuses (Water's view) will show the extent of the disease, especially involvement of the maxillary sinus. CT scan of the nose and PNS in axial, sagittal and coronal planes will provide far more diagnostic information regarding extent of the disease (Fig. 28.3).
2. *Diagnostic nasal endoscopy:* It may be carried out preoperatively to assess the origin and extent of the disease (Fig. 28.4).
3. *Investigations for nasal allergy:* These will be positive in cases of nasal allergy (see chapter 27 for details).
4. *Histopathology:* After surgical removal, polypi are sent for histopathology. If allergic fungal sinusitis is suspected, part of the specimen should be sent in normal saline for fungal stains and fungal culture.

Differential Diagnosis

The condition has to be differentiated from *antrochoanal polyp*, *neoplasia* and *foreign bodies*. Antrochoanal polyp is unilateral and single. Malignancy should be suspected if the polyp is red, fleshy and friable with granular surface especially in old age. Below the age of 2 years, possibility of meningocoele and encephalocoele is more likely. In unilateral cases, *inverted papilloma (Ringert's tumor)* must be differentiated from the polyp. In teenage males with history of recurrent epistaxis and nasal mass, possibility of nasopharyngeal angiofibroma should be ruled out.

Treatment

Early mucosal changes during the development of polyp may revert to normal by antihistamine and topical steroid spray. Most of the cases of ethmoidal polyp need surgery. The aim of surgery in these cases is to remove the polypi and restore favorable environment for proper drainage and ventilation of the paranasal sinuses. There are different procedures or methods for removal of polypi and its selection depends on the severity and extent of the disease, facilities available and recurrence etc.

Now endoscopic sinus surgery is considered as far superior than conventional surgical procedures in cases of ethmoidal polypi. It is a minimally invasive surgery and has gained popularity in the management of sinonasal diseases (see chapter 25). Through the endoscope, nasal polypi can be removed and the ethmoidal air cells along with other involved sinuses are cleared through the nasal route.

The other conventional surgical procedures used to treat ethmoidal polypi are:

1. *Intranasal polypectomy:* When the patient present for the first time, a simple intranasal polypectomy is done (Fig. 28.5) and post operatively allergy is controlled accordingly.
2. *Ethmoidectomy:* Extensive and recurrent polypi needs more radical surgery to clear the ethmoidal sinuses along with other sinuses in the form of ethmoidectomy.

Three types of ethmoidectomy operations are described.

i. *Intranasal ethmoidectomy:* The ethmoidal sinuses are reached through the nose. All the ethmoidal air cells especially the posterior cells cannot be clear through this route.
ii. *Trans-antral ethmoidectomy:* The ethmoidal air cells are reached through the maxillary antrum. This approach is indicated when the maxillary sinus is also affected and filled with polypi. Maxillary sinus is opened by Caldwell luc's approach and the ethmoidal cells are approached through the medial wall of the antrum. Anterior ethmoidal cells are difficult to clear through this approach.
iii. *External ethmoidectomy:* The ethmoidal cells are reached through an external incision medial to the inner canthus of the eye. All the ethmoidal cells may be clear through this approach by displacing the orbit laterally. Because of the obvious scar on the face and advent of endoscopic sinus surgery, external ethmoidectomy is rarely performed now.

Surgical Treatment of Ethmoidal Polypi

- Endoscopic sinus surgery.
- Intranasal polypectomy.
- Ethmoidectomy:
  - Intranasal.
  - Trans-antral.
  - External.

ANTROCHOANAL POLYP

This type of polyp arises from the maxillary antrum and prolapsed through the ostium of the sinus in the middle meatus. Initially, it hangs in the nasal cavity and grows towards the choana; thus it has three parts, *the antral, choanal and nasal*. The antral part is present in the maxillary antrum and attached with other two parts through a thin stalk. The choanal part of the polyp may be seen in the oropharynx where it pushes the soft palate downward and forward (Fig. 28.6). The nasal part is flattened and visible on anterior rhinoscopy.

Fig. 28.5: Multiple ethmoidal polypi after intranasal surgical removal.

Fig. 28.6: Antrochoanal polyp visible in the oropharynx.

Pathology

The etiology of antrochoanal polyp is exactly unknown but it is supposed to be due to sinus infection. Some research workers have suggested that it is a result of faulty development of the maxillary sinus ostium which is always large in these cases. Nasal allergy may contribute in the formation of this polyp.

Antrochoanal polypi are much less common than the ethmoidal polypi. They are more common in males and can occur at any age but mostly before the age of 40. It is mostly unilateral and rarely bilateral. Histologically, a polyp is covered with normal respiratory epithelium. The submucosa is grossly edematous and similar in appearance with the ethmoidal polyp except that there is no eosinophilia.

Clinical Features

The common symptom is a unilateral nasal obstruction but when it is large the choanal part may cause a bilateral nasal obstruction. Anterior nasal discharge is usually present which is mucoid in nature. Voice may become thick and dull due to hyponasality *(Rhinolalia Clausa)*.

On anterior rhinoscopy, the nasal part may be visible as a single, unilateral, pale and glistening polyp (Fig. 28.7). Choanal part if large enough may be visible in the pharynx, pushing the soft palate (Fig. 28.6). In less severe cases the choanal part is visible on posterior rhinoscopic examination.

Fig. 28.7: Single antrochoanal polyp visible on anterior rhinoscopy.

Investigations

1. *Imaging studies:* On plain X-ray of the paranasal sinuses (Water's view) opacification or haziness of the maxillary antrum is seen on the affected side. Plain X-ray of soft tissues in the nasopharynx (lateral view) may show a soft tissue swelling. CT scan of the nose and PNS will show origin and extent of the polyp (Fig. 28.8).
2. *Nasal endoscopy:* It is done to assess the origin and extent of the disease.
3. *Histopathology:* After surgical removal of the polyp, it is sent for a histopathology.

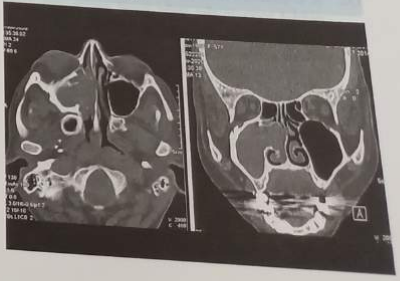
Differential Diagnosis

Antrochoanal polyp has to be differentiated from *hypertrophied inferior turbinate* and other *neoplasia*. Turbinate is attached with the lateral wall, pink, hard to firm and insensitive to touch. Common neoplasm that has to be differentiated is inverted papilloma or nasopharyngeal angiofibroma. Inverted papilloma mostly occurs after the age of 40 years while a nasopharyngeal angiofibroma is common in teenage males and recurrent profuse epistaxis is the usual symptom.

Treatment

Antrochoanal polyp is treated by surgical removal. Now endoscopic sinus surgery is the preferred choice of treatment for an antrochoanal polyp. Conventionally intranasal polypectomy is used in these cases, but complete removal of the polyp from maxillary antrum is difficult by this approach (Fig. 28.9). Polyp is removed by pulling type of snare to remove its antral part as well. If the antral part is not removed during polypectomy, recurrence is common. Recurrent antrochoanal polyp is treated by Caldwell Luc's operation. In young patients where the dentition is not completed, a Caldwell luc's operation is contraindicated and a simple intranasal polypectomy is advised only.

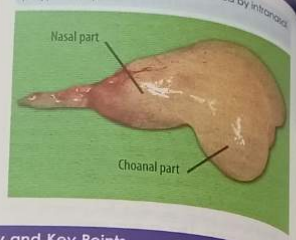
Fig. 28.8: CT scan (Axial and coronal view showing antrochoanal polyp.



Surgical Treatment of Antrochoanal Polyp

- Endoscopic sinus surgery.
- Intranasal polypectomy.
- Caldwell Luc's operation.

Fig. 28.9: Antrochoanal polyp removed by intranasal polypectomy.



Chapter Summary and Key Points

Two distinctive clinical types of nasal polyp are described: the antrochoanal and ethmoidal polypi. Ethmoidal polypi are much more common than the antrochoanal type. Nasal allergy is supposed to be the most common etiological factor in the formation of ethmoidal polypi. Ethmoidal polypi are mostly bilateral and multiple in contrast to antrochoanal type, which is mostly single and unilateral. Antrochoanal polyp arises from the maxillary antrum. Endoscopic sinus surgery is now the preferred method of treatment.

Difficult words

- *Hypertelorism:* abnormal distance between two paired organs.
- *Telecanthus:* Increased distance between medial canthi of the eye. Syn. canthal hypertelorism.

Best Choice Questions

Q1. What is the incidence of ethmoidal polyp among all the cases of nasal polyp?
a. 30%.
b. 50%.
c. 70%.
d. 90%.

Q2. A 45-year-old male patient presented with a polypoidal mass in the right nasal cavity and diagnosed clinically as a case of antrochoanal polyp. Which of the following should be considered in the differential diagnosis in this case?
a. allergic fungal sinusitis.
b. dermoid cyst.
c. inverted papilloma.
d. squamous papilloma.

Q3. A 36-year-old male patient reported a bilateral ethmoidal nasal polypi. He also had history of asthma and hypersensitivity with some drug. Which of the following drug is most likely responsible for this association?
a. aspirin.
b. frusemide.
c. penicillin.
d. quinine.

Q4. Which of the following fungal infection of the nose and paranasal sinuses presents as bilateral multiple nasal polypi?
a. acute fulminant fungal sinusitis.
b. allergic fungal sinusitis.
c. fungal mycetoma.
d. granulomatous invasive fungal sinusitis.

Q5. A 28-year-old female patient presented with extensive bilateral ethmoidal nasal polypi. She was also complaining of some change in her voice. What will be the character of her voice?
a. buccal voice.
b. hoarse voice.
c. hot potato voice.
d. nasal voice.

Q6. A 32-year-old male patient came in OPD with the complaint of bilateral nasal obstruction since many years. On examination he has extensive bilateral nasal polypi, with increase in distance between inner canthi of the two eyes. What is the most relevant first investigation in this patient?
a. biopsy and histopathology.
b. CT scan of the nose and PNS.
c. nasal smear for C/S.
d. X-ray PNS (water's view).

Q7. Surgical treatment was advised to a 36-year-old male patient, who was diagnosed with allergic fungal sinusitis. Which of the following solution will be used to send the specimen for fungal culture after surgery in this patient?
a. formalin solution.
b. glucose solution.
c. normal saline solution.
d. sodium bicarbonate solution.

Q8. A one-year-old boy presented unilateral nasal polyp. Which of the following condition should be excluded before making the diagnosis of a nasal polyp?
a. aplasia of the sinuses.
b. cavernous sinus thrombosis.
c. congenital choanal atresia.
d. meningocoele.

Q9. What is the origin of antrochoanal polyp?
a. ethmoidal sinus.
b. frontal sinus.
c. maxillary sinus.
d. sphenoid sinus.

Answers with Explanations

1. c majority are of this type.
2. c.
3. a triad of nasal polypi, aspirin hypersensitivity and asthma.
4. b type I hypersensitivity to fungus.
5. a nasal resonance is absent.
6. b to find the extent of the disease.
7. c.
8. d may present as a polypoidal mass.
9. c.

CHAPTER

29 Neoplasia of the Nose, Nasopharynx and PNS

- Squamous papilloma
- Transitional cell papilloma
- Osteoma
- Nasopharyngeal angiofibroma
- Nasopharyngeal carcinoma
- Carcinoma of the nose and paranasal sinuses

A wide variety of tumors of different histological types are found in the nasal cavity, paranasal sinuses and postnasal space. Benign tumors in these areas are not uncommon and malignant tumors are rare. The presenting symptomatology of these tumors is much similar and histopathology is essential for diagnosis. The following are the names of common neoplasia of the nose, nasopharynx and paranasal sinuses:

Benign tumors:

- Angiofibroma.
- Squamous papilloma.
- Inverted papilloma.
- Osteoma.
- Chordoma.
- Hemangioma.
- Ossifying fibroma.
- Fibrous dysplasia.
- Ameloblastoma.
- Neurofibroma.
- Meningioma.

Malignant tumors:

- Nasopharyngeal carcinoma.
- Squamous cell carcinoma.
- Adenocarcinoma.
- Adenoid cystic carcinoma.
- Olfactory neuroblastoma.
- Rhabdomyosarcoma.
- Fibrosarcoma.
- Lymphoma.
- Chondrosarcoma.
- Malignant melanoma.

SQUAMOUS PAPILLOMA

Squamous papilloma involving the skin of nasal vestibule and anteroinferior part of the nasal septum is quite common. These lesions are similar to skin warts on other parts of the body. It may be single or multiple, sessile or pedunculated. It is usually treated under local anesthesia by cautery or cryo surgery. After excision, the base of the lesion is cauterized to prevent recurrence.

TRANSITIONAL CELL PAPILLOMA

This is also called *'inverted papilloma'* or *'Ringert's tumor'*. Histologically, the deep invasion of the epithelium into the stroma rather than on the surface is typical of this tumor and that is why it is called an inverted papilloma (Fig. 29.1). There is a male preponderance of 5:1 and may present at any age but found most commonly in fifth decade. It is usually found unilaterally arising from the lateral wall. There is a tendency to undergo malignant change in about 2% to 3% of the cases. Clinically, it presents as red or grayish mass very similar to a nasal polyp. Recurrence after endoscopic or local intranasal removal is very common. Therefore, it is treated by a wide surgical excision through the *lateral rhinotomy* approach or sometimes by medial maxillectomy operation.

Fig. 29.1: Histopathology of inverted papilloma

OSTEOMA

Osteoma is a benign tumor of bony origin. Majority are asymptomatic and do not progress rapidly. Osteoma is often found as an incidental finding in the frontal sinus on X-ray. Surgical excision is indicated when they produce symptoms or show sudden increase in size.

NASOPHARYNGEAL ANGIOFIBROMA

Nasopharyngeal angiofibroma is a benign but locally aggressive tumor. Although it is a rare tumor, it is the most common benign tumor of the nasopharynx. It occurs mostly in adolescent males so is also called a *juvenile angiofibroma*.

Pathology

The usual age of onset is in the second decade. It occurs exclusively in males. The exact etiology of the tumor is unknown but is thought to be a hormonal dependent tumor (male sex hormones). Histologically, an angiofibroma is composed of fibrous connective tissues interspersed with variable proportion of endothelium lined blood spaces. The ratio of fibrous and vascular component may vary. Mostly the vessels are just endothelium lined spaces with no muscle coat. That is why severe bleeding may occur on taking biopsy and surgical removal, as these vessels cannot contract to stop bleeding.

The tissue of origin remains unknown, although various theories have been proposed. The site of origin of the tumor is also a matter of dispute. Previously, it was thought that it arises from the roof or posterior wall of the nasopharynx. Now, it is believed that it arises from the posterior part of lateral wall of the nose close to sphenopalatine foramen. From here the tumor extends into the nasal cavity, nasopharynx, paranasal sinuses and the pterygopalatine fossa.

Nasopharyngeal angiofibroma is a benign tumor but locally it is invasive and destroys the adjoining structures. From the site of its origin near the sphenopalatine foramen the tumors grow in different directions. Anteriorly it extends into the nasal cavity and may invade the paranasal sinuses including the maxillary, ethmoid and sphenoid sinuses. Laterally, it may extend into the pterygopalatine fossa and from there to infra temporal fossa and cheek. It may enter into the orbit through the inferior and superior orbital fissures. It may extend above into the middle and anterior cranial fossa. In middle cranial fossa, it enters through foramen lacerum or through sphenoid sinus. In anterior cranial fossa, it enters through the ethmoidal sinuses or through the cribriform plate. Posteriorly, it extends into the nasopharynx.

Clinical Features

Profuse and recurrent epistaxis is usually the first and most prominent presenting symptom. It is associated with progressive nasal obstruction and hyponasal voice. Due to obstruction of the eustachian tube, conductive hearing loss and middle ear effusion may be present. Extension of tumor in different directions produces other symptoms like facial swelling, proptosis, diplopia, broadening of nasal bridge, palatal bulge and cranial nerve palsies (Fig. 29.3).

On examination in the nose and nasopharynx, a pink or purplish lobulated soft mass is seen (Fig. 29.2). The mass may bleed on touch. Other signs due to extension of tumor in different directions are also visible.

Investigations

Besides baseline hematological and biochemical studies, relevant investigations for angiofibroma are:

1. *Imaging studies:* Plain X-rays of the nasopharynx (lateral view) and paranasal sinuses (occipitomental view) will show the presence of soft tissue mass. CT scan is particularly helpful to find the extent of the tumor. In addition, CT scan with contrast enhancement will show the vascularity of the tumor. Magnetic Resonance Imaging (MRI) is also helpful especially to see extension of soft tissue tumor into the cranium, orbit or infratemporal fossa.

Fig. 29.2: Patient of nasopharyngeal angiofibroma with a mass in the left nasal cavity.

Fig. 29.3: Patient with extensive angiofibroma causing cheek swelling.

2. *Angiography:* Carotid or four-vessel angiography (two carotids and two vertebral) will show the vascular nature of the tumor, it's feeding vessels and extension of the tumor. In addition during angiography, embolization of the feeding vessel can be done pre-operatively to shrink the tumor and reduce bleeding during surgery (Fig. 29.4).
3. *Biopsy:* Biopsy is contraindicated in suspected cases of angiofibroma because it will cause profuse bleeding (as the muscular coat of the vessels is absent). If it is very essential to differentiate from other tumors, biopsy can be done under general anesthesia with all arrangements to control bleeding and facility for blood transfusion. The diagnosis of angiofibroma is generally made using an angiography and CT scan.

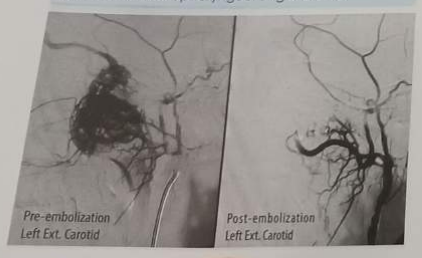
Treatment

Surgical excision of a tumor is the treatment of choice. Various surgical approaches are described depending on the extent and site of the tumor. Usually, more than one approach is required. The various approaches are:

1. Trans-antral.
2. Transpalatal.
3. Trans-mandibular.
4. Lateral rhinotomy.
5. Lateral pharyngeal.
6. Mid facial degloving.
7. Endoscopic (FESS).

Profuse bleeding during surgery is the main problem in removal of nasopharyngeal angiofibroma. Different methods are described to reduce bleeding during surgery. Previously *'external carotid artery ligation'* was employed before surgery to reduce bleeding. Some surgeons have described preoperative *'estrogen therapy'* for three weeks before surgery to reduce the vascularity. Now *'super selective embolization'* is done prior to surgery. In super selective embolization, after angiography, embolization of the different feeding vessels is done (Fig. 29.4). Surgery is performed usually within 24 to 48 hours after embolization.

Fig. 29.4: Pre and post-embolization angiography in a patient with nasopharyngeal angiofibroma.



NASOPHARYNGEAL CARCINOMA

Nasopharyngeal carcinoma has a distinctive epidemiological pattern. Its incidence among the Chinese is about 50 times higher than in other part of the world. It is an uncommon tumor in Pakistan and mainly occurs in people of Mongoloid origin. It is 2 to 3 times more common in males than in females. The incidence begins to rise at the end of second decade and reaches a peak in the fourth decade and then stays at a plateau.

Etiology

The etiology of nasopharyngeal carcinoma is obscure. As mentioned above the incidence is higher in Chinese people even if they migrate to other countries. A susceptible genetic constitution clearly plays a part and some environmental cofactors are equally important. *Epstein Barr Virus (EBV)* is said to be closely associated as a causative factor for nasopharyngeal carcinoma. Besides Epstein Barr Virus, a variety of inhaled and ingested agents have been proposed as the causative factors including cigarette smoking, household smoke, fumes, industrial fumes and chemicals, Chinese herbal medicines and certain metals like arsenic, chromium and nickel. Among ingestant, salted smoked fish has been proposed as an important etiological factor.

Pathology

According to the WHO classification, three histological types are recognized which include *squamous cell carcinoma*, *non-keratinizing carcinoma* and *undifferentiated carcinoma*. All the various grades of squamous cell carcinoma are described. The term *lympho-epithelioma* is used to describe non-keratinizing and undifferentiated nasopharyngeal carcinoma in which numerous lymphocytes are found among the tumor cells. It has no characteristic macroscopic feature. The lesion may appear as ulcerative, infiltrative or proliferative polypoidal in nature. The most common site of origin of these tumors is *'fossa of Rosenmuller'* in the lateral wall of the nasopharynx. From here, they can spread in many directions. Regional lymph node metastasis is very common because of rich lymphatic channels in the nasopharynx.

Clinical Features

Most patients have multiple symptoms, which are insidious in onset. The symptoms are related to *cervical metastasis* (60%), *nose* (40%), *ear* (30%) and *neurological* (20%). It has a higher tendency for early lymphatic spread. The first palpable lymph node involvement occurs in jugulodigastric and upper deep cervical nodes. The nasal symptoms include obstruction, discharge, epistaxis and rhinolalia clausa. The otological symptoms are due to

obstruction of the eustachian tubes and include conductive hearing loss, tinnitus and dizziness. The neurological symptoms are due to extension of tumor, causing involvement of cranial nerves at the base of skull. Any cranial nerve may be involved. The tumor, may directly invade the orbit leading to exopthalmous and blindness. Distant metastasis may occur to the bones, lungs, liver and other sites.

Clinical Features of Nasopharyngeal Carcinoma

- Cervical lymphadenopathy.
- Nasal symptoms: obstruction, discharge, epistaxis, rhinolalia clausa.
- Otologic symptoms: conductive deafness, tinnitus, dizziness, serous otitis media.
- Neurologic symptoms: due to involvement of cranial nerves.
- Distant metastasis.

Investigations

1. *Imaging studies:* Plain X-rays of the nasopharynx, skull base and paranasal sinuses will show the presence of soft tissue mass, its extension and bone erosion. CT scan is very helpful for detecting bone erosion and extension of the tumor. MRI is helpful especially in cases where cranial nerve involvement or intracranial extension of the tumor is suspected.
2. *Biopsy:* Biopsy is essential to find the histopathological diagnosis. In suspected cases of nasopharyngeal carcinoma showing no obvious growth in the nasopharynx, biopsy from the fossa of Rosenmuller can be taken under direct endoscopic view.
3. *Fine Needle Aspiration Cytology (FNAC):* FNAC from the neck swelling is indicated in cases with neck node metastasis.

Treatment

Radiation therapy is the treatment of choice for nasopharyngeal carcinoma. Because of the close proximity to the skull base bones and its early involvement, surgery has no role in these cases. Neck nodes, can be treated by radical or modified radical neck dissection. Chemotherapy has been used to supplement radiotherapy in advance tumors with cervical and distant metastasis.

CARCINOMA OF THE NOSE AND PARANASAL SINUSES

Carcinoma of the nasal cavity and paranasal sinuses is a lethal condition with very poor prognosis. Fortunately, these tumors are rare and constitute less than 1% of all malignancies in the body.

Etiology

Like most of the other malignancies of the body, exact etiology is unknown. A number of factors have been described which are associated with this carcinoma. People working in hard wood furniture industry, nickel refining, leather work and manufacturing of mustard gas have shown higher incidence of carcinoma of the nose and PNS. Adenocarcinoma in the nasal cavity and sinuses are known to be common among wood workers. The particular type of wood also appears to be significant and among it, *African mahogany* being the most dangerous.

Pathology

The most common histological type is the *squamous cell carcinoma*, which is present in about 80% of the cases. Next common type is *adenocarcinoma* followed by *adenoid cystic carcinoma*. The primary site of origin is not always possible to determine because of involvement of other sinuses by the time of first presentation. The majority of these tumors (about 60%) originate from the maxillary antrum, about 30% arise in the nasal cavity and the remaining 10% from the ethmoid sinuses. Primary frontal and sphenoid tumors are very rare.

Palpable cervical lymph node metastasis is present in about 15% of cases at the time of first presentation.

Classification and Stages

For the classification and staging of carcinoma of nose and paranasal sinuses, there is no universally accepted classification. Different research workers have suggested different systems of classifications. Among these, *Ongreen's classification* and Ladderman's classification are most popular. More recent, *American Joint Committee on Cancer (AJCC) classification* is now used more popularly.

Clinical Features

The clinical presentation of each particular case depends on the primary site, the direction and extent of its spread. Carcinoma of the maxillary sinus may remain silent for a long time giving vague symptoms of sinusitis. Nasal cavity tumor occurs with nasal obstruction, nasal discharge (often blood stained) and epistaxis. Ethmoidal tumors initially present with nasal symptoms but later on with orbital symptoms due to extension appear like proptosis, epiphora and diplopia. Late cases of maxillary sinus carcinoma present symptoms depending on its direction of spread and involvement of different structures. Regional nodal metastasis is uncommon and occurs in late stages of the disease. Distant metastasis to other part of the body is also rare.

Investigations

1. *Imaging studies:* Plain X-rays and CT scans are helpful to find out the site of origin, extent of the disease and

bone erosion. Staging of the disease is done on findings of CT scan.

2. *Biopsy:* It is taken for histopathology, if visible growth is present in the nasal cavity. If the tumor is limited to the maxillary antrum, biopsy can be taken by Caldwell Luc's approach but this approach is controversial due to potential danger of tumor spread. In such cases, biopsy through intranasal antrostomy approach is a better choice.

Treatment

There is no wide spread agreement on treatment regimen of this carcinoma. In most centers, a combination of *radiotherapy* and *surgery* is used. Radiotherapy can be given before or after surgery. Surgical procedures include different forms of maxillectomy, ethmoidectomy and lateral rhinotomy for radical clearance of the tumor.

Chapter Summary and Key Points

Benign tumors are more common than malignant in the nose, nasopharynx and paranasal sinuses. Nasopharyngeal angiofibroma is a benign but aggressive tumor which occurs mostly in adolescent males. Biopsy in this case is contraindicated because of profuse bleeding. Surgical removal of this tumor is the treatment of choice. Radiation therapy is the treatment of choice in patients of nasopharyngeal carcinoma. Carcinoma of the nose and paranasal sinuses is particularly prevalent in wood workers. Majority of these tumors originate from the maxillary antrum.

Difficult words

- *Lateral rhinotomy:* It is a surgical approach in which the nasal cavity is approached by opening through an incision given along the lateral aspect of the external nose.
- *Medial Maxillectomy:* It is an enbloc resection of the lateral nasal wall including a bone at the lateral and superolateral aspect of the piriform aperture, medial 30% of the orbital floor and orbital rim together with pars papyracea and lacrimal fossa.

Best Choice Questions

Q1. What is the most common site of origin of a nasopharyngeal angiofibroma?

a. foramen ovale.
b. posterior wall of the nasopharynx.
c. roof of the nasopharynx.
d. sphenopalatine foramen.

Q2. What is the other name for 'inverted papilloma'?

a. antrochoanal polyp.
b. common wart.
c. squamous papilloma.
d. transitional papilloma.

Q3. In which of the following demographic group, an 'inverted papilloma' is most commonly seen?

a. female child.
b. male around puberty.
c. middle age female.
d. old age male.

Q4. In which of the following demographic group, a 'nasopharyngeal angiofibroma' is most commonly seen?

a. middle age female.
b. middle age male.
c. teenage female.
d. teenage male.

Answers with Explanations

1. d.
2. d.
3. d males after 50 years.
4. d exclusively seen in males.

SECTION III

Oral Cavity and Pharynx

Contents

CHAPTER

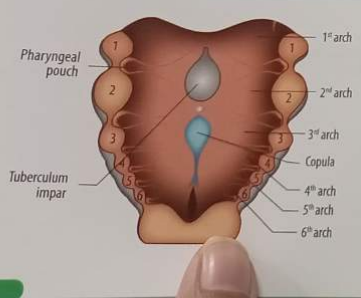
30 Anatomy of the Oral Cavity and Pharynx

- Development
- Anatomy of the oral cavity
- Anatomy of the pharynx
  - Nasopharynx
  - Oropharynx
  - Laryngopharynx (hypopharynx)
  - Walls of the pharynx
  - Tonsils and adenoids

DEVELOPMENT

During the early stages of fetal development, six *pharyngeal arches* appear on the lateral aspect of the head. These mesenchymal arches form ridges and furrows in the overlying ectoderm and endoderm of the pharynx. The ectodermal furrows form the *branchial clefts* while the endodermal furrows form the *pharyngeal pouches* (Fig. 30.1). Each arch has its own nerve supply. The pharynx develops from the anterior end of the *primitive foregut*. At the end of the first fetal month, the foregut ends blindly at the buccopharyngeal membrane. This membrane soon ruptures and the stomodeum (primitive mouth) becomes continuous with the pharynx. *Stomodeum* or primitive mouth is the space, which exists between the frontonasal process above and the first pharyngeal arch below and lateral. The portion of mouth, which originates from the stomodeum, is lined by an ectoderm. The epithelium of the hard palate, cheek, lips, enamel of the teeth, parotid gland and submandibular gland are ectodermal in origin. The buccopharyngeal membrane breaks down so early that it is difficult to say where the ectoderm and endoderm meet.

Fig. 30.1: Pharyngeal arches, pouches and branchial clefts in an embryo.



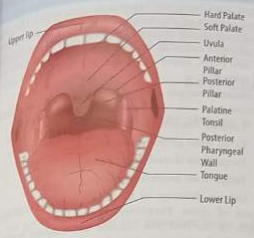
Tongue develops from the tuberculum impar, two lateral tubercles and the hypobranchial eminence. Tuberculum impar fuses with two lateral tubercles to form anterior two-thirds of the tongue. This is from the first pharyngeal arch. The hypobranchial eminence arises from the second and third pharyngeal arch and forms the posterior one-third of the tongue. Between the hypobranchial eminence and the tuberculum impar, there is a median diverticulum, which extends downwards to form the thyroid gland. The obliterated lingual end of the thyroglossal duct forms the foramen caecum. The mandible develops in the first pharyngeal arch from Meckel's cartilage on each side, which fuse anteriorly.

ANATOMY OF THE ORAL CAVITY

Oral cavity extends from lips to the oropharyngeal isthmus and continues posteriorly with the oropharynx (Fig. 30.2). It has the following regions:

1. *Lips:* It forms the anterior boundary of the oral cavity.
2. *Vestibule:* It is the region, which lies outside the teeth and gums. It is formed laterally by the cheek mucosa.
3. *Gums:* This surround the teeth and cover the upper and lower alveolar ridges.
4. *Retromolar trigone:* It is a triangular area of mucosa covering the anterior surface of the ascending ramus of mandible. Through this area, vestibule of the mouth communicates with the oral cavity proper behind the last molar tooth.
5. *Palate:* Hard palate forms the roof of the oral cavity. Soft palate lies in the pharynx and forms a partition between the nasopharynx and the oropharynx.
6. *Floor of the mouth:* It is a crescent shaped area between the lower gums and under surface of the tongue. Opening of the submandibular duct is present in the anterior part on either side of the frenulum.
7. *Tongue:* Anterior two-thirds of the tongue is present in the oral cavity while posterior one-third lies in the

Fig. 30.2: Oral cavity and oropharynx.



oropharynx. Tongue consists of a mass of muscles covered with mucous membrane, which is lined by stratified squamous epithelium.

The muscles of tongue are classified into extrinsic and intrinsic muscles. The extrinsic muscles include genioglossus, hyoglossus, styloglossus and palatoglossus. The intrinsic muscles include superior longitudinal, inferior longitudinal, vertical and transverse muscles.

ANATOMY OF THE PHARYNX

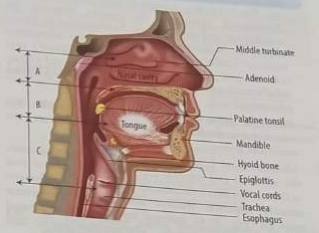
Pharynx is a roughly funnel-shaped fibromuscular tube forming upper part of the air and food passage. In adults, it is about 10 to 12 cms in length and extends from the base of skull to the level of sixth cervical vertebra. It is broadest at its upper end and its lower end is the narrowest part of the whole digestive tract, where it is continuous with the esophagus (Fig. 30.3). The pharynx opens in front, into the nose, mouth and larynx from above downwards and is divided into three parts:

1. Nasopharynx.
2. Oropharynx.
3. Laryngopharynx or hypopharynx.

Nasopharynx

It opens anteriorly into the nasal cavity. It is bounded above by the base of skull and below by the soft palate. The boundaries of nasopharynx are the roof, floor, posterior and lateral walls. Roof is formed by the base of skull while the first cervical vertebra lies behind the posterior wall. Lower opening of the eustachian tube is situated in the lateral wall of the nasopharynx. Nasopharyngeal tonsils or adenoids are situated submucosally at the junction of the roof and posterior wall of the nasopharynx.

Fig. 30.3: Anatomy and relationship of the pharynx: A= nasopharynx; B = oropharynx; C = hypopharynx or laryngopharynx.



Oropharynx

This is middle part of the pharynx and it communicates with the oral cavity anteriorly. Its roof is formed by the soft palate. An imaginary horizontal line at the level of the tip of epiglottis separates the oropharynx from the laryngopharynx. Second and third cervical vertebrae are in posterior relation to the oropharynx. Lateral wall of the oropharynx contains palatine tonsils between the anterior and posterior pillars of the fauces. Posterior third of the tongue forms the lower part of its anterior wall.

Laryngopharynx (Hypopharynx)

It opens anteriorly into the larynx through the sloping laryngeal inlet. Superiorly, it is separated from the oropharynx by an imaginary horizontal line at the tip of the epiglottis. Inferiorly, it is continuous with the esophagus at the level of lower border of cricoid cartilage. 4th, 5th and 6th cervical vertebrae with intervening intervertebral discs and prevertebral muscles are in its posterior relation. Hypopharynx consists of three parts, viz. pyriform fossa, postcricoid region and posterior pharyngeal wall. Laterally on each side pyriform fossae are present, which are two shallow pyramidal shaped fossae bounded laterally by thyroid cartilage and medially by aryepiglottic folds. Valleculae are paired shallow recesses lying between base of the tongue and epiglottis. In the midline, glosso-epiglottic fold separates the two valleculae with each other while laterally, it is bounded by the lateral pharyngo-epiglottic fold. Postcricoid region is the part of hypopharynx, which lies behind the cricoid cartilage.

Walls of the Pharynx

The pharynx is a fibromuscular tube and is made up of four layers:

1. *Mucous membrane:* Mucous membrane lines the whole pharynx. Ciliated columnar epithelium is present in the nasopharynx while oropharynx and hypopharynx are lined by the stratified squamous epithelium. Transitional epithelium is present between the oropharynx and nasopharynx. Subepithelial lymphoid tissues are scattered widely beneath the pharyngeal mucosa. Collectively, they form the *Waldeyer's ring*, consisting of palatine tonsils, adenoids, lingual tonsils, tubal tonsils and other discrete nodules in the posterior pharyngeal wall.
2. *Pharyngeal aponeurosis:* This is an incomplete connective tissue coat in the lateral and posterior wall between the muscular layers.
3. *Muscular layer:* It is made up of two muscular coats, the external and internal layer. External layer or coat is formed by three constrictor muscles of the pharynx namely superior, middle and inferior constrictor muscles (Fig. 30.4). Internal layer or coat is formed by the stylopharyngeus, salpingopharyngeus and palatopharyngeus muscles.
4. *Buccopharyngeal fascia:* This is a thin layer of fascia and covers the outer surface of constrictor muscles of the pharynx.

TONSILS AND ADENOIDS

Tonsils and *adenoids* are the collection of lymphoid tissues situated submucosally in the pharynx and are part of the Waldeyer's ring. Like other lymphoid tissues of the Waldeyer's ring, they only have efferent lymphatic channels but no afferent channels.

Palatine tonsils or more commonly called 'tonsils' are almond shaped masses of the lymphoid tissue lying in the oropharynx, between the anterior and posterior pillars of the fauces. The free medial surface is covered by stratified squamous epithelium with 10 to 15 crypts invaginating from the surface. *Crypta magna* or intra-tonsillar cleft is the largest crypt, lying near upper pole of the tonsil. The deeper lateral surface of the tonsil is covered by a false capsule, which separates it from the superior constrictor muscle of the pharynx called as *'tonsillar bed'* (Fig. 30.5). Each tonsil has two poles, upper and lower and two borders, anterior and posterior.

Arterial supply of the tonsil is from the following arteries:

1. Tonsillar branch of the facial artery.
2. Twigs from greater palatine artery.
3. Twigs from dorsal lingual artery.
4. Twigs from ascending pharyngeal artery.

Venous drainage of the tonsil goes to the pharyngeal plexus of veins. Paratonsillar vein lies along the whole length of its bed just outside the capsule. This is the vein, which causes profuse hemorrhage in tonsillectomy operation.

Lymphatic drainage of the tonsil is into the jugulodigastric lymph node. This node is situated just below and behind the angle of mandible and is popularly known as 'tonsillar lymph node'.

Adenoids are the collection of lymphoid tissues and lies between the roof and upper part of the posterior wall of the nasopharynx. It is a single midline structure, pyramidal in shape. The free surface has no connective tissue capsule as in palatine tonsils. The surface is covered with ciliated columnar epithelium. It is variable in size and regresses after puberty. On palpation, its consistency is like a 'bag of worms'. Its lymphatic drainage is into the retropharyngeal lymph nodes.

Fig. 30.4: Constrictor muscles of the pharynx and its relationship.

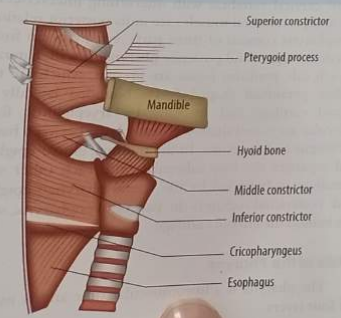
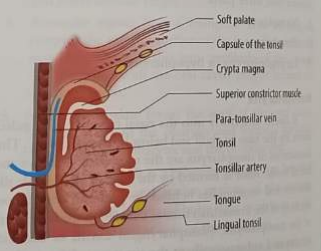


Fig. 30.5: Schematic diagram showing a section through the palatine tonsil.



Chapter Summary and Key Points

Pharynx is divided into three parts, nasopharynx, oropharynx and hypopharynx. It extends from the base of skull to the level of sixth cervical vertebra, where it is continuous with the esophagus. Tonsils and adenoids are collection of the lymphoid tissues in submucosa of the pharynx. Both of these lymphoid tissues have only efferent lymphatic channels and no afferent channels. The efferent channels of the palatine tonsil drain into the jugulodigastric lymph nodes.

Best Choice Questions

Q1. What is the rough shape of the pharynx in an adult male?
a. cubical.
b. cylindrical.
c. funnel shape.
d. pyramidal.

Q2. What is the length of the pharynx in an adult male?
a. 10–12 cms.
b. 13–15 cms.
c. 16–18 cms.
d. 19–21 cms.

Q3. Where is the broadest part of the pharynx in adults?
a. lower end.
b. middle part.
c. near to lower end.
d. upper end.

Q4. What is the level for the lower limit of the pharynx in adults?
a. 5th cervical vertebra.
b. 6th cervical vertebra.
c. 1st thoracic vertebra.
d. 2nd thoracic vertebra.

Q5. Lower end of the eustachian tube opens in the nasopharynx. In which wall of the nasopharynx, this opening is situated?
a. anterior wall.
b. lateral wall.
c. posterior wall.
d. roof.

Q6. Where are the palatine tonsils present?
a. hypopharynx.
b. nasopharynx.
c. oral cavity.
d. oropharynx.

Q7. What is the corresponding level of vertebrae, where hypopharynx lies in a normal adult person?
a. 4th and 5th cervical vertebra.
b. 5th and 6th cervical vertebra.
c. 3rd, 4th and 5th cervical vertebra.
d. 4th, 5th and 6th cervical vertebra.

Q8. In how many parts, hypopharynx is further subdivided in human beings?
a. two parts.
b. three parts.
c. four parts.
d. five parts.

Q9. Which structure forms the medial wall of the pyriform fossa?
a. aryepiglottic fold.
b. arytenoid cartilages.
c. glosso-epiglottic fold.
d. lamina of thyroid cartilage.

Q10. How many layers are present in the wall of the pharynx in adults?
a. two layers.
b. three layers.
c. four layers.
d. five layers.

Q11. What is the rough shape of palatine tonsils in an adult male?
a. almond shaped.
b. lemon shaped.
c. mango shaped.
d. walnut shaped.

Q12. Which of the following artery gives 'Tonsillar artery' to the palatine tonsils?
a. ascending pharyngeal artery.
b. dorsal lingual artery.
c. facial artery.
d. greater palatine artery.

Q13. Which of the following node receives lymphatic drainage from the palatine tonsils?

a. Jugulo omohyoid lymph node.
b. Jugulodigastric lymph node.
c. Supradigastric lymph node.
d. Supraclavicular lymph node.

Q14. How many adenoids are present in a normal child?

a. One.
b. Two.
c. Four.
d. Multiple.

Answers with Explanations

1. c broader end above.
2. a.
3. d funnel-shaped.
4. b lower border.
5. b.
6. d posterior limit of oral cavity is anterior pillar.
7. d.
8. b pyriform fossa, postcricoid area and posterior pharyngeal wall.
9. a.
10. c.
11. a.
12. c.
13. b called tonsillar lymph node.
14. a it is a midline single structure.

Physiology of the Oral Cavity and Pharynx

CHAPTER 31

- Respiration
- Deglutition
- Taste
- Speech
- Salivation
- Protective function of subepithelial lymphoid tissues

Functions of the oral cavity and pharynx are as following:

1. Respiration.
2. Deglutition.
3. Taste.
4. Speech.
5. Salivation.
6. Protective function of subepithelial lymphoid tissues.

RESPIRATION

All three parts of the pharynx take part in the formation of upper respiratory tract. The pharynx lies between the nasal cavity and the larynx and forms the respiratory conduit between these.

DEGLUTITION

After mastication, food is carried to the stomach by an orderly sequence of coordinated movements of muscles of the mouth, pharynx and esophagus. The act of swallowing is divided into three stages. There is no pause or gap between these stages and once the first stage is initiated, the whole act inevitably follows. The three stages are:

1. Oral stage.
2. Pharyngeal stage.
3. Esophageal stage.

Oral stage is the first and *voluntary* stage. Closure of the mouth is associated with cessation of respiration. Contraction of the muscles of floor of mouth occurs which causes elevation of the tongue and pushes it against the palate. This movement causes the food bolus to be pushed backwards into the oropharynx. Soft palate closes the nasopharynx so that food cannot regurgitate into the nose. Palatoglossus muscle also contracts to close the faucial isthmus to prevent any return of food into the oral cavity.

Pharyngeal stage is the second, *involuntary* and *reflex* stage. Food is carried through the oropharynx and hypopharynx into the esophagus. Soft palate is raised to close the nasopharynx. Larynx is also raised and the laryngeal inlet is closed with cessation of respiration. Contraction of the constrictor muscles pushes the food through relaxed cricopharyngeal sphincter.

Esophageal stage is the third and *reflex* stage. Food is carried by peristaltic movement of the muscles of esophagus.

Deglutition is a reflex act, except for the initiation of the first stage. The center is situated in the medulla, close to the vagus nucleus.

TASTE

Taste is one of the important functions of mouth and pharynx. Taste buds are sensory end organs for taste. They are mainly found on the upper surface of tongue but are also scattered on the hard palate, pillars, tonsils, posterior pharyngeal wall, epiglottis and cheek mucosa. The primary taste sensations are sweet, sour, salt and bitter. Umami is now considered as the fifth primary taste sensation and it is usually described as savory or meaty.

Taste sensations from anterior two-thirds of the tongue is carried through the chorda tympani nerve while from posterior one-third of the tongue is carried through the glossopharyngeal nerve.

SPEECH

Articulation of speech and vocal resonance are the two important functions of mouth and pharynx. The mouth and pharynx along with the nose act as resonating cavities, which modify the basic laryngeal sound. The pharynx, soft palate, tongue and lips all play a part in articulation of the various sounds to produce speech.

SALIVATION

Saliva is the secretion of three large paired salivary glands and numerous minor salivary glands. Salivation is a reflex phenomenon and stimulation of the parasympathetic nervous system causes an increase in salivary secretions.

About 1 litre of saliva is secreted in 24 hours in adults. Saliva contains an enzyme *ptyalin*, which causes hydrolysis of starch. It also contains certain bactericidal substances including IgA antibodies. About 70% of the saliva secretion in 24 hours is from the submandibular gland. Parotid gland secretion is stimulated only during food intake.

PROTECTIVE FUNCTION OF SUBEPITHELIAL LYMPHOID TISSUES

The collection of subepithelial lymphoid tissues at the entrance of air and food passage has a protective function against the organisms entering into it. The lymphoid tissues of *Waldeyer's ring* are present at birth, which increases with age until puberty. After puberty, they tend to diminish and regress in size. These lymphoid tissues help in the formation of lymphocytes and antibodies. They also help in acquiring immunity against organisms entering the mouth and nose. These lymphoid tissues also cause localization of infection entering the body through the mouth and nose. They are situated to act as filter at the entrance of air and food passage.

Chapter Summary and Key Points

Respiration and deglutition are two important functions of the pharynx. The nasopharynx is involved in respiration only, hypopharynx in deglutition and oropharynx in both respiration and deglutition. First stage or oral stage of swallowing is voluntary while the next two stages are involuntary. In 24 hours, about one litre of saliva is secreted by the salivary glands. Among this, the submandibular gland is responsible for about 70% of saliva secretion in 24 hours. Parotid gland secretion is serous in nature and stimulated only during food intake.

Best Choice Questions

Q1. In how many stages, the act of swallowing is divided?
a. two stages.
b. three stages.
c. four stages.
d. multiple stages.

Q2. What are the characteristics of oral stage during the act of swallowing?
a. it is first and voluntary stage.
b. it is first and involuntary stage.
c. it is second and voluntary stage.
d. it is second and involuntary stage.

Q3. Where is the center for swallowing reflex situated?
a. medulla.
b. midbrain.
c. pons.
d. thalamus.

Q4. How many primary taste sensations are present in human beings?
a. three.
b. four.
c. five.
d. six.

Q5. Which of the following nerve carries taste sensation from anterior two-third of the tongue?
a. facial nerve.
b. hypoglossal nerve.
c. lingual nerve.
d. vagus nerve.

Q6. What is the amount of secretions from the submandibular gland in 24 hours, in normal adults?
a. 30% of the total salivary secretions.
b. 50% of the total salivary secretions.
c. 70% of the total salivary secretions.
d. 90% of the total salivary secretions.

Answers with Explanations

1. b oral, pharyngeal and esophageal.
2. a only this stage is voluntary.
3. b close to vagus nucleus.
4. b sweet, sour, salt and bitter.
5. a through the chorda tympani nerve.
6. c.

Symptoms of Oral and Pharyngeal Diseases

CHAPTER 32

- Sore throat
- Dysphagia
  - Buccal dysphagia
  - Pharyngeal dysphagia
  - Esophageal dysphagia
- Disturbances of salivation
- Disturbances of taste
- Rhinolalia
- Abnormal appearance
- Trismus
- Mouth ulcer
- Burning sensation in the mouth
- Halitosis
- Feeling of lump in the throat
- Cough
- Bleeding
- Dysarthria
- Foreign bogy
- Nasal regurgitation
- Neck mass or swelling
- Earache and deafness

Patients of oral and pharyngeal disease may present with one or more of the following symptoms:

1. Sore throat or pain in the throat.
2. Dysphagia and odynophagia.
3. Disturbances of salivation.
4. Disturbances of taste.
5. Rhinolalia.
6. Abnormal appearance.
7. Trismus.
8. Mouth ulcer.
9. Burning sensation in the mouth.
10. Halitosis.
11. Feeling of lump in the throat.
12. Cough.
13. Bleeding.
14. Dysarthria.
15. Foreign body.
16. Nasal regurgitation.
17. Neck mass or swelling.
18. Others like fever, earache and deafness.

SORE THROAT

Sore throat is the most common symptom of pharyngeal disease. There is pain, discomfort or sometimes irritation in the throat. Depending on its duration, sore throat may be *acute* or *chronic*. Following are the common causes of sore throat:

1. Acute and chronic tonsillitis. In children, *acute tonsillitis* is the most common cause of sore throat.
2. Acute and chronic pharyngitis. Chronic pharyngitis is the most common cause of chronic sore throat in adults.
3. Quinsy.
4. Pharyngeal diphtheria.
5. Retropharyngeal abscess.
6. Parapharyngeal abscess.
7. Glandular fever.
8. Vincent's angina.
9. Agranulocytosis.
10. Leukemia.
11. Use of tobacco, alcohol and smoking.
12. Acid reflux.
13. Burns and corrosive injury.
14. Foreign body abrasion.
15. Oral and pharyngeal malignancies.
16. Glossopharyngeal neuralgia.

Detailed history about the pain or sore throat should be obtained, including it's:

- Duration.
- Onset.
- Progress.
- Severity.
- Character.
- Aggravating and relieving factors.
- Associated symptoms.
- Effect of deglutition. Pain that occurs during the act of swallowing is called odynophagia.

DYSPHAGIA

Dysphagia means difficulty in swallowing. The act of swallowing is divided into three stages, buccal, pharyngeal and esophageal. Dysphagia may occur in pathology affecting one or more stages of swallowing.

Buccal Dysphagia

Buccal dysphagia results from a lesion, which affects the first phase or buccal phase of swallowing. Diseases of the oral cavity, tongue, palate etc, cause this type of dysphagia. The common causes of buccal dysphagia are as following:

1. Palatal defects e.g. cleft palate, short palate and paralysis.
2. Paralysis of the tongue.
3. Immobility of the tongue e.g. malignancy.
4. Diminished salivation, like radiation mucositis.
5. Oral carcinoma.
6. Submucous fibrosis.

Pharyngeal Dysphagia

When the dysphagia is due to disturbance in the pharyngeal or second phase of swallowing. Common causes of pharyngeal dysphagia are:

1. Enlarged tonsils.
2. Malignancies of the oropharynx.
3. Palatal defects.
4. Paralysis of the constrictor muscles.
5. Pharyngeal web (Plummer-Vinson's syndrome).
6. Parapharyngeal tumors.
7. Globus hystericus. A diagnosis of globus hystericus or psychological dysphagia should be made only after the patient has been fully investigated and organic pathology is excluded.
8. Immobility of the larynx.
9. Ludwig's angina.

Esophageal Dysphagia

When the dysphagia is due to disturbance in the esophageal or third stage of swallowing. Following are the common causes:

1. Strictures and atresia of esophagus.
2. Esophagitis.
3. Achlasia and diffuse spasm of esophagus.
4. Foreign body in the esophagus.
5. Trauma to esophagus e.g. corrosives and instrumentation.
6. Tumors of the esophagus.
7. Extrinsic pressure on the esophagus by mediastinal mass or massive goiter.
8. Hiatus hernia.

The history taking in a patient with the complaint of dysphagia must include:

- Duration.
- Onset.
- Progression.
- Severity and character. Either for solid or liquid food. Dysphagia for solids is mainly because of mechanical obstruction, while dysphagia for liquids is due to neuromuscular disorders like Achlasia cardia.
- Continuous or intermittent.
- Aggravating and relieving factors.
- Associated symptoms.

The choice of investigations in a patient with dysphagia are determined by the clinical findings. Radiological evaluation by X-ray, a barium swallow is important and vital. Endoscopy is mandatory in every case where the diagnosis is in doubt.

Odynophagia

Odynophagia is a symptom when there is pain during swallowing. It occurs due to painful oral and pharyngeal pathologies like ulcers, quinsy, retropharyngeal abscess, acute tonsillitis and epiglottitis etc.

DISTURBANCES OF SALIVATION

The disturbances in salivation may include either decreased or increase salivation.

Xerostomia

It is a condition where there is dryness of the mouth due to reduction in salivary secretions. Xerostomia may cause dysphagia, as the lubricant effect of saliva is lost. The causes of xerostomia may be:

1. Lesions of the salivary glands.
2. Interruption in the central secretory pathway to the salivary glands.
3. Mouth breathing due to nasal obstruction.
4. Radiotherapy.
5. Certain drugs e.g. anticholinergic drugs.
6. Psychiatric disturbances.
7. Sjogren's syndrome.
8. Diabetes mellitus.
9. Renal failure.

Ptyalism

It is a condition when there is excessive flow of saliva. The causes of ptyalism include:

1. Mouth ulcers.
2. Poor oral hygiene.
3. Irritation in the mouth due to ill-fitting dentures.

4. Tumors of the mouth, pharynx and esophagus.
5. Certain drugs.
6. Morning sickness in pregnancy.
7. Psychiatric disturbances.
8. In patients who are unable to swallow their own saliva due to some obstruction, lower down in the pharynx or esophagus. This obstruction in the flow of saliva will lead to drooling of saliva. In true sense, it is not excessive production of the saliva but an obstruction in its flow.

DISTURBANCES OF TASTE

Disturbances of taste include unilateral or bilateral loss of taste, diminished taste or perverted taste. Lesions may be present in the tongue causing loss of taste buds, central taste pathway or the higher center for taste. Common causes of taste disturbances are:

1. Facial nerve paralysis involving the chorda tympani.
2. Ear surgery leading to damage to the facial or chorda tympani nerve.
3. Heavy coating over the tongue.
4. Fungal infection or thrush.
5. Partial or total removal of tongue.
6. Xerostomia.
7. Functional and psychogenic.
8. Lesions of taste center.

RHINOLALIA

Rhinolalia is a condition when there is change in the tonal character of voice due to disturbances in the resonating regions. Two forms are described:

1. Rhinolalia aperta.
2. Rhinolalia clausa.

Rhinolalia Aperta

Rhinolalia aperta, also called *'nasal voice'*, results from incomplete closure of the nasopharyngeal sphincter and leakage of air though the nose. It occurs in:

1. Cleft palate.
2. Short palate.
3. Limited palatal movement due to paralysis.
4. Limited palatal movement due to mechanical impedance.

Rhinolalia Clausa

Rhinolalia clausa also called *'buccal voice'* results from obstructive lesions in the nose and the nasopharynx. There is no nasal resonance in this type because of the obstruction. Patients cannot properly pronounce the letters 'M' and 'N'. Common causes of rhinolalia clausa are:

1. Enlarged adenoids.
2. Common cold.
3. Nasal polypi.
4. Deviated nasal septum.
5. Nasal or nasopharyngeal growth.
6. Choanal atresia.

ABNORMAL APPEARANCE

Patients can see several parts of their own oral cavity and oropharynx in the mirror. A patient may notice an abnormal finding in the oral cavity or oropharynx and consult the physician for this abnormality. This type of abnormality may include any swelling, growth, coating of the tongue, fistula, ulcer, cleft palate, bifid uvula etc.

TRISMUS

Trismus is the inability to open the mouth. There are many causes of trismus. The causes may be in the temporomandibular joint, around the joint, muscles, mandible, oral cavity, oropharynx, external auditory canal or even systemic diseases like tetanus. The important and common causes of trismus in the oral cavity and oropharynx include:

1. Quinsy.
2. Dental abscess.
3. Ulcerative lesions of the mouth.
4. Submucous fibrosis.
5. Trauma and fractures.
6. Oral cancer.

MOUTH ULCER

See chapter 35 for details.

BURNING SENSATION IN THE MOUTH

Burning sensation in the mouth is a very common complaint. It is mostly seen in patients with:

1. Oral submucous fibrosis.
2. Stomatitis.
3. Glossitis.
4. Vitamin deficiencies.
5. Immunological disorders.
6. Excessive use of spicy food or irritants.
7. Geographic tongue or fissured tongue.
8. Mouth ulcers.

HALITOSIS

Halitosis or bad breath from the mouth, if it remains for a long time, is mainly due to some pathology. Bad breath may occur for a brief time after eating some specific type of food. The following are common cause of halitosis:

1. Poor oral or dental hygiene.

2. Dental problems like cavities.
3. Gum pathologies like chronic periodontitis.
4. Dry mouth.
5. Chronic infections in the oral cavity and pharynx like chronic tonsillitis.
6. Constant post-nasal dripping.
7. Chronic illnesses where patient is not taking orally.
8. Gastric Acid Reflux Disease (GERD).
9. Systemic diseases like uncontrolled diabetes.
10. Smoking and use of tobacco.

FEELING OF LUMP IN THE THROAT

Sometimes a patient complains of a lump/something in the throat. It is known as globus pharyngeus or globus hystericus. It is a persistent or intermittent, non-painful sensation of a lump or foreign body in the throat. The following are important causes:

1. Gastro-Esophageal Reflux Disease (GERD).
2. Abnormal upper esophageal sphincter function.
3. Esophageal motor disorder.
4. Hypertrophy of tongue base.
5. Retroverted epiglottis.
6. Post-thyroidectomy.
7. Fear of malignancy.
8. Psychologic factors and stress.

COUGH

Cough is a frequent problem in diseases of the larynx, trachea, bronchus and lungs but it may be present in many diseases of the pharynx. Cough due to a pharyngeal disease is usually dry or non-productive in nature. Following are the common and important causes of cough due to pharyngeal and related diseases:

1. Post-nasal dripping.
2. Allergic pharyngitis.
3. Smoking.
4. Elongated uvula.
5. Mouth breathing.
6. Dry and hot weather.
7. Gastro-Esophageal Reflux Disorder (GERD).
8. Pharyngeal diverticulum.
9. Use of ACE inhibitor drugs.

BLEEDING

Sometimes, the patient may come with the complaint of bleeding from the mouth. The bleeding may be from the oral cavity, gum, oropharynx, hypopharynx or even nose and nasopharynx. Hematemesis is the vomiting out of blood and in most cases, it is from the esophagus or the stomach.

DYSARTHRIA

In *Dysarthria*, there is difficulty in speech articulation. It could be caused by local pathology in the articulation structures or by a pathology anywhere in the neuromuscular bundle or its connection to the higher center or the higher center itself.

FOREIGN BODY

Foreign body impact in the pharynx is quite common. An ingested foreign body may lodge in the tonsil, base of the tongue, vallecula and pyriform fossa. In these places usually, sharp objects like fish bone and needle are impacted. The most common site of impact for an impacted foreign body is at or above the cricopharyngeus sphincter. The site of impact of the foreign body depends mainly on its size and shape. Children are common victims as they have tendency to put different objects in the mouth. These objects may get lodged in the aerodigestive tract while playing. In adults, a foreign body may get lodged accidentally or in psychotic patients by themselves to commit suicide. Common foreign bodies in the pharynx are coins, fish bone, meat bolus, chicken bone, dentures, safety pin and needle etc.

NASAL REGURGITATION

During swallowing, the soft palate closes the naso-pharynx, so the food does not go above. Many conditions can cause nasal regurgitation of the food specially liquids during eating and swallowing. The common causes are:

1. Palatal paralysis.
2. Palatal perforation.
3. Short palate.
4. Cleft palate.
5. Oro-antral fistula.

NECK MASS OR SWELLING

See chapter 54 for details.

EARACHE AND DEAFNESS

The diseases of oral cavity and the oropharynx may cause earache and deafness. Earache mostly results from common sensory innervation (see chapter 3). Deafness is due to disturbance in the eustachian tube function, which results in conductive type of deafness. Common causes are:

1. Cleft palate.
2. Palatal paralysis.
3. Enlarged adenoids.
4. Enlarged tonsils.
5. Recurrent tonsillitis and pharyngitis.

Chapter Summary and Key Points

Sore throat is the most common symptom of pharyngeal disease. In adults, chronic pharyngitis and in children, acute tonsillitis are the common causes. The diagnosis of psychological dysphagia or globus hystericus is made with great caution and only after thorough investigation. Earache may occur due to pathology in the mouth and pharynx and sometimes may be the only symptom.

Best Choice Questions

Q1. A female patient came with the complaint of difficulty in swallowing and the consultant suspected that she has some problem in the pharyngeal phase of swallowing. Which of the following condition is the most likely possibility?

a. achlasia.
b. hiatus hernia.
c. esophageal tumor.
d. Plummer Vinson's syndrome.

Q2. Some surgery was performed on a patient and post-operatively, he complained of loss of taste sensations on the anterior two thirds of the tongue on one side. Which of the following surgery was most likely done on this patient?

a. adenoidectomy.
b. mastoidectomy.
c. parotidectomy.
d. tonsillectomy.

Q3. A child came with the complaint of some change in the character of his voice and his attending physician told him that this is called rhinolalia aperta. Which of the following condition is the most likely possibility for this type of voice change?

a. bilateral nasal polypi.
b. cleft palate.
c. congenital choanal atresia.
d. laryngomalacia.

Answers with Explanations

1. d causes pharyngeal web formation.
2. b injury to chorda tympani nerve.
3. b it causes leakage of air during closure of nasopharynx by the soft palate.

CHAPTER

33 Clinical Examination of the Throat and Neck

- External examination
- Examination of the oral cavity and oropharynx
- Examination of the ulcer
- Indirect laryngoscopy
- Palpation of the oral cavity
- Palpation of the larynx
- Palpation of cervical lymph nodes
- Examination of the swelling
- Inspection
- Palpation
- Auscultation

It includes examination of the oral cavity, pharynx, larynx and the external aspect of neck and face.

EXTERNAL EXAMINATION

Patient is examined by sitting in front of the examiner with proper illumination using a head light or head mirror. External aspect of the following regions are examined:

1. *Lips:* Both upper and lower lips are inspected for any color change, swelling, vesicles, ulcers, crust, scars, cleft lip etc. Each lip has an outer skin lined surface and inner mucosal surface with a vermilion border.
2. *Maxillary region:* Maxillary region is inspected because the diseases involving the upper jaw may have clinical signs on the external aspects. This region is inspected for the condition of skin, color change, swelling etc.
3. *Mandibular region.*
4. *Submandibular region:* This region is inspected especially for any swelling.
5. *Larynx:* External inspection of the larynx is done for signs of inflammation over the skin, swelling, widening of the larynx and change in contour of laryngeal structures. Movement of the larynx during swallowing is also seen. Patient is asked to take a deep breath and stridor is looked for. He is then asked to quickly count the number to assess the voice and air reservoir of the patient. Due to a gap in the glottic closure, there will be an air leak and patient will not be able to count longer. He is then asked to cough to assess the glottic closure and also for any swelling that appears on coughing (laryngocele).
6. *Neck:* Examination of the throat is not complete until the neck is examined by inspection and palpation. At this stage neck is inspected for any swelling and condition of the skin. Patient is asked to swallow to assess any swelling that moves on deglutition. He is also asked to protrude the tongue to assess swelling that moves on tongue protrusion (thyroglossal cyst).

EXAMINATION OF THE ORAL CAVITY AND OROPHARYNX

Patient is asked to open his mouth and oral cavity and oropharynx is then inspected with and without the help of tongue depressor. All regions of the oral cavity and oropharynx are examined serially including cheeks, vestibule, gums, teeth, pillars, tonsils, posterior pharyngeal wall, palate, dorsum of tongue, under surface of tongue and floor of the mouth. Mucosa is inspected for color change, pigmentation, ulceration, vesicles, bullae, fibrosis, raised patches, swelling and growth. Opening of the parotid duct is seen opposite the second upper molar tooth in vestibule of the mouth. Tongue is first inspected in its natural position and then the patient is asked to protrude the tongue and its movement is checked in all directions.

Floor of the mouth and under surface of tongue is examined by asking the patient to elevate the tongue. A tongue depressor may be used for retracting the tongue for examination of floor of the mouth. Floor of the mouth is examined for the opening of the submandibular duct, sublingual folds and frenulum of the tongue. Both the tonsils are inspected for size, symmetry, inflammation, presence of pus in the crypts, ulceration, growth and bulging. Pillars are seen for congestion, which occurs in cases of chronic tonsillitis. Movement of soft palate and uvula are checked by asking the patient to say 'Aaa'. Uvula is a midline structure and its position is checked. Posterior pharyngeal wall is inspected for lymphoid nodules and postnasal dripping.

EXAMINATION OF THE ULCER

An ulcer if present in the oral cavity, face or head and neck region, it should be examined in detail. An ulcer is usually examined by inspection and palpation.

Inspection

Inspection of the ulcer is done for:

- Number: whether one or multiple in number.
- Size of the ulcer.
- Shape of the ulcer like rounded, oval, irregular etc.
- Site of the ulcer is described in detail, where it is situated along with its extension in adjacent areas.
- Margins of the ulcer are examined whether it is slopping, everted, undermined, rolled up or punched out. The typical etiology of the ulcer according to the characteristic margins are as follows (Fig. 33.1):
  - Slopping margin is usually found during healing process of the ulcer.
  - Punched out margin is typically seen in syphilitic or trophic ulcers.
  - Undermined margin is seen in tuberculous ulcer.
  - Rolled up margin is typically seen in basal cell carcinoma.
  - Everted margin is typically present in squamous cell carcinoma.

Fig. 33.1: Different types of margins of the ulcer.

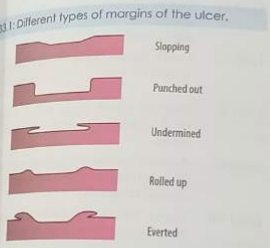
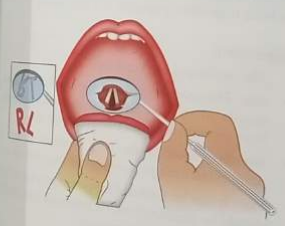


Fig. 33.2: Method of performing indirect laryngoscopy. Inset = showing right and left side relationship.



- Surrounding area of the ulcer for signs of inflammation, color change, edema etc.
- Floor of the ulcer is inspected for color change, presence of slough, bleeding, granulation tissues or discharge etc.

Palpation

Palpation of the ulcer in the oral cavity is done with the help of index finger. The margins, base of the ulcer, deeper tissues and surrounding area are palpated for induration and change in texture of the soft tissues. In addition, tenderness and temperature of the ulcer and surrounding area is also checked.

INDIRECT LARYNGOSCOPY

By *indirect laryngoscopy*, interior of the larynx and hypopharynx is examined indirectly through a mirror. Patient is seated in front and is asked to protrude the tongue. Tongue is held with a gauze piece using the thumb and index finger of the left hand. A laryngeal mirror is first warmed from its mirror surface to prevent fogging and then is held in right hand like a pen with the mirror facing downwards. Patient is asked to breathe through his/her mouth so that the soft palate is elevated to close the nasopharynx. Laryngeal mirror is introduced and held against the soft palate and uvula, which is further pushed upwards and backwards (Fig. 33.2). Interior of the larynx and hypopharynx is examined by tilting the mirror in different directions. Mobility of the vocal cords is checked by asking the patient to say *'Aaa'* and *'Eee'*. Indirect laryngoscopy permits examination of the oropharynx, hypopharynx and larynx. The structures visible through indirect laryngoscopy include base of the tongue, both valleculae, glosso-epiglottic fold, epiglottis, aryepiglottic folds, arytenoids, false vocal cords, true vocal cords, subglottic region, upper few tracheal rings, both pyriform fossae, postcricoid region and posterior pharyngeal wall (Fig. 33.3 and 33.4).

Fig. 33.3: Structures visible through indirect laryngoscopy.

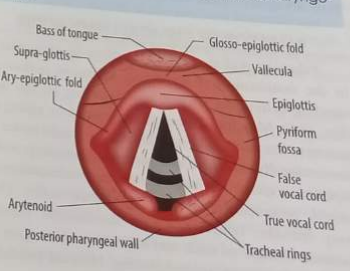


Fig. 33.4: Normal larynx and hypopharynx visible through laryngoscopy.

Fig. 33.5: Method of performing bimanual palpation of the floor of mouth and submandibular region.

PALPATION OF THE ORAL CAVITY

If any pathology like swelling, growth or ulcer is present in the oral cavity, it must be palpated with the index finger. Swelling in the floor of the mouth and submandibular region is palpated bimanually. In bimanual palpation of the right submandibular region, left hand is placed externally, index finger of the right hand is placed inside the mouth under the tongue and the floor of the mouth is palpated (Fig. 33.5). This examination is very important to differentiate between the swelling of the submandibular salivary gland from that of submandibular lymph node. Submandibular lymph node is superficial to the mylohyoid muscle and is difficult to palpate in the floor of mouth.

PALPATION OF THE LARYNX

Larynx is palpated from the outside for laryngeal crepitus and normal contour of laryngeal skeleton. When the larynx is moved from side to side, a grating sensation is felt called *laryngeal crepitus*. This sound is produced by movement of the larynx over the pharynx and prevertebral muscles. Any pathology in the postcricoid region like tumor or foreign body may cause fixation of the larynx and thus laryngeal crepitus will be lost.

PALPATION OF CERVICAL LYMPH NODES

Palpation of all the cervical lymph nodes is mandatory in the examination of the throat. Palpation is done by standing behind the patient, who is sitting on the stool (Fig. 33.6). Muscles of the neck are relaxed by asking the patient to flex and bend his neck. Cervical lymph nodes are conventionally classified into superficial and deep nodes. Superficial group includes submental, submandibular, parotid, postauricular and occipital lymph nodes. Deep group includes lymph nodes in the anterior triangle, posterior triangle of neck and supraclavicular region. In 1981, the Memorial Sloan-Kettering Hospital published *levels* for lymph nodes in the head and neck region, which are now widely used (Fig. 33.7). Levels are as follows:

- Level I: Submental and submandibular group.
- Level II: Upper jugular group include lymph nodes around the upper one-third of internal jugular vein.
- Level III: Middle jugular group includes lymph nodes around the middle one-third of internal jugular vein.
- Level IV: Lower jugular group include lymph nodes around the lower one-third of internal jugular vein.
- Level V: Posterior triangle group include lymph nodes of the posterior triangle and supraclavicular nodes.
- Level VI: Anterior compartment group (visceral group) include lymph nodes surrounding the midline visceral structures.
- Level VII: Upper anterior mediastinal group include lymph nodes below suprasternal notch.

EXAMINATION OF THE SWELLING

If any swelling is present in head and neck region, it should be examined individually. Examination of a swelling includes inspection, palpation and auscultation.

Inspection

The swelling is inspected for:

- Site: The exact location of the swelling is described usually in relation with the anatomical landmarks bony prominences and triangles of the neck.
- Number: Most of the neck swellings are single in number but multiple swellings are also commonly seen.
- Size: It can be estimated approximately but ideally it should be measured with a measuring tape at least in two perpendicular dimensions.

Fig. 33.6: Palpation of the cervical lymph nodes.

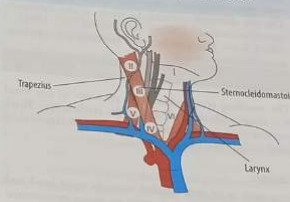
- Shape: The shape of the swelling is usually described as three-dimensional geometrical form like spherical, oval or irregular etc.
- Margins: The margins of the swelling are examined whether it is sharply demarcated or diffuse and regular or irregular.
- Surface: The surface of the swelling is examined whether it is smooth, rough or nodular. The condition of skin overlying the swelling is inspected for color change, pigmentation, scar mark, sinus, opening, discharge and pulsation etc.
- The swelling in the anterior or lateral aspect of neck is checked for movement during deglutition and during tongue protrusion. In addition, patient is asked to cough to observe increase in size of the swelling during coughing.
- Pulsatile: Swelling arising from a vascular tissue or lying over a major artery may appear pulsatile.

Palpation

The swelling is palpated to confirm the observations during inspection regarding size, shape, number, margins and surface of the swelling. In addition, it is palpated for:

- Tenderness: The swelling is pressed gently to elicit tenderness which is observed by seeing the patient's facial expressions.
- Temperature: The temperature of the swelling is assessed by comparing temperature of its surrounding area. This is done by putting the back of the finger tips on the swelling and the skin of the surrounding area.
- Consistency: The consistency of the swelling is assessed by pressing the swelling. A large spectrum of clinical findings from the hard to soft consistency can be found in different cases, but typically three categories are described hard, firm and soft. The hard consistency is usually found in malignancy or bony swelling. The fluid filled cysts are typically soft but sometimes fluid is present under tension giving its consistency firm or sometimes hard. Lipoma is typically soft in consistency. Swelling arising from the lymph nodes because of inflammation are usually firm.
- Fluctuation: It is elicited by putting fingers of both hands on either sides of the swelling and pressing the swelling with one finger and feeling the bounce on the other side finger (Fig. 12.7). If there is fluid in the swelling, it will move on pressing and can be felt on the other side of the swelling. In a large swelling, a fluid thrill can be elicited by tapping the swelling with a finger and feeling the pressure wave on the other side.
- Reducibility: The lump which disappears on pressure and does not appear spontaneously is called a reducible. In neck, a laryngocele appears or increases with coughing, so patient should be asked to cough.
- Compressibility: When the swelling disappears on pressure but again develops spontaneously is called compressible. Vascular tumors and malformations are characteristically compressible.
- Mobility of the swelling. It must be checked in two directions perpendicular to each other. Fixity to the underlying structures is a typical feature of malignancy. Swelling arising from the structure like an artery, vein or nerve is mobile in the direction perpendicular to its course but not mobile in direction along its length. If a swelling is lying superficial to a muscle, its mobility must be checked in both conditions of muscle relaxation and contraction.
- Mobility of the skin over swelling. It is assessed by pinching the skin over the swelling, thus origin of the swelling can be evaluated whether it is deep to skin or arising within the layers of the skin or subcutaneous tissues. Malignant swelling arising deep to the skin and subcutaneous tissue, due to its invasion in the surrounding area, can cause fixity to the skin.
- Transillumination: It should ideally be done in a dark room, with a pencil torch directing light from on

Fig. 33.7: Levels of the cervical lymph nodes.



side of the swelling. A clear fluid containing swelling will glow brilliantly like cyst, cystic hygroma etc. Lipoma although contains fat tissue, is also brilliantly transilluminated. During daytime in the OPD, a rolled X-ray film can be used with torch to perform transillumination test.

Auscultation

The swelling is auscultated for presence of any bruit and it is done with the bell side of the stethoscope. Bruit is present is vascular lesions or swellings with abnormally increased blood flow like goiter.

Percussion:

Percussion is of very limited value in most head and neck swellings, but it is important to assess retrosternal extension of the goiter.

Checklist for Clinical Examination of the Throat

1. Introduce yourself.
2. Explain the procedure.
3. Take appropriate consent.
4. Sit in proper position.
5. Expose the examining part properly.
6. Illuminate the part properly with headlight or head mirror.
7. Begin by external inspection of:
   a. Lips.
   b. Cheek and maxillary region.
   c. Mandibular region.
   d. Submandibular region.
   e. Larynx.
   f. Neck.
8. Ask the patient to open the mouth and inspect all the areas of the oral cavity and oropharynx.
9. Inspect with tongue depressor:
   a. Hold the tongue depressor correctly.
   b. Depress the tongue and inspect oropharynx.
   c. Inspect both vestibules.
   d. Inspect undersurface of the tongue.
   e. Inspect floor of the mouth.
10. Perform indirect laryngoscopy:
    a. Explain the procedure.
    b. Hold the mirror correctly in right hand.
    c. Hold the tongue with a gauze piece by left hand.
    d. Warm the mirror surface.
    e. Check the mirror for temperature.
    f. Reassure the patient that mirror is slightly warm and will not hurt him.
    g. Ask the patient to breathe through his/her mouth.
    h. Introduce the mirror correctly.
    i. Put the mirror on soft palate/uvula and push it upwards.
    j. Record the findings adequately.
11. Palpate the following regions:
    a. Swelling, growth or ulcer in the oral cavity (if present)
    b. Bimanual palpation of the floor of mouth.
    c. Laryngeal crepitus.
    d. Cervical lymph nodes.
12. Examine the swelling (if present)
    a. Inspection.
    b. Palpation.
    c. Auscultation.
13. Rewrap the exposed part and say thanks.

Best Choice Questions

Q1. During clinical posting in ENT OPD, the consultant asked a medical student to examine opening of the parotid duct in a 20-year-old male patient. What is the landmark against which the student will find this opening?

a. first upper molar tooth.
b. first upper premolar tooth.
c. second upper molar tooth.
d. second upper premolar tooth.

Q2. While performing indirect laryngoscopy, the mirror is always warmed before the procedure. What is the reason for this warming?

a. preventing discomfort to the patient.
b. preventing fogging on the mirror.
c. preventing a gag reflex.
d. sterilization of the instrument.

Q3. A medical student was asked to perform indirect laryngoscopy on a 26-year-old male patient. What instructions does the student have to give to the patient during this procedure?

a. breathe through his mouth.
b. breathe through his nose.
c. expire forcefully.
d. hold his breath.

Q4. While performing indirect laryngoscopy, the patient is advised to say 'Eee', for assessing vocal cords mobility. What is the position of vocal cords during this?

a. cadaveric position.
b. fully abducted position.
c. fully adducted position.
d. paramedian position.

Q5. On examination of a 35-year-old lady, laryngeal crepitus was found to be present. What is the most likely possibility in this patient?

a. foreign body in the hypopharynx.
b. fracture of the laryngeal cartilages.
c. normal larynx and hypopharynx.
d. postcricoid tumor.

Q6. During clinical examination of a 60-year-old male patient, he is found to have multiple palpable lymph nodes at level V. Which group of lymph nodes are palpable in this patient?

a. anterior compartment group.
b. lower jugular group.
c. posterior triangle group.
d. submental group.

Answers with Explanations

1. c.
2. b.
3. a so soft palate will go up.
4. c vocal cord closes on speaking and opens on breathing.
5. c normal larynx is mobile and produces crepitus.
6. c lymph nodes of the posterior triangle and supraclavicular region.

CHAPTER 34

Congenital Malformations of the Oral Cavity and Pharynx

- Cleft lip and palate
- Malformations of the tongue
  - Macroglossia
  - Microglossia
  - Aglossia
  - Bifid tongue
  - Tongue tie or ankyloglossia
- Lingual thyroid

CLEFT LIP AND PALATE

Cleft lip or *cleft palate* may occur independently or in combination. Cleft palate results from failure of the palatine processes to fuse with each other and with the nasal septum. It may be partial or complete. Inferior border of the nasal septum may be exposed. Cleft lip results from failure of fusion of the maxillary process with the median nasal process (Fig. 34.1). It may be unilateral or bilateral and complete or partial. Cleft lip may be associated with the cleft palate.

Signs and symptoms produced by the cleft lip and cleft palate depend on the degree of the cleft. In minor degrees of cleft, no symptoms are produced and patient may present with cosmetic problems. In severe degrees of cleft palate, regurgitation of food occurs into the nose. Eustachian tube dysfunction may occur as a result of cleft palate, which leads to ear symptoms. Treatment of cleft lip and palate is reconstructive surgery.

MALFORMATIONS OF THE TONGUE

A number of congenital malformations occur in the tongue related with its size and shape. It includes:

Macroglossia

The tongue is bigger in size. This may occur in acromegaly, cretinism and due to lymphangioma of the tongue.

Microglossia

The tongue is smaller in size.

Aglossia

There is complete absence of the tongue. This condition is extremely rare.

Bifid Tongue

It occurs due to failure of fusion of the two lateral tubercles of the first arch.

Tongue Tie or Ankyloglossia

It is a condition where the tongue is attached to the floor of the mouth by a short frenulum (Fig. 34.2). This results in limitation of the tongue movements and as a result of this speech is affected. The patient is unable to protrude the tip of the tongue beyond the limits of lower incisors. It is treated by surgical division of the short frenulum and freeing the tongue.

Fig. 34.1: Cleft lip.

Fig. 34.2: Tongue tie.

LINGUAL THYROID

Sometimes the median diverticulum fails to descend in the neck and the thyroid gland is formed within the substance of the tongue *(lingual thyroid)*. It may present as a mass in the posterior part of the tongue, which may cause obstruction, dysphagia and sometimes bleeding.

Treatment is surgical excision if these conditions are causing symptoms. Before the removal of any thyroid tissue, it must be determined first that the normal thyroid gland is present and functioning by performing a thyroid function tests and an isotope thyroid scan.

Chapter Summary and Key Points

Congenital malformations of the mouth, pharynx and neck are quite common. Most of the anomalies need surgical treatment. Cleft lip and cleft palate may be present independently or in combined form. In ankyloglossia, if patient is unable to protrude his tongue out of the mouth, it needs surgical excision of the short frenulum, otherwise speech will be affected. Before removal of the lingual thyroid or accessory thyroid, it must be ascertained that the normal thyroid is present and functioning.

Best Choice Questions

Q1. Cleft lip results from failure of fusion of two processes. What are the names of these processes?

a. maxillary process and lateral nasal process.
b. maxillary process and mandibular process.
c. maxillary process and median nasal process.
d. maxillary process and palatine process.

Q2. What is the other name for 'tongue tie'?

a. aglossia.
b. ankyloglossia.
c. macroglossia.
d. microglossia.

Answers

1. c.
2. b.

CHAPTER

35 Stomatitis and Mouth Ulcers

- Herpes simplex
- Herpes zoster
- Herpangina
- Hand, foot and mouth disease
- Candidiasis
- Angular stomatitis
- Vincent's stomatitis
- Tuberculosis
- Syphilis
- Behcet's syndrome
- Aphthous ulcer
- Major aphthae
- Radiation mucositis
- Lichen planus
- Geographic tongue

Stomatitis is a collective name for inflammatory diseases of the oral mucous membrane. Inflammatory lesions of the oral mucosa are produced by a variety of causes, which may be local or systemic. As the skin and mucous membrane are both epithelial surfaces, many diseases of the skin also affect the oral mucous membrane. As a result of inflammation, loss of epithelial tissues may occur and ulcers are formed. Following are the common causes of stomatitis and mouth ulcers:

1. Infections:
   a. Herpes simplex.
   b. Herpes zoster.
   c. Herpangina.
   d. Hand, foot and mouth disease.
   e. Candidiasis.
   f. Vincent's stomatitis.
   g. Tuberculosis.
   h. Syphilis.
2. Traumatic:
   a. Denture stomatitis.
   b. Chemical burn.
   c. Thermal burn.
3. Benign Oral Ulceration:
   a. Aphthous ulcer.
   b. Herpetiform ulcer.
   c. Major aphthae.
4. Immune Disorders:
   a. Behcet's syndrome.
   b. Lichen planus.
   c. AIDS
5. Neoplasms:
   a. Malignant tumors.
6. Skin Disorders:
   a. Bullous pemphegoid.
   b. Lupus erythematosis.
   c. Erythema multiformis.
7. Hematological Disorders.
   a. Anemia.
   b. Leukemia.
   c. Agranulocytosis.
   d. Thrombocytopenic purpura.
   e. Hemophilia and Christmas disease.
8. Endocrine Disorders.
   a. Pituitary dysfunction.
   b. Addison's disease.
   c. Parathyroid dysfunction.
   d. Diabetes.
9. Vitamin Deficiencies:
   a. Folic acid deficiency.
   b. Vitamin B12 deficiency.
   c. Vitamin C deficiency.
10. Allergy:
    a. Lipstick and dental material.
    b. Food allergy.
11. Drugs:
    a. Local: e.g. mouth washes, toothpaste etc.
    b. Systemic.
12. Radiotherapy: Radiation mucositis.

During history taking from a patient with mouth ulcer following point must be specifically asked:

- Duration.
- Onset.
- Progression of the disease
- Painful or not. Many types of ulcers are painful while many are painless. Malignant ulcers and syphilitic ulcers are example of painless ulcers while aphthous ulcers are very painful.
- History of discharge from the ulcer.
- Aggravating and relieving factors in case of recurrent ulceration.
- Associated symptoms and diseases. As mentioned above so many systemic and skin conditions may cause oral ulceration.

HERPES SIMPLEX

Herpes simplex is one of the common causes of acute ulcerations especially in children. Oral lesions are produced due to herpes simplex type-I virus. Small vesicles are distributed singly or in groups over the oral mucous membrane. Ulcers are painful and often associated with vesiculation. Recurrent herpetic infection after primary herpes fever. Recurrent herpetic infection after primary herpes can occur in 30% of cases. The recurrence usually affects the lips (*herpes labialis*) (Fig. 35.1). Topical antiviral agents e.g. acyclovir may be used, but its role is controversial. Systemic use of acyclovir is helpful.

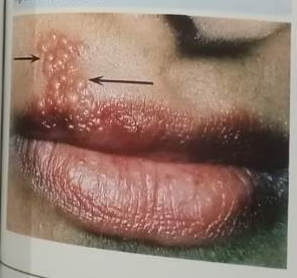
HERPES ZOSTER

The infection is caused by *varicella-zoster virus*. It usually affects the skin of the face in the distribution of the trigeminal nerve. It can also affect the mucosa of the oral cavity. There is a sharp demarcation line in the midline. Enlargement of the cervical lymph nodes is common. Systemic antiviral agent should be started early.

HERPANGINA

It is caused by *Coxsackie's virus*. Children are mostly affected, where multiple small vesicles are present over tonsils, soft palate, uvula and pillars. No specific treatment required.

Fig. 35.1: Herpes labialis.



HAND, FOOT AND MOUTH DISEASE

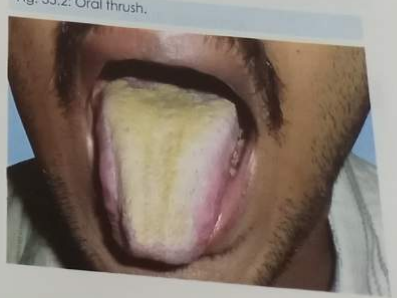
This is caused by 'A strains' of the *Coxsackie's virus*. It is highly contagious, affects children and may occur in epidemics. Ulcers are present in the mouth along with rashes and ulcers on the hands and feet. No specific treatment is required.

CANDIDIASIS

Acute and chronic *candidiasis* is common in the mouth. The most usual infection is acute oral candidiasis, commonly known as *'thrush'* or *'moniliasis'*. It is caused by *candida albicans*. In the mouth soft, creamy yellow, curd like patches are formed on the surface of the mucous membrane (Fig. 35.2). It is mostly seen in debilitated elderly persons, debilitated new born and children, immunocompromised patients, diabetes, HIV infection, chemotherapy, local irradiation and those taking broad spectrum antibiotics or corticosteroids. When these patches are rubbed off, they leave an erythematous mucosa. The diagnosis is made by taking a swab from the oral cavity, which shows presence of fungal hyphae under microscope. This condition is treated by topical antifungal agents. Nystatin in the form of drops or lozenges is prescribed. Local application of gentian violet is also very effective, but has the disadvantage of staining. Topical clotrimazole is also very effective. In resistant cases, systemic antifungal like ketoconazole or fluconazole is used.

In chronic hypertrophic candidiasis, persistent white plaques are present which are very difficult to differentiate from leukoplakia. These chronic lesions cannot be wiped off. Scraping of the lesion will show the presence of fungus when seen under microscope. This is also treated by topical or systemic antifungal agents.

Fig. 35.2: Oral thrush.



ANGULAR STOMATITIS

Angular stomatitis or angular cheilitis is the condition where fissures are present at angle of the mouth (Fig. 35.3). It is mostly seen in vitamin and other nutritional deficiencies, especially riboflavin and other vitamin B complex. It is often associated with oral candidiasis.

Fig. 35.3: Angular stomatitis or angular cheilitis.

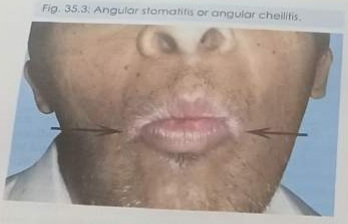


Fig. 35.4: Aphthous ulcer.

VINCENT'S STOMATITIS

This condition is similar to Vincent's angina and involves the interdental papillae and margins of the gingivae (see chapter 36). The causative organisms are the same i.e. double infection with *fusiform bacilli* and *Vincent's spirochetes*. Clinical features and treatment is the same as in Vincent's angina.

TUBERCULOSIS

A primary tuberculous lesion in the oral cavity is extremely rare. However, in advanced pulmonary tuberculosis, lesions may be seen in the mouth especially on the tongue.

SYPHILIS

Syphilitic lesions in the oral cavity may be present in any of the three stages of syphilis. It is also rare nowadays.

BEHCET'S SYNDROME

It consists of a triad including anterior uveitis, genital ulceration and mouth ulcers. The appearance of oral ulcer is very similar to major aphthae.

APHTHOUS ULCER

In this condition, superficial small recurrent ulcers form on the mucosa of the oral cavity. Inner surface of the lips, buccal mucosa, floor of the mouth and soft palate are mostly involved. The underlying cause is not exactly known, but several factors have been suggested. The etiological factors suggested are viral, psychogenic, vitamin deficiency, hormonal and autoimmune disorders. Most of the patients belong to clerical, semiprofessional and professional groups, when period of stress causes exacerbation.

Initially, small vesicles are formed and soon ulceration of the mucosa occurs. The size of ulcer varies from pinhead to 2 to 3 cms. The ulcers have a sloughing base with marked area of hyperemia (Fig. 35.4). These ulcers are painful and recurrence is common.

Treatment of aphthous ulcer includes attention to oral hygiene and its underlying cause. Topical application of steroid paste is very effective. Topical application of local anesthetic agent may bring temporary pain relief. Vitamin or other nutritional deficiency if present, should be corrected by giving supplements.

MAJOR APHTHAE

In *major aphthae*, the ulcers are much larger, upto several centimeters in maximum diameter. These ulcers may persist for a long time upto many months and after resolution, fibrosis may occur. Clinically, this condition may mimic malignant ulcers and it is very difficult to differentiate. In long standing cases, biopsy should be done to exclude malignancy.

RADIATION MUCOSITIS

Radiation therapy in the head and neck region may cause changes in the oral mucosa and the term is called *'radiation mucositis'* (Fig. 35.5). The effects of radiotherapy are direct and indirect. The direct effects include reduction in mitosis and proliferation of the normal cells and some cells may undergo degeneration. The indirect effect is due to damage to the small blood vessels leading to local ischemia. Multiple ulcers may form in the oral cavity. The mouth becomes dry because of the reduction in saliva production. The condition usually improves as the time passes. Treatment includes maintenance of oral hygiene and use of lubricants.

ORAL LICHEN PLANUS

Oral Lichen Planus is a chronic mucocutaneous disorder and it is a T-cell mediated autoimmune disease in which an autotoxic CD8+ cells triggers apoptosis of the oral epithelium. The specific antigen which triggers this reaction is unknown. The lesions in oral lichen planus

Fig. 35.5: Radiation Mucositis. A: Buccal mucosa. B: Hard and soft palate.

Fig. 35.6: Lichen planus of the buccal mucosa.

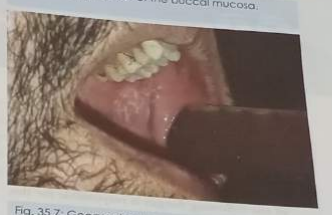


Fig. 35.7: Geographic tongue.

are mostly bilateral, widespread with irregular white lesions or plaques (Fig. 35.6). Sometimes, erythema and superficial ulceration may be present. Most of the oral lichen planus patients are symptomatic with complaint of burning sensation in the mouth. Adult females are more commonly affected with history of other autoimmune disorders. Clinically, typical presentation and appearance is enough for diagnosis but histopathology is required for definite diagnosis and to exclude malignancy. The treatment is mainly medical and symptomatic with topical and sometimes intra-lesional corticosteroid. In recalcitrant lichen planus, immune modulation drugs, antimetabolites and cytotoxic drugs can be used like cyclosporine, azathioprine, methotrexate and dapsone. Predisposing factors like broken or sharp teeth, dental prosthesis etc. should be eliminated. Regular follow-up is required for any malignant change.

GEOGRAPHIC TONGUE

Geographic tongue also known as Benign Migratory Glossitis is a benign condition with unknown etiology and pathogenesis and may occur in up to 3% of the general population. It is mainly asymptomatic but sometimes patients may complain of increased sensitivity to hot and spicy food. The classical presentation is an area of erythema, with atrophy of the filiform papillae of the tongue, surrounded by a serpiginous, white, hyperkeratotic border (Fig. 35.7). Spontaneous resolution of the lesion with return of normal architecture may occur at one place and that may reappear at the other site. This activity may wax and wane over time, and patients are occasionally free of lesions. Diagnosis is mainly clinical and histopathology is rarely required. As most of the patients are asymptomatic, no treatment is required. In symptomatic patients, topical steroids, topical and systemic antihistamines, topical retinoid and cyclosporine can be used.

Chapter Summary and Key Points

Stomatitis and mouth ulcers are produced by a variety of local and systemic causes. In cases of non-healing ulcers, biopsy is essential to rule out malignancy. Specific treatment of individual variety is given, according to the cause in addition to general symptomatic treatment of stomatitis and mouth ulcers.

Best Choice Questions

Q1. A 28-year-old lady came with the history of recurrent herpes simplex infection (herpes labialis) on the upper lip. What is the incidence for this recurrence after a primary herpes?

a. 10% of the total cases.
b. 30% of the total cases.
c. 50% of the total cases.
d. 70% of the total cases.

Q2. A 35-year-old male patient came in the OPD with complaint of creamy yellowish white patch on his tongue for last 5 to 7 days. Which of the following fungus is responsible for this condition?

a. aspergillus albus.
b. aspergillus flavus.
c. candida albicans.
d. mucormycosis.

Q3. A 27-year-old male patient has history of recurrent aphthous ulcers in the oral cavity. What are the characteristic appearance of such ulcers?

a. painless and 1–2 mm.
b. painless and pinhead to 2–3 cms.
c. painful and pinhead to 2–3 cms.
d. painful and pinhead to 2–3 mm.

Q4. What is the other name for an oral thrush?

a. aphthous ulcer.
b. herpengia.
c. major aphthae.
d. moniliasis.

Q5. A 35-year-old man was clinically diagnosed with oral thrush and the patch was rubbed off for examination. What will happen when such a patch is rubbed off?

a. bleeding will occur.
b. it will leave an erythematous mucosa.
c. it will not be removed.
d. underlying mucosa will be normal.

Q6. A 45-year-old male patient came in OPD and was diagnosed with radiation mucositis. What is the etiological factor of this condition?

a. prolonged exposure to sun rays.
b. radiation exposure during plain radiography.
c. radiation exposure during CT scan.
d. radiotherapy in head and neck region.

Answers with Explanations

1. b.
2. c also called moniliasis.
3. c.
4. d.
5. b.
6. d.

Inflammatory Diseases of the Pharynx

CHAPTER 36

- Acute pharyngitis
- Pharyngeal diphtheria
- Vincent's angina
- Infectious mononucleosis
- Cytomegalovirus infection
- Chronic pharyngitis
- Chronic specific pharyngiti
  - Tuberculosis
  - Syphilis
  - Leprosy
  - Others
- Plummer vinson's syndrome

In the pharynx, infection usually occurs in the oropharynx. Nasopharynx may be involved with the infection of nose and sinuses but clinically it is not of much significance as such. The infection of hypopharynx is virtually unknown.

ACUTE PHARYNGITIS

Acute pharyngitis is very common especially in cold climates and is more likely to attack people with lowered resistance. This term is frequently used synonymously with acute tonsillitis. However, in reality, there is a spectrum of conditions, from acute inflammation localized primarily to the tonsils, which is a part of the oropharynx (acute tonsillitis) to generalized inflammation of the entire pharynx (acute pharyngitis). This is usually caused by both *virus and bacteria*. Viruses are more common and often are primary effectors, followed by secondary bacterial infection. Common viruses are adenovirus, rhinovirus and influenza virus. Common bacteria involved are beta hemolytic streptococcus, nonhemolytic streptococcus, pneumococcus and hemophilus influenza. It is also a common prodromal manifestation of measles, scarlet fever, glandular fever, influenza, typhoid and small pox. Local trauma to the pharyngeal mucosa may predispose a person to infection like ingestion of corrosives, abrasions by foreign bodies etc.

Clinical Features

Pharyngitis may occur with varying severity from mild to severe in nature and the clinical features depend on its severity. In mild pharyngitis, there is discomfort in the throat especially on swallowing with low-grade fever and some general malaise. Referred otalgia may be present in an degree of pharyngitis. On examination of the pharynx, there is marked congestion of the pharyngeal mucosa, sometimes with edema of the soft palate (Fig. 36.1). Lymphadenopathy is usually not present in mild cases. In severe cases all the symptoms are more prominent. There is severe pain in the throat with dysphagia and high-grade fever. On examination, there is marked congestion of the pharyngeal mucosa with mucopurulent exudates on it. Enlargement of the lymphoid follicles on the posterior pharyngeal wall may be seen. Edema and congestion of the surrounding area including soft palate, uvula and oral cavity is also seen. Cervical lymphadenopathy is also present. Clinically, it is difficult to differentiate between viral and bacterial pharyngitis. Viral infections are usually mild and accompanied with infection of the nose and paranasal sinuses. Secondary bacterial infection is very common especially in our region.

Clinical Features of Acute Pharyngitis

Mild

- Discomfort in the throat.
- Low grade fever.
- Earache.
- No lymphadenopathy.
- Congestion of pharyngeal mucosa.

Severe

- Pain in the throat: severe.
- Dysphagia.
- Earache.
- High grade fever.
- Cervical lymphadenopathy.
- Malaise, headache.

Investigations

Complete blood picture will show a rise in total white cell count. In bacterial pharyngitis, there will be a marked increase in neutrophils. Culture of a throat swab may isolate the causative organism. Failure to get any bacterial growth suggests a viral etiology.

Fig. 36.1: Acute pharyngitis.

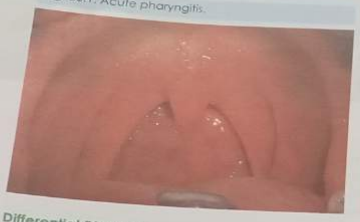


Fig. 36.2: Pharyngeal diphtheria.

Differential Diagnosis

This condition has to be differentiated with other causes of acute sore throat (see chapter 32). Distinction between a viral and bacterial pharyngitis is difficult. Viral infections are common under five years of age, less severe and leukocytosis is not much marked. Acute pharyngeal diphtheria must be excluded. In diphtheria, fever is not high grade but there is marked toxaemia. Throat swab is diagnostic.

Complications

Complications are common, especially in children. There is extension of infection from the pharynx leading to acute otitis media, inflammation of the larynx, Ludwig's angina and lower respiratory tract infection. Generalized complications include septicaemia, nephritis, endocarditis, pericarditis etc., but all are relatively rare.

Treatment

General measures include bed rest, antipyretic, warm saline or antiseptic gargles, soft and liquid diet etc. Antibiotic is given if bacterial infection is suspected. Oral antibiotic against streptococci should be started immediately which can be changed later on after a C/S report is available.

PHARYNGEAL DIPHTHERIA

It is a pharyngeal infection caused by a gram +ve bacillus, *Corynebacterium diphtheriae* or *Klebs-Loeffler bacillus* (KLB). The incidence of diphtheria has fallen markedly due to mass immunization against diphtheria. Diphtheria spreads by droplet infections and the incubation period is two to seven days. Children are particularly affected, especially between the ages of two to five years.

Pathology

Locally on the pharyngeal mucosa, diphtheria bacillus causes necrosis, which results in formation of a false membrane. The color of the membrane is usually grey but it could be white, yellow or dark brown. It is firmly attached to the mucosa and leaves a bleeding surface when removed. After removal of the membrane, it reforms quickly. The diphtheria bacillus also produces a powerful exotoxin, which may cause myocarditis, nephritis and peripheral neuritis.

Clinical Features

Oropharynx including palatine tonsils is commonly affected but the infection may spread to the larynx, nasopharynx and nasal cavity. Patient presents with sore throat and low-grade fever. Toxaemia is marked and the patient looks very ill. On examination, characteristic false membrane will be seen on the tonsils, faucial pillars, soft palate and the posterior pharyngeal wall (Fig. 36.2). Cervical lymph nodes are enlarged and tender, particularly jugulodigastric lymph nodes. Sometimes, cervical lymph nodes enlargement produces a characteristic *'Bull neck appearance'*.

Clinical Features of Pharyngeal Diphtheria

- Sore throat.
- Fever: low grade.
- Severe toxaemia.
- Presence of false membrane.
- Cervical lymphadenopathy.
- Myocarditis, nephritis, neuritis.

Diagnosis

Diagnosis is usually made by the presence of characteristic false membrane. Fever is usually of low grade, not more than 101°F with weak and disproportionately rapid pulse. Throat swab will show the presence of diphtheria bacillus.

Complications

Corynebacterium diphtheriae produces powerful *exotoxins* which are highly toxic to heart and nerves. It causes

myocarditis, cardiac arrhythmia and acute circulatory failure etc. Neurological complications usually appear few weeks after the acute phase and include paralysis of the soft palate, diaphragm and ocular muscles.

Treatment

Diphtheria antitoxin should be started as early as possible to prevent complications produced by the exotoxins. If there is strong suspicion of diphtheria on clinical grounds, antitoxin can be started before the report of throat swab. The dose of antitoxins depends on the severity and inconvenient parts. The dose varies from 20,000 to 120,000 units intramuscularly or intravenously. Systemic penicillin should also be given every 6 hours and in sensitive individual, erythromycin can be used. Larynx may be involved along with the pharynx, leading to respiratory obstruction which may require tracheostomy.

VINCENT'S ANGINA

Vincent's angina is an acute ulcerative lesion, which involves one or both tonsils and may spread to faucial pillars, soft palate and gums. This infection is caused by a gram-ve fusiform bacilli and Vincent's spirochetes. It is often also associated with secondary anaerobic streptococci. More often the disease affects young adults and middle aged persons. Predisposing factors are carious teeth, poor oral hygiene, poor diet and over crowding. This disease was common in troops during World War I *(Trench mouth)*.

Clinical Features

The onset is sudden with marked pain in the throat on the affected side. Swallowing is painful and foul breath is present (foetor oris). There is also high grade fever. On examination, a grey membrane is seen covering the tonsils, which can be removed easily. On removal of membrane, tonsils may show ulceration, which bleeds easily. Cervical lymph nodes especially the tonsillar lymph nodes are enlarged and tender.

Investigations

Throat swab is taken and a smear is prepared which shows presence of fusiform bacilli and Vincent's spirochetes.

Differential Diagnosis

This condition is to be differentiated with other causes of acute sore throat especially pharyngeal diphtheria, acute tonsillitis and quinsy.

Treatment

Treatment includes systemic antibiotics from the penicillin group along with metronidazole. Local antiseptic gargles, analgesics, antipyretic and other supportive treatment should be given.

INFECTIOUS MONONUCLEOSIS

Infectious mononucleosis or *glandular fever* is a systemic infection, which is caused by *Epstein Barr virus*. It is a disease of young adults and rarely seen during childhood. It is transmitted through saliva of the infected individuals or by direct contact of the mouth as occurs in kissing. Incubation period of this disease is usually five to seven weeks. The disease is characterized by an increase in abnormal mononuclear cells in the blood.

Clinical Features

There is a prodromal period of four to seven days with malaise, anorexia, low-grade fever, headache and sore throat of varying severity. The most common manifestation is the enlargement of cervical lymph nodes, which are painful and tender (that is why the condition is called glandular fever). This lymphadenopathy persists for several months. The pharyngeal signs are variable, it is usually congested and superficial ulcers may be present. Spleenomegaly occurs in 50% of cases and hepatomegaly in 10% of cases. Skin rashes sometimes occur especially if ampicillin is mistakenly prescribed for this condition.

Clinical Features of Infectious Mononucleosis

- Prodromal symptoms: 4 to 7 days.
- Cervical lymph nodes enlargement.
- Fever: low grade.
- Sore throat.
- Spleenomegaly.
- Hepatomegaly.
- Skin rashes: if ampicillin is given.

Investigations

1. *Blood picture:* The diagnosis of infectious mononucleosis is confirmed by finding atypically large mononuclear cells in the blood. There is a rise of total white cell count in the blood.
2. *Serological tests: Paul Bunnell test* and *Monospot test* are usually positive in the first week of disease and show the presence of antibodies.

Treatment

There is no specific treatment apart from symptomatic treatment including rest, analgesics, antipyretic and warm saline gargles. Antibiotics play no part in the treatment. Ampicillin is contraindicated in this condition, as it will produce skin rashes. In severe cases, steroids may be given to bring symptomatic relief.

CYTOMEGALOVIRUS INFECTION

This condition is caused by Cytomegalovirus and clinically it is very similar to infectious mononucleosis. It

is more common in immunocompromised patients. It is also diagnosed on a serological test.

CHRONIC PHARYNGITIS

Chronic pharyngitis is a chronic inflammatory condition and is due to chronic infection of the submucosal lymphoid follicles in the posterior pharyngeal wall. There are many causative and contributory factors, which lead to this condition. It is seen in heavy smokers and drinkers. It is very common in people with postnasal dripping due to nasal or sinus diseases. Prolonged exposure to dry and dusty atmosphere and industrial pollution are also important predisposing factors. Infected gums and teeth, and mouth breathing, may also contribute. In addition, it is also very common in patients having Gastroesophageal Reflux Disorder (GERD).

Contributing Factors in Chronic Pharyngitis

- Heavy smoker.
- Excessive alcohol use.
- Postnasal dripping.
- Mouth breathing.
- Gums and teeth infections.
- Dry and dusty atmosphere.
- Industrial pollution.
- Allergy.
- Gastrooesophageal Reflux Disorder (GERD).
- Lowered resistance.

Clinical Types

The following clinical types of chronic nonspecific pharyngitis are recognized:

1. *Catarrhal:* In this type, there is chronic congestion of the pharyngeal mucosa with or without edema. The uvula may appear enlarged and elongated.
2. *Hypertrophic or granular:* There is hypertrophy of the lymphoid follicles present in the posterior pharyngeal wall. Small nodules of lymphoid follicles are scattered all over giving a granular appearance of the posterior pharyngeal wall (*Fig. 36.3*).
3. *Atrophic:* In this type, the pharyngeal mucosa is thin and atrophic and it appears dry with some viscid mucous on its surface. This type is usually associated with atrophic rhinitis.

Clinical Features

There is continuous discomfort or irritation in the throat, which is usually more marked in the morning. There is foreign body sensation in the throat and the patient has a constant desire to swallow or clear his throat. Irritation in the throat causes constant dry hawking cough. Tiring of the voice occ... adily. On examination, features in the pharynx varies with the clinical type. In catarrhal pharyngitis, there is congestion in the posterior pharyngeal wall with engorgement of blood vessels. There is increase mucous production, which may cover the pharyngeal mucosa. In hypertrophic pharyngitis, hyperplasia follicles on the posterior pharyngeal wall are prominent giving a granular appearance. In atrophic pharyngitis, the pharyngeal mucosa appears dry and glazed with thick viscid secretions over it.

Clinical Features of Chronic Pharyngitis

- Irritation and discomfort in the throat.
- Foreign body sensation.
- Dry cough.
- Tiring of voice.
- Local signs depends on the clinical type.

Treatment

The basic treatment of chronic nonspecific pharyngitis is to find the causative factor and to eradicate it. If postnasal dripping is present, the nasal or sinus diseases should be treated accordingly. Local infection in the mouth including the gums and teeth should be treated. Any irritating factor if present, should be eradicated including avoidance of smoking, alcohol, atmospheric pollution, allergy etc. Cold drinks and sour substances should be avoided. Warm saline gargles are advised to relieve discomfort. Rarely in hypertrophied follicles, cautery or cryosurgical removal is advised.

CHRONIC SPECIFIC PHARYNGITIS

Chronic specific pharyngitis are due to specific well-defined pathological entity. It is much less common than chronic nonspecific pharyngitis. Following are the specific chronic inflammations of the pharynx.

Tuberculosis

Primary tuberculosis of the pharynx is rare to manifest clinically. Tonsils and adenoids may be the site of primary tuberculosis but it remains asymptomatic or a long time. Later on, it may lead to tuberculous cervical lymphadenopathy and manifest clinically.

Secondary involvement of the pharynx as a result of primary cavitating pulmonary tuberculosis may occur in some cases. The route of spread is mostly sputogenic when massive Acid-Fast Bacilli (AFB) are present in the sputum. Multiple painful and shallow ulcers are present in the pharynx and oral cavity. The clinical features of secondary pharyngeal involvement are usually masked by the primary pulmonary tuberculosis.

Pharyngeal tuberculosis need no specific treatment. It is treated at the same time with primary pulmonary tuberculosis by antituberculous drug therapy.

Fig. 36.3: Chronic hypertrophic or granular pharyngitis.

Fig. 36.4: X-ray barium swallow showing pharyngeal web formation.

Syphilis

Syphilis of the pharynx is also a very rare disease nowadays. Manifestations in the pharynx may occur in any of the three stages of syphilis i.e. primary, secondary or tertiary.

Leprosy

Leprosy of the pharynx is also very rare. Pharyngeal involvement usually follows the nasal disease. Isolated leprosy of the pharynx does not occur. The diagnosis is made by taking biopsy of the pharyngeal lesion. It is treated in the same way by drug therapy (like dapsone) as leprosy of other parts of the body.

Others

Involvement of the pharynx may occur in other chronic inflammatory diseases, but all are rare. This includes *tuberculosis, toxoplasmosis, malignant granuloma* and *sarcoidosis* etc.

PLUMMER VINSON'S SYNDROME

Other synonyms for this syndrome are *Paterson Brown Kelly's syndrome, sideropenic dysphagia, chronic hypopharyngitis* and *chronic pharyngo-esophagitis*. It is a chronic atrophic type of mucosal inflammation involving the hypopharynx and upper part of the esophagus. This syndrome is characterized by dysphagia, microcytic anemia, angular stomatitis, koilonychia and glossitis.

It is a fairly common condition in our region, especially in rural population. It is mostly seen in females with iron deficiency, poor general health and other nutritional deficiencies.

Pathology

The exact etiology of this condition is unknown. Iron deficiency is probably the basic cause, but other nutritional deficiencies are also supposed to have some effects. Some research workers have suggested an autoimmune basis of this disease.

It is characterized by thinning of mucosa of the upper digestive tract. There is loss of rete pegs and a reduction or absence of glycogens in the cells of the mucosa. Mucosal involvement mostly affects the hypopharynx, upper part of the esophagus, oropharynx, tongue, oral cavity and lips. Along with atrophy of the mucosa, fibrosis in the subepithelial tissue occurs, which may be responsible for web formation. Web formation is characteristically present anteriorly at the pharyngo-esophageal junction. This web formation leads to progressive dysphagia and further nutritional deficiencies. Malignant changes are prone to occur in the hypopharynx.

Clinical Features

The patient presents with progressive dysphagia, which is initially for solid food and later for liquids as well. This may be associated with feeling of 'something in the throat' and sometimes regurgitation of food. On examination, all or some of the features of the syndrome may be present including anemia, koilonychia, fissures at the angle of mouth, superficial glossitis, poor general health etc.

Investigations

1. *Complete blood picture:* Low hemoglobin with hypochromic microcytic anemia will be present. The other features suggestive of malignancy in a solitary nodule on ultrasound are; ill-defined margins, irregular shape, hypo-echogenicity, halo sign, calcification, increased vascularity and invasion to surrounding tissues.
2. *X-ray barium swallow:* Pharyngeal web formation may be seen on X-ray barium swallow (Fig. 36.4).
3. *Endoscopy:* Endoscopic examination of the hypopharynx and esophagus will demonstrate atrophic changes of mucosa and the pharyngeal web.
4. *Biopsy:* Mucosal biopsy is taken in cases where there is suspicion of malignant change in the lesion.

Treatment

The basic treatment of this condition is to correct iron deficiency and other nutritional deficiencies by giving iron and other vitamin supplements. The condition usually improves when these deficiencies are corrected. In cases of web formation, endoscopic excision of the web is done. Long term follow-up is necessary for any malignant changes.

Chapter Summary and Key Points

Acute pharyngitis in most of the cases is primarily due to viruses but secondary, bacterial infection is very common especially in our region. Clinically, it is difficult to differentiate between viral and bacterial infections. The incidence of pharyngeal diphtheria has decreased dramatically because of the mass immunization against diphtheria. In strongly suspected cases of diphtheria, antitoxins can be started even before the report of a throat swab. Ampicillin is contraindicated in cases of infectious mononucleosis.

Chronic pharyngitis is the most common cause of sore throat in adults. Treatment of this condition is directed towards its underlying cause. Specific infections of the pharynx are much less common than nonspecific pharyngitis. Plummer Vinson's syndrome is due to iron deficiency. It is very common is our part of the globe, especially in females of rural areas. This syndrome is a common cause of dysphagia in adult females.

Difficult words

- *Paul Bunnell test and Monospot test:* These are serological tests for detection of antibodies against the virus. These tests are usually positive in the first week of the disease, although around 10% of the patients never develop a positive test.
- *Trench mouth:* It is so called because the disease was very common among the soldiers lying in the trench during World War I, who had lack of facilities for proper oral hygiene and cleaning of eating or drinking utensils.
- *X-ray barium swallow:* A radiopaque dye like barium sulphate is given perorally and radiographs are taken during swallowing phase to localize any abnormal stricture, growth, mucosal irregularity or ulcerations in the pharynx and esophagus.
- *Koilonychia:* A condition where outer surface of the nails become concave, also called as 'spoon nails'.

Best Choice Questions

Q1. A 16-year-old boy presented with acute pharyngitis. What is the most common microorganism responsible for this condition?

a. adeno virus.
b. hemophilus.
c. pneumococcus.
d. streptococcus.

Q2. Complete blood picture was advised in a 20-year-old male patient who presented acute bacterial pharyngitis. What will be the finding on this investigation?

a. decrease in basophil count.
b. decrease in total white cell count.
c. increase in lymphocyte count.
d. increase in neutrophil count.

Q3. A 38-year-old female patient came with the complaint of dysphagia for solid food for last 2 to 3 months. On examination she appeared to be anemic with koilonychia. Blood was sent for hemoglobin and iron studies. Which of the following finding would you expect in this patient?

a. megaloblastic anemia.
b. raised iron binding capacity.
c. raised mean corpuscular hemoglobin.
d. raised serum iron level.

Q4. A 5-year-old boy was brought in ER with complaints of sore throat and fever for last two days. On examination there was a yellowish membrane over the tonsils and oropharynx. His temperature was 100°F and pulse was 140 per minute. Throat swab was sent for microorganisms. Which of the following organism in the report would you expect?

a. beta hemolytic streptococci.
b. gram-ve fusiform bacilli.
c. Klebs Loeffler's bacilli.
d. staphylococcus aureus.

Q5. What is the 'incubation period' for pharyngeal diphtheria?

a. 2 to 7 days.
b. 8 to 12 days.
c. 13 to 16 days.
d. 17 to 25 days.

Q6. What is the age group in which 'pharyngeal diphtheria' is most common?

a. less than 1 year.
b. 2 to 5 years.
c. 6 to 12 years.
d. 15 to 20 years.

Q7. A 4-year-old girl came in ER and clinically suspected to be suffering from pharyngeal diphtheria. What complications can occur if diphtheria antitoxin is not given immediately?

a. myocarditis and muscle paralysis.
b. nephritis and electrolyte imbalance.
c. peripheral neuronitis and deafness.
d. pleural effusion and pneumonia.

Q8. Diagnosis of pharyngeal diphtheria was made in a 6-year-old girl who came with some findings on clinical examination. Which of the following finding is typically suggestive of this condition?

a. high grade fever.
b. cervical lymphadenopathy.
c. membrane over the tonsils.
d. disproportionately rapid pulse.

Q9. A 19-year-old male patient presented cervical lymphadenopathy and sore throat with superficial ulceration in the pharynx. His ENT consultant suspected him to be a case of infectious mononucleosis so Paul Bunnell test and Monospot test were advised. What is the time duration when these tests will become positive?

a. 1st week of the disease.
b. 2nd week of the disease.
c. 3rd week of the disease.
d. 4th week of the disease.

Answers with Explanations

1. a adenovirus, rhinovirus etc.
2. d.
3. b microcytic anemia is present.
4. c other name for gram +ve corynebacterium diphtheriae.
5. a.
6. c school going children.
7. a due to release of powerful exotoxin.
8. d fever is usually low grade with weak and disproportionately rapid pulse.
9. a.

CHAPTER

37 Diseases of the Tonsils

- Acute tonsillitis
- Recurrent or chronic tonsillitis
- Tonsillectomy
  - Indications
  - Contraindications
  - Procedure
  - Post-operative care
  - Complications
- Quinsy

Palatine tonsils are present in the lateral wall of the oropharynx and its inflammation is called *'tonsillitis'*. It is classified into acute, recurrent and chronic tonsillitis.

ACUTE TONSILLITIS

Acute tonsillitis is the acute infection of palatine tonsils. It frequently involves school going children but adults are also affected. It may occur in an epidemic form. In most of the cases viral infection may be primary, which is followed by secondary bacterial infection. *Beta hemolytic streptococcus* is the most common infecting organism, the other being *pneumococci, hemophilus influenzae, M. catarrhalis* and *staphylococci.* Excessive use of cold drinks, ice creams, sour substances and local infections in the nose and paranasal sinuses are common predisposing factors.

Pathology

Depending on the severity and structures of tonsils involved, different clinical forms of acute tonsillitis are recognized:

1. *Acute catarrhal or superficial tonsillitis:* The infection is superficial involving only the covering mucous membrane and the infection is part of generalized pharyngitis.
2. *Acute follicular tonsillitis:* The infection spreads into the tonsils, which are filled with infected fibrin and pus (Fig. 37.1). This leads to the characteristic spotted appearance as opening of the crypts are filled with pus.
3. *Acute parenchymatous tonsillitis:* The infection spreads to the underlying lymphoid tissues and causes increase of the lymphoid follicles. The tonsils are enlarged uniformly.
4. *Acute membranous tonsillitis:* This is a more severe and advanced stage where the exudation from the crypts coalesces giving the appearance of a whitish yellow false membrane on the tonsil (Fig. 37.2).

These types are not always clearly distinct and tend to merge. The infection to the draining cervical lymph node i.e. *jugulodigastric* or tonsillar lymph node occurs, leading to its enlargement and tenderness.

Clinical Features

Clinical features vary with severity of the infection. Sore throat and difficulty or pain during swallowing with fever and malaise are the predominant symptoms. Fever

Fig. 37.1: Acute follicular tonsillitis.

Fig. 37.2: Acute membranous tonsillitis.

is usually high grade and may be associated with chills and rigors. Earache is relatively common which may be referred or due to spread of infection to the middle ear through the eustachian tube. The other constitutional symptoms like bodyache, headache, weakness etc. are also present and may be very marked.

On examination, the tongue may be coated with poor oral hygienic. Signs of inflammation are present over the pillars, tonsils, soft palate and posterior pharyngeal wall. The signs on the tonsils depend on severity and stage of inflammation. In acute follicular tonsillitis, yellow spots on the tonsils are present due to presence of pus in the crypts of crypts. In acute parenchymatous tonsillitis, tonsils are enlarged and congested. In acute membranous tonsillitis, whitish yellow membrane is present over the tonsils, which can be easily wiped off without bleeding.

The jugulodigastric or tonsillar lymph nodes are enlarged, palpable and tender. These lymph nodes are present below and behind the angle of mandible.

Clinical Features of Acute Tonsillitis

- Sore throat.
- Difficulty or pain on swallowing.
- Fever.
- Bodyache, malaise, headache.
- Referred earache.
- Congested and enlarged tonsils and pillars.
- Pus in the crypts or over the tonsils.
- Palpable and tender jugulodigastric lymph nodes.

Differential Diagnosis

Acute tonsillitis must be differentiated from the other causes of acute sore throat. The important causes are:

1. Pharyngeal diphtheria.
2. Vincent's angina.
3. Glandular fever.
4. Quinsy.
5. Retropharyngeal or parapharyngeal abscess.
6. Acute epiglottitis.
7. Scarlet fever.

Treatment

Systemic, appropriate and broad spectrum antibiotics must be started immediately. As most of the infections are due to streptococci, antibiotics like penicillin or erythromycin are the drug of choice. Analgesic and antipyretic like paracetamol is given according to the age of patient. General measures include bed rest, soft diet, proper fluid intake etc. Antiseptic gargle can be given in older children and adults.

Complications

The complications of acute tonsillitis are uncommon nowadays because of effective and broad spectrum antibiotics. Following are the complications and sequelae of acute tonsillitis:

1. *Recurrent or chronic tonsillitis:* Acute attack of tonsillitis may not resolve completely and lead to recurrent or chronic tonsillitis. Infection persists in the lymphoid follicles (core of the tonsils), in the form of small micro-abscesses.
2. *Quinsy:* Quinsy or peritonsillar abscess may occur where the abscess is present in bed of the tonsils outside its capsule.
3. *Retropharyngeal and parapharyngeal abscess:* It occurs due to the spread of infection in retropharyngeal and parapharyngeal space.
4. *Acute otitis media:* It occurs due to spread of infection in the middle ear cleft through the eustachian tube.
5. *Rheumatic fever:* It occurs in tonsillitis due to beta hemolytic streptococcal infection. There may be a latent period of about six weeks. The joints are affected by antibodies produced against the streptococci.
6. *Acute glomerulonephritis:* It also occurs due to cross-reacting antibodies against the streptococci.
7. *Subacute bacterial endocarditis:* It may occur especially in patients with valvular heart disease.
8. *Septicaemia.*
9. *Cervical abscess:* Due to suppuration of jugulodigastric lymph node.

RECURRENT OR CHRONIC TONSILLITIS

Recurrent or *chronic tonsillitis* occurs most commonly as a complication of acute tonsillitis. It is mostly seen in children and young adults. Small micro-abscesses are formed within the core of the tonsils, which are surrounded by fibrous tissues. The microorganisms are present within these micro-abscesses and are not eradicated by antibiotic therapy, as the antibiotic cannot reach in proper concentration. The fibrous tissues surrounding the abscesses are avascular and prevent the antibiotic to reach these abscesses. Whenever the local condition favors these microorganisms to grow, it causes recurrence of clinical symptoms. Chronic infections in the sinuses and teeth may also act as predisposing factors in chronic tonsillitis.

Pathology

Three clinical forms are recognized depending on appearance of the tonsils:

1. *Follicular tonsillitis:* In this type, tonsillar crypts are filled with infected mucopurulent secretions and the surface of tonsils show presence of yellowish spots. It is more commonly seen in adults.

2. *Parenchymatous tonsillitis:* In this type, there is hyperplasia and proliferation of the lymphoid tissues. Tonsils are enlarged in size and sometimes may interfere with speech, swallowing and respiration. This type is more commonly seen in children between the age of 4 and 15 years.
3. *Fibroid tonsillitis:* Due to recurrent or chronic tonsillitis, there is micro-abscesses formation and necrosis within the core of the tonsils. When healing occurs, it is replaced by fibrous tissues so the tonsils appear small, fibrosed and shrunken.

Clinical Features

In recurrent tonsillitis, there are recurrent attacks of sore throat with no symptoms in between the attacks. The frequency of attacks depend on the severity of infection. In chronic tonsillitis, symptoms remain continuous throughout the year with frequent acute exacerbation. During the attack patient has sore throat, pain on swallowing, fever, malaise and bodyache. There may be irritation in the throat with chronic cough, bad taste and foul breath. Jugulodigastric lymph nodes are enlarged, palpable and may be tender. On examination tonsils may show varying degrees of features, depending on the pathological type. In parenchymatous type, tonsils are enlarged and congested while in fibroid type, tonsils are shrunken and smaller in size (Fig. 37.3). Pillars are congested and anterior pillar is specifically involved.

Differential Diagnosis

Chronic tonsillitis is to be differentiated from chronic pharyngitis. In chronic tonsillitis, the pathology is within the tonsils with obvious clinical signs. In chronic pharyngitis, prominent lymphoid follicles may be present in the posterior pharyngeal wall.

Complications

Complications are same as in acute tonsillitis.

Fig. 37.3: Patient of chronic tonsillitis with enlarged tonsils.

Treatment

Treatment during the acute attack is the same as in acute tonsillitis. When the attacks are frequent or the enlarged tonsils interfere with swallowing, speech or respiration, surgical removal of the tonsils is indicated *(tonsillectomy)*.

TONSILLECTOMY

Indications

1. Recurrent tonsillitis: Tonsillectomy is indicated when there are seven attacks in one year or five attacks in a year, for two consecutive years or three attacks in a year for three consecutive years.
2. Chronic tonsillitis: When the symptoms are continuous and not responding to medical treatment.
3. Enlarged tonsils interfering with swallowing, respiration or speech.
4. Quinsy: As peritonsillar abscess may recur, so to prevent its recurrence, tonsillectomy is indicated after one attack of quinsy usually after 4 to 6 weeks.
5. For biopsy: In unilaterally enlarged tonsils and in cases with suspicion of neoplasm, tonsillectomy is done for histopathological examination.
6. After pharyngeal diphtheria, to prevent carrier state.
7. When a complication is present as a result of chronic tonsillitis e.g. rheumatic fever, glomerulonephritis or endocarditis.
8. Tonsillar stones and cysts.
9. As an approach to the structures in its bed like glossopharyngeal nerve and styloid process.

Contraindications

1. During the acute attack or acute respiratory tract infection.
2. Uncontrolled clotting or bleeding disorders.
3. Children under three years of age.

Fig. 37.4: Patient in Rose's position with mouth gag applied.

4. Anemia.
5. Uncontrolled systemic diseases like diabetes mellitus, hypertension, asthma, cardiac and renal diseases.

Procedure

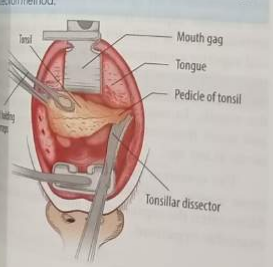
Tonsillectomy is done under general anesthesia with nasal or oral endotracheal intubation. The patient lies supine with head extended by placing sand bag under the shoulder known as *'Rose's position'* (Fig. 37.4). The mouth is opened by a Boyle Davis mouth gag which is suspended by Dingle's suspension rods. Two most popular and widely used methods of tonsillectomy are by *'dissection method'* and *'diathermy method'*. The tonsil is grasped with tonsil holding forceps and pulled medially. An incision is made in the mucous membrane of the tonsil along the anterior pillar with a knife, scissors or diathermy. Tonsil is separated from its bed by tonsillar dissector or by diathermy till the lower pole of the tonsil is reached (Fig. 37.5). Pedicle can be cut by tonsillar snare, diathermy or scissors after applying Vulsellum forceps on its pedicle (Fig. 37.6). Tonsillar bed is checked for any bleeding and procedure is repeated on the other side. Hemostasis in the tonsillar bed is achieved either by coagulation diathermy or tying with silk suture.

There are also other methods for removal of tonsils like, *harmonic scalpel, diode or CO_2 LASER, radiofrequency* (RF), *microdebrider* and *coblation* tonsillectomy.

Methods of Tonsillectomy

- Dissection or cold steel.
- Diathermy.
- Laser: diode, CO_2 etc.
- Harmonic scalpel.
- Radiofrequency ablation.
- Microdebrider or shaver.
- Coblation.

Fig. 37.5: Method of performing tonsillectomy using a dissection method.



Post-operative Care

Patient is kept in lateral position until he is fully conscious and recovered from anesthesia. Patient must be observed for bleeding from mouth. Vital signs including pulse, respiration, BP and temperature are checked at regular interval. The patient is kept NPO (Nothing Per Orally) for four to six hours and after that liquid diet and ice cream are advised. Diet is gradually allowed from soft to solid food. Oral hygiene is maintained by regular mouthwash and gargles with some topical antiseptic solution. Suitable antibiotic and proper analgesic are prescribed for a week or so. Nowadays tonsillectomy is performed on a day care basis and the patient can be discharged from the hospital same day evening. Regular follow-up is required till healing in the tonsillar bed is complete (Fig. 37.7).

Complications

1. *Hemorrhage:* Post tonsillectomy hemorrhage is the most important complication which can be fatal. It is conventionally divided into three types:
   a. Primary.

Fig. 37.6: Removed palatine tonsils after a tonsillectomy.

Fig. 37.7: Tonsillar fossa in a patient, few days after a tonsillectomy.

b. Reactionary.
c. Secondary.

Primary hemorrhage occurs on the operation table after removal of the tonsils. Injury to the paratonsillar vein is a common cause of this type of hemorrhage. It is treated by ligating the bleeder.

Reactionary hemorrhage occurs within 24 hours after the operation. It may either occur either immediately after surgery in the recovery room or in the ward. It occurs because of slipping of the ligature or by elevation of blood pressure when the hypotensive effect of general anesthesia is over. Slipping of the ligature occurs when it is loose and violent efforts like coughing or vomiting predispose its slippage. In cases of severe reactionary hemorrhage, it is treated by taking the patient back to the operation theatre and ligating the bleeder under general anesthesia. In minor degree of reactionary hemorrhage patient may be managed conservatively by keeping under observation for few hours. The bleeding may stop spontaneously, otherwise bleeder should be ligated under general anesthesia.

Secondary hemorrhage may occur after 24 hours till 14 days, when the healing in tonsillar fossa is completed. Usually it occurs on the 5th post-operative day or afterwards. The cause of secondary hemorrhage is infection of the tonsillar bed with sloughing and opening of small blood vessels in its bed. The hemorrhage is usually not profuse and is associated with fever. It is treated by giving proper antibiotics, rest, sedation and observation in the hospital. In severe and profuse secondary hemorrhage not responding to medical treatment, fossa is packed and the pillars are stitched together under general anesthesia and the pack is removed after few days, when the condition is settled.

Post-Tonsillectomy Hemorrhage

Primary
- Occurs on the operation table.
- Treated by ligation.

Reactionary
- Occurs within 24 hours.
- In the recovery room or ward.
- Caused by slippage of ligature, elevation of BP and violent efforts.
- Treated by ligation in the OT.

Secondary
- Occurs usually on 5th post-operative day.
- Occurs after discharge at home.
- Due to infection of the tonsillar bed.
- Treated medically by antibiotics etc.

2. *Injury to oral cavity and pharynx:* Damage to the structures in the mouth and pharynx, including lips, gums, teeth, tongue, palate etc, may occur. Dislocation of the temporomandibular joint may occur by excessive and forceful opening of the mouth after inserting a mouth gag. Dislocation subluxation or injury to the intervertebral joints may occur due to excessive manipulation of the neck. Structures in the tonsillar bed especially the superior constrictor muscle may be injured.
3. *Aspiration of blood:* In cases of hemorrhage, aspiration of blood in the lower respiratory tract may occur as the patient is not fully conscious and the cough reflex is suppressed due to the effects of anesthesia. This complication is prevented by placing the patient in lateral 'coma position'.
4. *Anesthetic complications:* It includes cardiac arrest, atelectasis, cerebral hypoxia etc.
5. *Palatal injury:* Injury to soft palate may occur during surgery, which is followed by fibrosis, scarring, shortening of soft palate and velopharyngeal insufficiency.
6. *Referred earache:* Referred earache is not a complication but usually occurs after a tonsillectomy (see page 12 for details).
7. *Tonsillar remnants:* Tonsillar tissue may be left during surgery due to inadequate removal. This remnant may hypertrophy later on and may lead to recurrent sore throat.

QUINSY

Quinsy or *peritonsillar abscess* is the collection of pus in the peritonsillar space between the capsule of the tonsil and adjacent lateral pharyngeal wall (see Fig. 30.5).

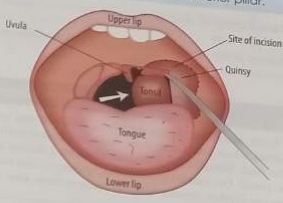
Pathology

Peritonsillar abscess usually follows an acute attack of tonsillitis but rarely it may arise de-novo. The route of infection is probably via a crypt (mostly crypta magna) that reaches or penetrates through the tonsillar capsule. Initially, inflammation is set up in the peritonsillar region outside the tonsillar capsule *(peritonsillitis)*. As the inflammation increases, pus is collected between the tonsillar capsule and superior constrictor muscle *(peritonsillar abscess)*. As the route of infection in majority of the cases is crypta magna, the peritonsillar abscess lies mostly near the upper pole of the tonsils. In majority of the cases, abscess is unilateral and most frequently affects young, adult male but may occur at any age.

The common causative organisms are usually *streptococcus pyogene, staphylococcus aureus* or *anaerobic* organisms. More often the organisms are mixed with both aerobic and anaerobic organisms.

Fig. 37.8: Quinsy or peritonsillar abscess on right side.

Fig. 37.9: Diagram showing the site of incision in quinsy. Horizontal line is drawn along the base of uvula and vertical line along the anterior pillar.



Clinical Features

The onset of symptoms is sudden and may follow an attack of tonsillitis. There is severe pain in the throat, which is unilateral with severe odynophagia. The swallowing may be so painful that patients cannot swallow even his own saliva which dribbles out from the mouth. The patient looks ill and body temperature rises to about 104°F with rigors. Swelling in the throat imparts a thick muffled voice to the voice often called 'hot potato voice'. Trismus occurs due to spasm of the pterygoid muscles and it makes examination of the throat very difficult. Referred earache is very common which is sometimes very severe. Foul breath may be present due to sepsis in the oral cavity, collection of debris and poor oral hygiene.

On examination the tonsils, pillars and soft palate on the involved site are congested and swollen, with a bulge of soft palate and anterior pillar above the tonsils (Fig. 37.8). Uvula is swollen, edematous and pushed to the opposite side but its tip is directed towards the affected side because of reflex spasm of the muscularis uvulae. The affected tonsil is usually hidden by the swelling and may have some mucopus over its surface. The cervical lymph nodes are enlarged, palpable and tender. Without treatment the abscess may burst spontaneously. Other generalized symptoms like malaise, headache, bodyache and nausea may be present.

Clinical Features of Quinsy

- Severe unilateral pain in the throat.
- High grade fever with rigor.
- Odynophagia with dribbling of saliva.
- Thick muffled voice; hot potato voice.
- Trismus.
- Foetor oris.
- Malaise, headache, bodyache.
- Referred earache.
- Swelling or bulge of soft palate and anterior pillar.
- Uvula swollen and pushed to the opposite side.
- Tender and palpable cervical lymph nodes.

Differential Diagnosis

This condition is to be differentiated from acute tonsillitis, parapharyngeal abscess, neoplasms of the tonsils and retropharyngeal abscess.

Treatment

In the early stage of cellulitis (peritonsillitis) conservative medical treatment may cure the infection. Systemic broad spectrum antibiotics through parenteral route should be started immediately. Analgesic and anti-inflammatory drugs are also given along with antiseptic gargle and bed rest.

When a considerable swelling is present or if the pus is pointing, incision and drainage is required. Also when there is no response with conservative treatment within 24 to 48 hours, incision and drainage is done. The patient sits upright and the incision is given at the point of maximum bulge above the upper pole of the tonsil or at the point of junction of two lines, one drawn through the base of uvula and other along the anterior pillar (Fig. 37.9). Incision is given with the help of a guarded knife and then a sinus forcep is inserted to open the abscess. Wide bore needle aspiration can also be tried first.

As the condition may recur in future, tonsillectomy is advised four to six weeks following an acute attack of quinsy *(interval tonsillectomy)*. Some surgeons prefer to do tonsillectomy during the attack of quinsy, instead of doing an incision and drainage *(abscess tonsillectomy* or *hot tonsillectomy)*.

Complications

Complications are rare with advent of effective and broad spectrum antibiotics. It includes:

1. Parapharyngeal abscess: This is the most common complication.
2. Edema of the larynx: It may cause respiratory obstruction and needs tracheostomy.
3. Pneumonia and lung abscess: If spontaneous rupture of the abscess occurs with aspiration of pus in the lower respiratory tract.
4. Septicaemia.
5. Jugular vein thrombosis.
6. Mediastinitis.

Chapter Summary and Key Points

Acute tonsillitis occurs mostly in children and young adults. Tonsillectomy is indicated in recurrent or chronic tonsillitis when attacks are very frequent. Post-tonsillectomy hemorrhage is the most important complication which can be fatal. Tonsillectomy is contraindicated during acute attack. Quinsy is collection of pus outside the fibrous capsule of the tonsil. In contrast to tonsillitis, quinsy occurs mostly in adolescents. Recurrence is common in cases of quinsy, so to prevent further attacks, tonsillectomy is done after single attack of quinsy, usually after four to six weeks.

Difficult words

- *Odynophagia:* Painful swallowing or pain on swallowing.
- *Hot potato voice:* Characteristic voice due to a mass in the oropharynx similar to voice of a person having a piece of hot potato in his mouth and tries to speak at that time.
- *Tonsillar bed:* It is an area of the oropharynx on which the palatine tonsils rest. It is mainly formed by the superior constrictor muscle of the pharynx. Paratonsillar vein runs in the tonsillar bed and is responsible for profuse hemorrhage during tonsillectomy if traumatized.
- *Trismus:* Inability to open the mouth. In quinsy, it is due to spasm of the pterygoid muscles.
- *Foetor oris:* Bad breath or bad smell from the mouth.
- *De novo:* as such.

Best Choice Questions

Q1. A 17-year-old female patient presented acute tonsillitis for last 3 days. What is the most common bacterial microorganism for this condition?

a. hemolytic streptococcus.
b. hemophilus influnzae.
c. moraxella catarrhalis.
d. pneumococcus.

Q2. A 11-year-old boy came with the complaint of pain in the throat and fever. On examination, both tonsils showed congestion with pus in the crypts. What is the most likely diagnosis?

a. acute catarrhal tonsillitis.
b. acute follicular tonsillitis.
c. acute membranous tonsillitis.
d. acute parenchymatous tonsillitis.

Q3. A 9-year-old girl suffered from tonsillitis and as a complication she developed swelling and pain in multiple joints. What is the most likely microorganism responsible for this condition?

a. beta hemolytic streptococcus.
b. hemophilus influenzae.
c. moraxella catarrhalis.
d. staphylococcus aureus.

Q4. A 39-year-old male patient was planned for tonsillectomy to approach a cranial nerve in the tonsillar bed. Which of the following cranial nerve can be approached through this operation?

a. glossopharyngeal nerve.
b. hypoglossal nerve.
c. lingual nerve.
d. vagus nerve.

Q5. A 17-year-old male patient presented right sided peritonsillar abscess and incision and drainage was done in emergency. At time of discharge from the hospital, he was advised for a tonsillectomy after sometime. What is the most appropriate time for tonsillectomy in this patient?

a. two to three weeks.
b. four to six weeks.
c. seven to nine weeks.
d. ten to twelve weeks.

Q6. In which of the following condition 'hot potato voice' is typically seen?

a. cleft palate.
b. enlarged adenoids.
c. peritonsillar abscess.
d. vocal nodules.

Q7. Tonsillectomy was planned for a 10-year-old boy due to recurrent tonsillitis. What should be the position of patient during this surgery?

a. reverse Trendelenberg's position.
b. Rose's position.
c. supine position.
d. Trendelenberg's position.

Q8. A 17-year-old male patient presented severe pain in the right side of the throat with odynophagia, fever, trismus and dribbling of saliva for last 2 days. What is the most likely diagnosis?

a. acute epiglottitis.
b. acute retropharyngeal abscess.
c. acute tonsillitis.
d. peritonsillar abscess.

Answers with Explanations

1. a.
2. b pus in the crypts give spotted appearance.
3. a cross reaction of antibodies.
4. a present deep to tonsillar bed.
5. b.
6. c muffled tone in the voice.
7. b.
8. d.

CHAPTER

38 Adenoids

- Pathology
- Clinical Features
- Investigations
- Differential Diagnosis
- Treatment
- Adenoidectomy
  - Procedure
  - Post-operative Care
  - Complications

Adenoids are enlarged and hypertrophied nasopharyngeal tonsils, sufficient to produce symptoms. Nasopharyngeal tonsil is present in the nasopharynx at the junction of its roof and posterior wall. This is composed of vertical ridges of the lymphoid tissues, separated by deep cleft and covered by ciliated columnar epithelium. It is present at birth, show physiological enlargement and starts to atrophy at puberty. Hypertrophy sufficient to produce symptoms occur most commonly between the ages of three to seven years.

Pathology

Inflammatory changes occur in the nasopharyngeal tonsils as a result of only infection or infection in association with rhinorhinitis, and tonsillitis. Recurrent attacks of sinusitis or tonsillitis may cause chronic adenoid infection leading to its hypertrophy. Allergy of the upper respiratory tract may also contribute to the enlargement of adenoids. The symptoms of adenoids enlargement are produced due to respiratory obstruction and blockage of the eustachian tube.

Clinical Features

Signs and symptoms depend on the relative size of adenoids with that of the nasopharynx. Enlarged adenoids may cause nasal, aural and generalized disturbances.

Nasal Features

Nasal obstruction is the most common symptom and leads to mouth breathing and obstructive sleep apnea. Nasal discharge is also present partly due to obstruction in the drainage of normal secretions into the nasopharynx and partly due to recurrent infections. Epistaxis sometimes may occur during the acute phase of infection. The voice becomes toneless and looses nasal character due to nasal obstruction (buccal voice or *rhinolalia clausa*). Breathing may be noisy with pinched nostrils. Persistent nasal obstruction and mouth breathing leads to characteristic facial appearance called *'adenoid facies'* (Fig. 38.1). The child has open mouth, prominent incisors, pinched nostrils, drooling of saliva and dull expressions. On examination, nasal patency is reduced or absent as checked by holding a cold metal spatula below the nose and estimating nasal airway during respiration. Posterior rhinoscopy if possible, may show enlarged adenoids occupying the nasopharynx.

Aural Features

Aural features develop due to the mass effect of adenoids blocking the eustachian tube opening into the nasopharynx. This leads to conductive deafness with retracted tympanic membrane. Recurrent attacks of acute otitis media may occur due to spread of infection via the eustachian tube. Perforation of tympanic membrane can occur due to accumulation of pus in the middle ear cleft. Non-suppurative fluid may be collected in the middle ear due to eustachian tube blockage (otitis media with effusion).

Generalized Features

Nasal obstruction, mouth breathing and deafness may lead to mental dullness and apathy. Nocturnal enuresis and night terror may occasionally be present mainly because of hypoxia during sleep. There may be lack of development of thorax with flat chest and round shoulders.

Fig. 38.1: Patient with adenoid facies.

Investigations

- *Plain X-ray* of soft tissues of the nasopharynx in lateral view shows the enlarged adenoids with narrowing of the nasopharyngeal airway (Fig. 38.2).
- *Nasal endoscopy* is a useful tool to see and examine the nasopharynx in OPD (Fig. 38.3).

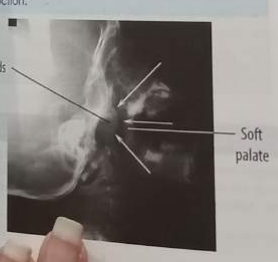
Clinical Features of Enlarged Adenoids

- Nasal, aural and generalized symptoms.
- Nasal obstruction and mouth breathing.
- Nasal discharge.
- Recurrent rhinosinusitis.
- Epistaxis: sometimes.
- Rhinolalia clausa.
- Adenoid facies.
- Conductive deafness.
- Recurrent otalgia.
- Recurrent otitis media.
- Mental dullness and apathy.
- Nocturnal enuresis and night terrors.

Differential Diagnosis

Enlarged adenoids must be differentiated with other causes of nasal obstruction like congenital choanal atresia, deflected nasal septum, foreign body in the nose, nasal polyp and nasal allergy. Some conditions of the oral cavity may predispose to mouth breathing in children like crowded teeth, narrow upper jaw and high arched palate.

Fig. 38.2: X-ray soft tissues nasopharynx (lateral view) showing enlarged adenoids causing an airway obstruction.



Treatment

Medical treatment may be helpful in cases where the symptoms are not marked. This includes use of topical or systemic nasal decongestant and systemic antihistamine if there is any coexistent nasal allergy.

When the symptoms are marked and not relieved by conservative measures, surgical removal of the enlarged adenoids is indicated *(adenoidectomy)*. If otitis media with effusion is present, myringotomy insertion of grommet may be done along with adenoidectomy.

ADENOIDECTOMY

Adenoidectomy is the operation for removal of adenoids. It may be performed alone or combined with tonsillectomy. In such cases, adenoids are removed first followed by a tonsillectomy, which provides more time for hemostasis in the nasopharynx.

Adenoidectomy is indicated in cases of hypertrophied adenoids causing significant symptoms and where symptoms fail to resolve after conservative measures. Contraindications for adenoidectomy are:

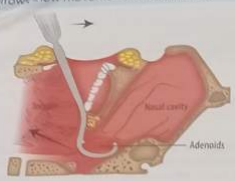
1. During acute upper respiratory tract infection.
2. Bleeding or clotting disorders.
3. Cleft palate.
4. Other medical problems where surgery or anesthesia is contraindicated.

Procedure

Adenoidectomy is done under general anesthesia with oral endotracheal intubation. The patient lies supine with head extended by placing a sand bag under the shoulders (*Rose's position*, see Fig. 37.2). The mouth is opened by inserting a Boyle Davis mouth gag. Adenoids are removed by inserting an adenoid currette through the mouth and with sweeping movement of the currette, adenoids are shaved off (Fig. 38.4 and 38.5). Hemostasis is achieved

Fig. 38.3: Nasal endoscopy showing enlarged adenoids obstructing the choana on right side.

Fig. 38.4: Method of performing adenoidectomy (arrows show movement of the curette).



by packing the nasopharynx for sometime. Bleeders may be coagulated under direct vision by a diathermy if it is visible by retracting the soft palate. Sometimes in profuse hemorrhage or where the bleeder is not visible, the postnasal space is packed for 24 to 48 hours (posterior nasal packing see chapter 26).

Endoscopic adenoidectomy is another method where adenoids are removed using a microdebrider or shaver under vision through nasal endoscope.

Post-operative Care

Patient is kept in lateral position until he is fully conscious and recovered from anesthesia. Patient must be observed for bleeding from the nose or mouth. Vital signs including pulse, respiration, BP and temperature are checked at regular intervals. The patient is kept NPO (Nothing Per Orally) for four six hours and after that liquid diet and ice cream are advised. Diet is gradually allowed from soft to solid food. Oral hygiene is maintained by regular mouthwash and gargles with some topical antiseptic solution. A suitable antibiotic and proper analgesics are prescribed for a week. Adenoidectomy is now performed on a day care basis and the patient is discharged from hospital on the same evening.

Complications

1. *Hemorrhage:* It is one of the important complications and is usually seen in immediate post-operative period. Mouth and nose may be full of blood, but a rising pulse rate is a good indicator of hemorrhage. Minor hemorrhage may stop spontaneously or by giving some coagulant. Profuse hemorrhage after adenoidectomy is infrequent and needs packing of the postnasal space.
2. *Injury to oral cavity and pharynx:* Damage to the structures in the mouth and pharynx may occur including lips, gums, teeth, tongue, palate etc. Excessive opening of the mouth gag may cause dislocation of the temporomandibular joint. Injury to the vertebrae and prevertebral muscles may rarely occur.
3. *Injury to eustachian tube:* Injury to the opening of the eustachian tube may occur during surgery leading to scarring and stenosis of the tube. This may lead to eustachian tube dysfunction and recurrent otitis media.
4. *Palatal injury:* Injury to palate may occur which leads to fibrosis and scarring and as a result velopharyngeal insufficiency may occur.
5. *Complications of general anesthesia:* This includes cardiac arrest and aspiration of blood or mucous leading to lung abscess, pneumonia, atelactasis etc.

Fig. 38.5: Adenoids after surgical removal.

Complications of Adenoidectomy

- Hemorrhage.
- Injury to oral cavity and pharynx.
- Injury to eustachian tube.
- Palatal injury.
- Complications of aesthesia.

Chapter Summary and Key Points

Adenoids are the enlarged and hypertrophied nasopharyngeal tonsils. Enlarged adenoids cause symptoms related to the nose, ear and generalized disturbances. Enlarged adenoids are often associated with chronic tonsillitis. Removal of the adenoids is indicated if it is causing severe symptoms. Adenoidectomy and tonsillectomy can be performed simultaneously.

Difficult words

- *Nocturnal enuresis:* Incontinence of urine during sleep, occurs as a result of smooth muscle relaxation because of hypoxia during sleep.
- *Night Terror:* Horrified bad dreams mainly because of disturbed sleep and hypoxia.

Best Choice Questions

Q1. What is the typical location of the adenoids in normal people?

a. lateral and posterior wall of the oropharynx.
b. lateral wall of the nasopharynx.
c. posterior and lateral wall of the nasopharynx.
d. roof and posterior wall of the nasopharynx.

Q2. What is the most common age group in which patients come with symptoms due to adenoids enlargement?

a. less than one year.
b. one to two years.
c. three to seven years.
d. eight to twelve years.

Q3. What is the most important and common symptom reported by a patient with enlarged adenoids?

a. hyposmia.
b. mouth breathing.
c. otalgia.
d. sore throat.

Q4. Plain X-ray nasopharynx (lateral view) was done on an 8-year-old girl, which showed grossly enlarged adenoids. What will be the typical voice of this patient?

a. buccal voice.
b. hoarse voice.
c. hot potato voice.
d. nasal voice.

Q5. A 7-year-old boy presented bilateral deafness. After evaluation, he was diagnosed with enlarged adenoids. What is the typical type of deafness in this patient?

a. conductive.
b. functional.
c. mixed.
d. sensorineural.

Q6. A 9-year-old boy presented grossly enlarged adenoids and on examination, he also had adenoid facies. Which of the following is a typical feature of such condition?

a. open mouth.
b. pooling of saliva.
c. prominent molars.
d. wide open nostrils.

Q7. A 7-year-old girl was diagnosed with enlarged adenoids with bilateral otitis media with effusion. Which of the following operation will be done in this patient along with adenoidectomy?

a. mastoidectomy.
b. myringoplasty.
c. myringotomy.
d. tympanotomy.

Answers with Explanations

1. d.
2. c.
3. b due to nasal obstruction.
4. a voice looses nasal resonance called rhinolalia clausa.
5. a due to eustachian tube blockage.
6. a.
7. c myringotomy with grommet insertion.

CHAPTER 39 Cysts and Premalignant Conditions of Oral Cavity & Pharynx

- Cysts
  - Ranula
  - Retention cyst (mucocoele)
  - Dermoid cyst
- Premalignant conditions
  - Leukoplakia
  - Erythroplakia
  - Oral submucous fibrosis
- Pharyngeal pouch

CYSTS

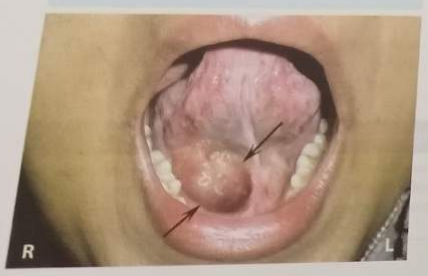
Ranula

Ranula is a retention cyst in the floor of the mouth arising from the mucous gland, the submandibular and sublingual salivary glands or their ducts. It is present in the floor of the mouth on one side of the frenulum and may push the tongue upwards. Two types are described:

1. *Simple ranula:* The retention cyst is limited to the floor of mouth (Fig. 39.1).
2. *Plunging type:* The cyst may extend into the tissues of the neck and may present externally in the submental or submandibular region.

In the floor of mouth, a soft cystic swelling usually bluish in color is present. If the ranula is small, complete surgical excision may be possible. However in most cases, surgical excision is not possible because the walls are very thin instead a *'marsupialization'* (decapping) is done i.e. roof of the ranula is removed and the remaining inner wall is stitched with oral mucosa.

Fig. 39.1: Simple ranula.



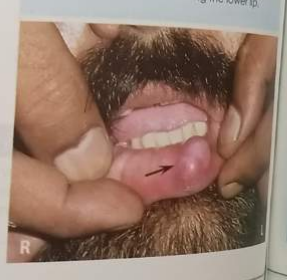
Retention Cyst (Mucocoele)

Mucous retention cyst *(mucocoele)* may occur anywhere on the lips and buccal mucosa. It is a smooth, roundish, filled swelling, bluish or yellowish in color (Fig. 39.2). They may also occur in any part of the plunging mucosa, especially in the vallecula. Most of the cysts are asymptomatic but larger cysts in pharynx and vallecula may produce dysphagia. Treatment is a surgical excision if possible, otherwise *decapping* can be done.

Dermoid Cyst

Only about 2% of the dermoid cysts occur in the mouth. They may be sublingual or submental depending on the relationship with the mylohyoid muscle. Sublingual cyst is present in the floor of the mouth and is present as a white mass. Submental dermoid cyst is present below the mylohyoid muscle and as a submental swelling behind the chin. It is treated by a surgical excision.

Fig. 39.2: Mucocoele, involving the lower lip.



PREMALIGNANT CONDITIONS

Leukoplakia

Leukoplakia is a raised white patch or plaque on the mucosal surface of the mouth (Fig. 39.3). Histologically, the following features are present:

1. Simple keratosis.
2. Various combinations of hyperkeratosis, parakeratosis and acanthosis.
3. Dysplasia from mild to severe.

These are commonly present on buccal and gingival mucosa but other sites such as lips, palate, tongue and floor of the mouth may also be involved. The incidence of carcinoma developing in this leukoplakic patch varies and upto 5% of all cases may show malignant change. In order to find the malignant change, every leukoplakic patch should be biopsied. Smoking is considered to be one of the important etiological factors. Malignant change in leukoplakia is more common in smokers and females. Chewing of pan, beetle nuts and tobacco in different combinations is another etiological factor, especially in our region. Small lesions need observation and regular follow-ups. Larger lesion or progressive lesions are to be excised and histopathology must be done after excision. Other options are cryosurgery and laser surgery.

Erythroplakia

Erythroplakia is a red patch or plaque on the mucous membrane, just similar to a leukoplakia. Erythroplakia has a very high potential for malignant change. It should be widely excised and histopathology of the specimen should be done after excision.

Oral Submucous Fibrosis

It is a chronic and insidious disease involving the oral cavity and sometimes the pharynx. It is characterized by *fibrosis* in the submucosal layer. It is a premalignant condition but the incidence of malignant change is still unknown and controversial. It is often seen in young females of lower socio-economic class. This disease is very prevalent in our part of the world.

Pathology

The exact etiology is unknown. Nearly in all cases, there is history of chewing chalia (beetle nut) either alone or with paan and tobacco. Dietary deficiencies including vitamin B complex, vitamin A, iron, zinc and other minerals are also thought to be an etiological factor. The basic change in this condition is a deposition of excessive fibroelastic tissues in the lamina propria. The overlying mucosa may show epithelial atrophy and sometimes vesicle formation. In the later stages, fibrosis is very marked especially over the soft palate, faucial pillars and buccal mucosa.

Clinical Features

Initially, patient may complain of burning sensation in the mouth and is unable to take spicy food. Tiny vesicles may develop repeatedly especially on the buccal mucosa. Later on, thick sheets of fibrous tissues may occupy the entire hard palate, soft palate, uvula, pillars, inner surface of the cheek and sometimes the posterior pharyngeal wall. At this stage, patient has restricted mouth opening (Fig. 39.4). In severe cases, patient is unable to open the mouth and it is very difficult to take food.

Treatment

No specific treatment is available for this condition. The management lies in its prevention by stopping consumption of beetle nut. Steroids in the form of topical gel or injection and systemic injections may be of some help to prevent more fibrosis. Topical injection of hyaluronidase enzyme with steroid is also used in these cases. Patients should be encouraged to perform jaw opening exercises by placing wooden sticks in between the teeth. Dietary deficiencies should be corrected with vitamin supplements. Surgical excision of the fibrous bands and covering of the

Fig. 39.3: Leukoplakia at the left lateral margin of the tongue.

Fig. 39.4: Oral submucous fibrosis with restricted mouth opening.

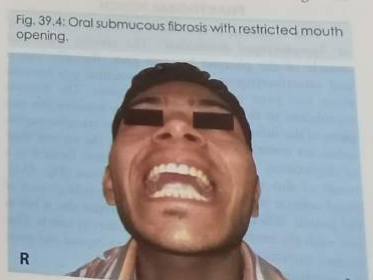
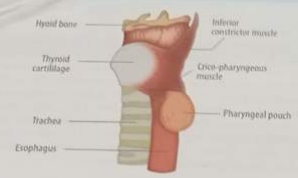


Fig. 39.5: Pharyngeal pouch bulging out between two parts of the inferior constrictor muscle.



raw area with regional rotation flaps may be undertaken in cases where there is severe trismus. CO_2 laser is also used for excision of fibrous bands with minimal post-operative fibrosis.

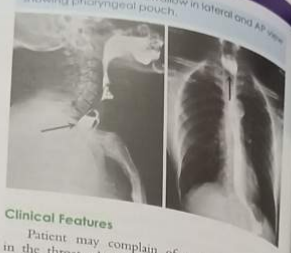
Treatment of Oral Submucous Fibrosis

- **Medical**
  - Symptomatic treatment.
  - Avoidance of exciting factor like beetle nut, paan etc.
  - Corticosteroid: topical or systemic.
  - Hyaluronidase injection: topical.
  - Jaw opening exercise.
  - Correction of dietary deficiencies.
- **Surgical**
  - Surgical excision with flaps.
  - CO_2 laser excision.

PHARYNGEAL POUCH

This condition is also called as *'Zenker's diverticulum'* or *'hypopharyngeal diverticulum'*. The inferior constrictor muscle of the pharynx has two parts, thyropharyngeus and cricopharyngeus. There is a potential gap between these two parts called *'Killian's dehiscence'*. The mucous membrane in this situation may bulge between the two parts of the inferior constrictor when the cricopharyngeus sphincter contracts prematurely during the second stage of deglutition. A pharyngeal pouch is thus formed as a result of this neuromuscular incoordination (Fig. 39.5). Food collects in this small pouch causing enlargement of the pouch. When the pouch gets to a certain size it lies in line with the esophagus and food goes directly into it. This further increases its size and causes it to expand and press the esophagus leading to dysphagia.

Fig. 39.6: X-ray Barium Swallow in lateral and AP view showing pharyngeal pouch.



Clinical Features

Patient may complain of a lump or 'something in the throat when the pouch is small. As the pouch enlarges in size, dysphagia may occur. After taking meals regurgitation of undigested food may occur. Overflow of this regurgitated food into the larynx may result in severe coughing. The food may regurgitate at night when the patient is recumbent. Weight loss may occur as a result of dysphagia. X-ray barium swallow is diagnostic and shows the sac and its size (Fig. 39.6).

Treatment

Conventionally, the pharyngeal pouch was treated by open surgery with excision of the pouch (diverticulectomy) and division of cricopharyngeus sphincter (crico-pharyngeal myotomy). Dohlman described endoscopic division of the common wall (between the posterior pharyngeal wall and anterior wall of the pouch) with electrocautery popularly known as *Dohlman's operation*. He introduced a specially designed slotted endoscope for this purpose. The main problem of this technique was high morbidity due to leakage and resulting mediastinitis. This problem is overcome by using laser (endoscopic laser diverticulectomy and stapler gun (endoscopic stapler assisted diverticulectomy).

Chapter Summary and Key Points

Retention cysts in the mouth and oral cavity are quite common. Surgical excision of the retention cyst in the mouth is difficult because of its thin walls. In such cases, marsupialization or decapping of the cyst is preferred. Any progressive lesion in the oral cavity with suspicion of malignancy must be biopsied. Regular follow-up is required in all premalignant conditions of the mouth. Oral submucous fibrosis is very common in our part of the globe because of betelnut, paan and tobacco consumption.

Difficult words

Marsupialization: This term is derived from the word 'marsupia' means pouch of a female kangaroo in which her baby is kept. It is a surgical procedure in which surface of the cyst is removed and its inner lining is stitched with the surface.

Best Choice Questions

Q1. A 20-year-old girl presented progressively increasing swelling in the floor of the mouth for the last 6 months. On examination, there was a large smooth, rounded and bluish color swelling seen on the right side of the floor of the mouth. What is the treatment of choice in this patient?

a. medical or conservative.
b. incision and drainage.
c. marsupialization.
d. excision of submandibular gland.

Q2. What is the most common site for leukoplakia in the oral cavity?

a. buccal mucosa.
b. floor of the mouth.
c. hard palate.
d. tongue.

Q3. A 40-year-old male patient had a lesion in the oral cavity for which surgery was advised. Patient refused for surgery but after sometime came with malignant change in this lesion. What is the most likely possibility for the earlier lesion?

a. erythroplakia.
b. leukoplakia.
c. lichen planus.
d. oral submucous fibrosis.

Q4. A 27-year-old male patient was diagnosed with simple ranula. What is the site where this pathology is most likely present?

a. dorsal surface of the tongue.
b. floor of the mouth.
c. lower lip.
d. midline of neck.

Q5. What are the two common clinical varieties of ranula?

a. exophytic and ulcerative.
b. pedunculated and sessile.
c. simple and plunging.
d. superficial and deep.

Answers with Explanations

1. c also called decapping.
2. a.
3. a.
4. b.
5. c.

CHAPTER 40 Neoplasia of the Oral Cavity and Pharynx

- Neoplasia of the oral cavity
  - Papilloma
  - Adenoma
  - Fibroma
  - Hemangioma
  - Lymphangioma
  - Squamous cell carcinoma
  - Verrucous carcinoma
  - Lymphoma
  - Melanoma
  - Salivary gland tumors
- Tumors of the nasopharynx
- Tumors of the oropharynx
  - Squamous cell carcinoma
  - Lymphoepithelioma
- Tumors of the hypopharynx
  - Carcinoma of the pyriform fossa
  - Carcinoma of the postericoid region
  - Carcinoma of the posterior pharyngeal wall

NEOPLASIA OF THE ORAL CAVITY

Neoplasia of the oral cavity is classified as benign and malignant. Majority of the tumors in the oral cavity are malignant. Benign tumors may arise either from the epithelial tissues or underlying connective tissues. Common benign tumors are papilloma, adenoma, fibroma, hemangioma and lymphangioma. Among the malignant tumors, squamous cell carcinoma accounts for about 95% of the cases. The rest being salivary gland tumors, lymphoma and melanoma.

Papilloma

Squamous papilloma is common in the oral cavity and commonly occurs as a discrete and pedunculated swelling. Human Papilloma Virus (HPV-6 and 11) is usually associated with this lesion. Most of them appear on the soft palate, hard palate, uvula, tongue and lips. Majority are less than 1 cm in size and white in color. It is treated by a surgical excision. Histopathology is essential after removal of the lesion.

Adenoma

This is a rare tumor that occurs commonly on the palate. Treatment is a surgical excision.

Fibroma

Fibroma is not uncommon in the oral cavity. It can occur anywhere in the oral or oropharyngeal mucosa but most frequently found on the buccal mucosa. It is a smooth, mucosa covered, pedunculated or sessile and soft to firm in consistency. It is treated by surgical excision.

Hemangioma

Hemangioma is not a true neoplasm but rather a vascular malformation. It is mostly seen in children and young adults (Fig. 40.1). Histologically three types of hemangioma are known; capillary, cavernous and mixed. Excision is done by diathermy, cryosurgery or laser therapy depending on the type and size of the tumor. In large lesions, embolization of the feeding vessel may be helpful as preoperative adjunct to surgery. Propanolol, a beta adrenergic blocker has been tried for reducing the size of hemangioma especially in infants.

Common Tumors of the Oral Cavity

- Benign:
  - Papilloma.
  - Adenoma.
  - Fibroma.
  - Hemangioma.
  - Lymphangioma.
  - Ameloblastoma.
  - Torus palatinus/mandibularis.
- Malignant:
  - Squamous cell carcinoma.
  - Verrucous carcinoma.
  - Adenoid cystic carcinoma.
  - Adenocarcinoma.
  - Lymphoma.
  - Melanoma.
  - Sarcoma.

Fig. 40.1: A small hemangioma present at the tip of the tongue.

Fig. 40.2: Lymphangioma.

Lymphangioma

It usually involves the anterior two-thirds of the tongue. Small lesions can be surgically excised completely but as diffuse involvement of the whole tongue, surgical excision is difficult (Fig. 40.2).

Squamous Cell Carcinoma

The incidence of oral squamous cell carcinoma varies worldwide. In UK, it accounts for 2% of all cancers. The incidence of oral cancer in our region is very high. Etiological factors responsible for this higher incidence are consumption of paan, chalia (beetle nut) and tobacco in different combinations. The other factors are smoking, dietary deficiencies and alcohol use. The role of dietary deficiency is not exactly known but deficiency of vitamin B complex, iron and other antioxidants may be responsible. There is a definite male preponderance with a peak age incidence of 50 to 60 years.

TNM Classification

According to the American Joint Committee on Cancer (AJCC), the 'T' staging of oral cancer is according to the size of tumor.

Primary Tumor (T)

T_x	Unable to assess primary tumor.
T_0	No evidence of primary tumor.
T_{is}	Carcinoma in situ.
T_1	Tumor is < 2 cm in greatest dimension.
T_2	Tumor > 2 cm and < 4 cm in greatest dimension.
T_3	Tumor > 4 cm in greatest dimension.
T_4 (lip)	Primary tumor invading cortical bone, inferior alveolar nerve, floor of mouth, or skin of the face (e.g. nose or chin)
T_{4a} (oral)	Tumor invades adjacent structures (e.g. cortical bone, into deep tongue musculature, maxillary sinus) or skin of face.
T_{4b} (oral)	Tumor invades masticator space, pterygoid plates, or skull base or encases the internal carotid artery.

Regional Nodes (N)

See chapter 49 for details.

Distant Metastasis (M)

See chapter 49 for details.

Staging

Stage 0	$T_{is} N_0 M_0$
Stage I	$T_1 N_0 M_0$
Stage II	$T_2 N_0 M_0$
Stage III	$T_3 N_0 M_0$; $T_{1-3} N_1 M_0$
Stage IVA	$T_{4a} N_{0-1} M0$; $T_{1-4a} N_2 M_0$
Stage IVB	$T_{4b} N_{0-2} M0$; $T_{1-4b} N_3 M_0$
Stage IVC	$T_{1-4b} N_{1-3} M_1$

Clinical Features

The clinical features of oral cancer depends on the site of origin and the stage of tumor and varies accordingly. The lesion may be exophytic, ulcerative or infiltrative. The common site of occurrence is the buccal mucosa, tongue, hard palate, lips, upper alveolus, lower alveolus and floor of the mouth (Fig. 40.3, 40.4 and 40.5).

In carcinoma of the tongue, the usual site is the lateral margin and tip of the tongue. In infiltrative type, the movement of the tongue may be restricted. The patient may complain of difficulty in eating, speaking and swallowing. If the regional lymph node metastasis is present, the patient may come with a painless lump in the

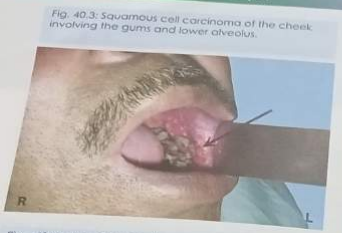


Fig. 40.3: Squamous cell carcinoma of the cheek involving the gums and lower alveolus.

Fig. 40.4: An extensive squamous cell carcinoma of the buccal mucosa extending outside to involve outer skin.

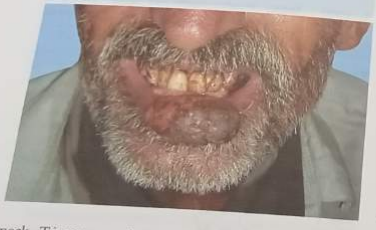


Fig. 40.5: An Orthopantomogram (OPG) showing erosion of the mandible by a squamous cell carcinoma of the oral cavity.

Fig. 40.6: An orthopantomogram (OPG) showing erosion of the mandible by a squamous cell carcinoma of the oral cavity.

neck. Trismus may be present with the involvement of the pterygoid muscles especially in the buccal carcinoma. Tumors of the alveoli or palate will interfere with the dentures.

On examination morphology, site and extent of the lesion is assessed. Movement of the tongue should be assessed for its fixation in tongue lesions. On palpation, the deep infiltration of the tumor can be assessed. Palpation of the regional lymph nodes should be done in every case to assess nodal metastasis.

Investigations

The aim of investigations in these cases is first, a histological diagnosis and then to assess the extension and metastasis of the tumor. Biopsy of the lesion can be done under local or general anesthesia. In general anesthesia, assessment of the primary tumor and palpation of the regional lymph node can be done more accurately. Radiological imaging like plain X-rays, orthopantomogram, CT scan and MRI can be done to stage the tumor. Orthopantomogram (OPG) is a special form of plain X-ray for evaluation of disease in the mandible and maxilla (Fig. 40.6). CT scan is very helpful for assessing deeper extent of the tumor, involvement of pterygoid muscles, erosion of bone by the tumor and nodal metastasis (Fig. 40.7).

Treatment

Different modalities of treatment are available including surgical excision, laser therapy, radiotherapy, chemotherapy or combination of these. The choice of modality of treatment depends on the site of tumor, extension, stage of the disease, histopathology, general condition of the patient and the facilities available. Surgery is usually the treatment of choice in most cases if the tumor is resectable and the reconstruction of the resectable part is possible. Small and superficial lesion can be treated by laser therapy.

Verrucous Carcinoma

It is a variant of squamous cell carcinoma and has a characteristic warty or papillary appearance usually grayish

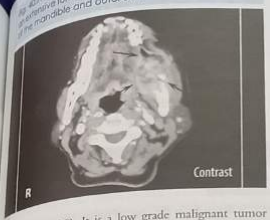


Fig. 40.7: CT scan (axial view with contrast) showing an extensive tumor of the oral cavity with involvement of the mandible and outer skin.

Fig. 40.8: Verrucous carcinoma of the cheek.

in color (Fig. 40.8). It is a low grade malignant tumor which rarely metastasizes to regional lymph nodes and never distantly. It has a very good prognosis and treated mainly by surgical excision with safe margins.

Lymphoma

Lymphoma may occur in the oral cavity and oropharynx. Majority of them involve the palatine tonsils. Males are more commonly affected than females. It usually occurs with unilateral enlargement of the tonsils and sometimes superficial ulceration. If lymphoma is suspected in the tonsil, then the entire tonsil is removed and sent for histopathology for definitive diagnosis and about its architecture. Treatment depends on the stage of the disease and includes surgery or radiotherapy or both.

Melanoma

It is a rare tumor of the oral cavity and oropharynx.

Salivary Gland Tumors

See chapter 52 for details.

TUMORS OF THE NASOPHARYNX

See chapter 29 for details.

TUMORS OF THE OROPHARYNX

Oropharynx is the middle part of the pharynx and lies behind the oral cavity (Fig. 30.2). Its roof is formed by the soft palate. Posterior one-third of the tongue forms its floor and the lateral wall is formed by tonsils and pillars. Posteriorly lies the posterior pharyngeal wall. Both benign and malignant tumors can occur in the oropharynx. Malignant tumors are far more common than benign tumors. Benign tumors can rise from the epithelial tissue or connective tissue and include the papilloma, adenoma, fibroma, hemangioma, neurilimmoma etc.

Fig. 40.9: A squamous cell carcinoma of the oropharynx involving the tonsil, tonsilolingual sulcus and base of the tongue on right side.

Among the malignant tumors, squamous cell carcinoma is most common. The others are lymphoepithelioma, adenocarcinoma and lymphoma.

Squamous Cell Carcinoma

The common site of origin is the tonsilolingual sulcus and the tonsil itself (Fig. 40.9). It may also rise from the soft palate, uvula, posterior pharyngeal wall and posterior one-third of the tongue. On gross appearance, the tumor may be exophytic, ulcerative or infiltrative in type. Various grades of differentiation include well-differentiated, moderately differentiated and poorly differentiated carcinoma.

Clinical Features

This depends on the site of origin, extent and the type of tumor. A persistent sore throat often mild in character is the usual complaint. Difficulty in swallowing and referred earache is also common. Sometimes, the patient reports enlarged cervical lymph nodes due to metastasis. Bleeding from the mouth and change of voice are late features.

Investigations

Direct laryngoscopy may be required to examine the posterior third of the tongue and extension of tumor lower down. Biopsy of the lesion and radiological investigations are done for histological diagnosis and assessing extent of the disease.

Treatment

Radiotherapy is often the treatment of choice in oropharyngeal squamous cell carcinoma. Surgery is indicated in some cases where the tumor is localized and resectable.

Lymphoepithelioma

It is a variant of squamous cell carcinoma. It is a highly anaplastic or poorly differentiated squamous cell carcinoma with admixture of lymphocytes. It is especially seen in younger patients and usually affects the tonsils, base of tongue and vallecula. It is treated by radiation therapy.

TUMORS OF THE HYPOPHARYNX

For the purpose of tumor classification the hypopharynx is divided into three regions:

1. Pyriform fossa.
2. Postcricoid region.
3. Posterior pharyngeal wall.

Both benign and malignant tumors can occur in the hypopharynx but benign tumors are exceptionally uncommon and practically all tumors are malignant. Benign tumors are papilloma, adenoma, fibroma, liomyoma and lipoma.

Almost all of the malignant tumors of the hypopharynx are squamous cell carcinoma. The incidence according to the site of origin is as follows:

Pyriform fossa	60%
Postcricoid region	30%
Posterior pharyngeal wall	10%

Carcinoma of the Pyriform Fossa

It is commoner in males and occurs mostly after 40 years of age. The pyriform fossa has a rich lymphatic drainage and the incidence of regional lymph node metastasis is very high (upto 75%). Because of the large area of pyriform fossa, most of the tumors remain asymptomatic for quite long period and the cervical lymph node metastasis may be the first presenting complaint. Tumor involving the medial wall of pyriform fossa may extend into the larynx and produce laryngeal symptoms (see chapter 45). The tumor may extend upwards to involve the base of tongue and vallecula and downwards to involve the postcricoid region and cervical esophagus.

Clinical Features

Besides regional lymph nodes metastasis, early symptoms are few and patient has a feeling of 'something in the throat'. Dysphagia is present in later stages. Referred otalgia and pain on swallowing is often present. With the involvement of larynx, change of voice and respiratory obstruction may be present.

Investigations

Extent of the growth is assessed by direct laryngoscopy and biopsy can be taken at the same time. X-ray barium swallow is helpful to assess the extent of growth. Other investigations include CT scan, MRI and FNAC of the cervical lump.

Treatment

It depends on the stage of tumor. If the tumor is small and limited to the pyriform fossa with no regional nodal metastasis, radiotherapy may be given with advantage of preserving the larynx. In later stage, when the tumor involves the medial wall of the pyriform fossa with larynx, total laryngectomy with partial pharyngectomy is done. The pharyngeal defect is closed by primary closure from mucosa of the other side. Radical neck dissection can be done at the same time for regional lymph node metastasis. If the tumor extends downward to involve the postcricoid region then total laryngopharyngectomy with myocutaneous flap, gastric pull-up or intestinal interposition.

Carcinoma of the Postcricoid Region

This variety is more common in females than males. Plummer Vinson's syndrome may be the precursor of carcinoma of postcricoid region. Postcricoid region can also be involved by extension of tumor from the pyriform fossa above and cervical esophagus below.

Clinical Features

Dysphagia is usually the predominant presenting complaint. Dysphagia is progressive in nature, which is initially for solid food and later on for liquids. Dysphagia results in malnutrition and severe weight loss. Larynx may be involved due to extension of the tumor and patients may have change of voice, stridor and respiratory obstruction.

Investigations

Investigations related to the extent of disease and tissue diagnosis are same as mentioned in carcinoma of the pyriform fossa. Special investigations are needed for iron deficiency like complete blood picture, morphology of the RBC's, total serum iron, iron binding capacity, serum folate level etc. (see chapter 36).

Carcinoma of postcricoid region is treated by total laryngopharyngectomy with reconstruction of the pharynx. The prognosis is poor. In some centers radiotherapy is used to treat this variety. It preserves both pharyngeal and laryngeal functions.

Carcinoma of the Posterior Pharyngeal Wall

This variety is mostly seen in males usually above 50 years of age. As mentioned, this variety is least common and constitutes only 10% of all hypopharyngeal tumors. The growth may be exophytic or ulcerative in type. Lymph node metastasis may occur bilaterally. Dysphagia is the predominant presenting complaint. Spitting of blood may be the first sign sometimes.

Treatment

Small and localized tumor can be excised by lateral pharyngectomy with primary closure. Advanced cases are treated by total laryngopharyngectomy with reconstruction of the pharynx. Radiotherapy is also used to preserve the larynx and pharynx as primary treatment.

Chapter Summary and Key Points

Benign tumors are less common and majority of the tumors are malignant in the oral cavity. Oral cancer has a high incidence in our region because of excessive and common use of paan, gutka, beetle nuts, tobacco and smoking, either alone or in combination. About 95% of the malignant tumors of the oral cavity are squamous cell carcinoma. Any progressive or non-healing ulcer in the oral cavity must be considered as malignant until proved otherwise. Biopsy is essential in all cases where there is suspicion of malignancy. Surgery is usually the treatment of choice in most cases.

In oropharynx and hypopharynx, malignant tumors are more common. Squamous cell carcinoma being the most common variety. Carcinoma of the postcricoid region is common in females and often associated with Plummer Vinson's syndrome.

Best Choice Questions

Q1. A 52-year-old male patient presented a malignant tumor of the oral cavity. What is the most likely pathology at this site?

a. adenoid cystic carcinoma.
b. lymphoma.
c. mucoepidermoid carcinoma.
d. squamous cell carcinoma.

Q2. A 28-year-old male patient presented a small, whitish, finger like swelling on the lower lip. What is the most likely diagnosis?

a. adenoma.
b. hemangioma.
c. papilloma.
d. squamous cell carcinoma.

Q3. A 58-year-old male patient came with a tumor on the right cheek. After evaluation, he was diagnosed with T_2 stage, squamous cell carcinoma. What is the most likely size of the tumor in this patient?

a. less than 1 cm.
b. more than 1 but less than 2 cms.
c. more than 2 but less than 4 cms.
d. more than 4 but less than 6 cms.

Q4. What is the most common site for origin of a squamous cell carcinoma of the tongue?

a. dorsum of the tongue.
b. lateral margin of the tongue.
c. posterior one-third of the tongue.
d. tip of the tongue.

Q5. A 62-year-old male patient came with squamous cell carcinoma of the cheek on left side with extension upto the lower gums. What is the most suitable investigation for assessing mandibular involvement in this patient?

a. Magnetic Resonance Imaging (MRI).
b. Orthopantomogram (OPG).
c. Plain X-ray face (AP and lateral view).
d. X-ray floor of mouth (occulusal view).

Q6. A 48-year-old male patient came with a growth on the left side of cheek which had a characteristically warty or papillary appearance. On histopathology, malignant squamous cells were present. What is the most likely possibility?

a. carcinoma in situ.
b. melanoma.
c. squamous cell carcinoma.
d. verrucous carcinoma.

Q7. A 56-year-old male patient came with an irregular, fungating growth on the right tonsil. On histopathology, it appeared as malignant tumor. What is the most likely possibility?

a. adenocarcinoma.
b. lymphoepithelioma.
c. lymphoma.
d. squamous cell carcinoma.

Q8. What is the most common site of origin of a squamous cell carcinoma in the oropharynx?

a. posterior one-third of the tongue.
b. posterior pharyngeal wall.
c. tonsilolingual sulcus.
d. uvula.

Q9. A 57-year-old male patient came with squamous cell carcinoma of the pyriform fossa with regional lymph node metastasis. What is the incidence of nodal metastasis in such patients?

a. 15%.
b. 35%.
c. 55%.
d. 75%.

Q10. A 60-year-old male patient came with squamous cell carcinoma of the pyriform fossa. What is the incidence of origin from this site among all the cases of a hypopharyngeal carcinoma?

a. 20%.
b. 40%.
c. 60%.
d. 80%.

Answers with Explanations

1. d about 95% of the cases.
2. c whitish pink in color.
3. c.
4. b.
5. b.
6. d usually grayish in color.
7. d.
8. c also the tonsil itself.
9. d because of rich lymphatics.
10. c.

SECTION IV

Larynx and Trachea

Contents

CHAPTER

41 Anatomy of the Larynx and Trachea

- Development of the larynx
- Dimensions of the larynx
- Laryngeal framework
- Muscles of the larynx
- Membranes and ligaments of the larynx
- Cavity of the larynx
- Blood supply of the larynx
- Lymphatic drainage of the larynx
- Nerve supply of the larynx
- Trachea

DEVELOPMENT OF THE LARYNX

The larynx is a *membrano-fibrocartilaginous* box situated above the trachea in front of the 4th, 5th and 6th cervical vertebrae in adult males, being somewhat higher in females and children. The epithelial lining of the larynx is endodermal in origin and develops from the cranial end of the laryngotracheal tube. The skeletal element is mesodermal in origin, develops from the caudal end of hypobranchial eminence and the fourth and sixth branchial arches.

During the fourth week of intrauterine life, a median *laryngotracheal groove* appears in the ventral wall of the pharynx. This subsequently deepens to become the *laryngotracheal tube*. The larynx develops from the cranial end of this tube, bounded by the caudal end of the hypobranchial eminence and fourth and sixth branchial arches. The epiglottis develops from the caudal end of hypobranchial eminence (fourth branchial arch). The thyroid cartilage also develops from the fourth branchial arch. The cricoid, arytenoids and corniculate cartilages develop from the sixth branchial arch. All the intrinsic muscles of the larynx develop from the sixth branchial arch except cricothyroid, which develops from the fourth branchial arch. The development of the larynx starts in the fourth week and by the end of eighth week most features of the adult larynx are identifiable.

DIMENSIONS OF THE LARYNX

There is a marked difference in the dimensions of the larynx between adult males and females. There is a little difference in size of larynx in boys and girls until after puberty when the anteroposterior diameter in the males almost doubles. The infantile larynx is both absolutely and relatively smaller than the adult and its lumen is disproportionately narrow. It is funnel-shaped and the narrowest part is at the junction of subglottic region with the trachea. Laryngeal cartilages in children are soft and mucosa especially in the subglottis is very lax.

LARYNGEAL FRAMEWORK

The skeletal framework of the larynx is formed by cartilages, which are connected to each other by ligaments and membranes and are moved in relation to one another by muscles (Fig. 41.1 and 41.2). The laryngeal cartilages are:

1. Thyroid cartilage.
2. Cricoid cartilage.
3. Arytenoid cartilages.
4. Epiglottic cartilage.
5. Corniculate cartilages.
6. Cuneiform cartilages.

Thyroid cartilage is the largest and consists of two plates fused anteriorly in the midline forming an angle. This angle is more prominent in males and called the Adam's apple. The thyroid cartilage forms the anterior and lateral wall of the larynx.

Cricoid cartilage is present below the thyroid cartilage. It is the only complete cartilaginous ring in the whole laryngotracheo-bronchial tree, so its integrity is very essential for maintaining patent airway. Cricoid cartilage forms the inferior part of the anterior and lateral wall and most of the posterior wall of the larynx. Its shape is like a signet ring comprising of a lamina situated posteriorly and a narrow arch situated anteriorly. It is a hyaline cartilage, which begins to calcify in the early twenties.

Arytenoid cartilages are paired pyramidal shaped cartilages each having three surfaces, a base, apex, muscular process and a vocal process. It articulates with the cricoid cartilage.

Epiglottis is a slightly curved thin leaf shaped cartilage situated in the midline anteriorly and projects upwards behind the hyoid bone and base of tongue. Epiglottis has a free upper border, which is broad and round, and a narrow base called 'petiole', which is attached to the inner aspect of thyroid cartilage below the thyroid notch. Epiglottis is a fibroelastic cartilage that never calcifies. In man, it is not functionally fully developed as respiration, deglutition and phonation can take place almost normally even after removal of the epiglottis.

Corniculate cartilages are two small conical fibroelastic cartilages, which articulate with the apex of arytenoid cartilage. They are situated in the posterior part of the aryepiglottic folds.

Cuneiform cartilages are two small elongated flakes of fibroelastic cartilages placed one in each margin of the aryepiglottic fold. The importance of this small cartilage is that it tends to thicken the aryepiglottic fold.

MUSCLES OF THE LARYNX

Muscles of the larynx may be grouped into *'extrinsic muscles'*, which attach the larynx to the neighbouring structures and *'intrinsic muscles'*, which move the various cartilages of the larynx. The extrinsic muscles are again grouped into *elevators* and *depressors* of the larynx. Elevators of the larynx are suprahyoid muscles, which include mylohyoid, stylohyoid, geniohyoid, digastric, stylopharyngeus, salpingopharyngeus and palatopharyngeus muscles. The depressors of the larynx are infrahyoid muscles, which include sternothyroid, sternohyoid, thyrohyoid and omohyoid muscles.

The intrinsic muscles of the larynx are grouped into:

1. Those that open and close the glottis (abductors and adductors) (Fig. 41.3). It includes the lateral cricoarytenoid, posterior cricoarytenoid, transverse arytenoid and oblique arytenoid.
2. Those that control the tension of vocal cords. It includes thyroarytenoid, vocalis and cricothyroid muscles.
3. Those that alter the shape of the laryngeal inlet. It includes the aryepiglotticus and thyroepiglotticus.

Fig. 41.1: Laryngeal framework as seen from anterolateral aspect.

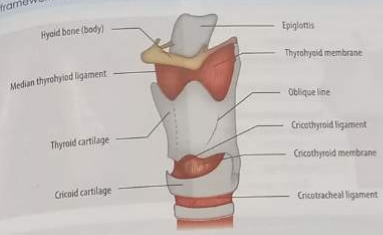


Fig. 41.2: Laryngeal framework as seen from behind (posterior aspect).

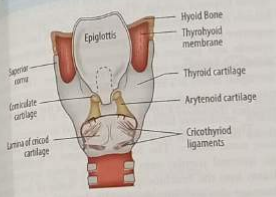


Fig. 41.3: Movements and position of the vocal cords. A = abduction; B = adduction; C = closure of the posterior glottic chink.

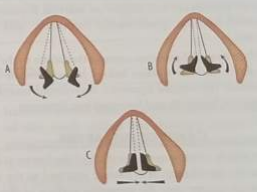
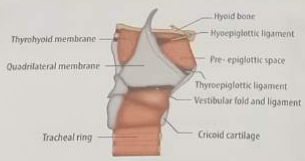


Fig. 41.4: Vertical (sagittal) section through the larynx, showing ligaments and membranes.



MEMBRANES AND LIGAMENTS OF THE LARYNX

The membranes and ligaments of larynx are again grouped into *'extrinsic'* and *'intrinsic'* types (Fig. 41.4). Intrinsic ligaments connect different cartilages of the larynx together and also form a broad sheet of fibroelastic tissue submucosally. This fibroelastic membrane lies beneath the mucous membrane and creates an internal framework. It is divided into the 'quadrangular membrane' and 'conus elasticus'.

The extrinsic ligaments connect the larynx to the hyoid bone above and the trachea below. It includes the lateral and median thyrohyoid ligament, thyrohyoid membrane, cricotracheal ligament and hyoepiglottic ligament.

CAVITY OF THE LARYNX

The whole of the internal surface of the larynx is lined by a mucous membrane. It is loosely attached to the walls of the larynx except over the posterior surface of the epiglottis, corniculate and cuneiform cartilages and vocal ligaments. Most of the mucous membrane is lined by ciliated columnar epithelium. Stratified squamous epithelium is present over the anterior surface of the supra hyoid epiglottis, margins on the posterior surface of epiglottis and over true vocal cords. Transitional epithelium is present where the stratified squamous and ciliated columnar epithelium meets. Mucous glands are freely distributed through out the mucous membrane.

The opening of the larynx superiorly into the pharynx is known as *'laryngeal inlet'*. It is bounded anteriorly and superiorly by the free edge of epiglottis, on each side by the aryepiglottic folds and posteriorly, by the arytenoids and interarytenoid region (Fig. 41.2).

The interior of the larynx is divided into three regions; *supraglottis, glottis* and *subglottis*. Supraglottis is the part, which lies above the true vocal cords. Glottis is composed of true vocal cords including the anterior and posterior commissure (Fig. 41.5). Subglottis extends from the free margins of the vocal cords to the lower border of cricoid

Fig. 41.5: Endoscopic view of the larynx showing the true vocal cords.

cartilage, where it is continuous with the trachea. Between the false and true vocal cords, air containing spaces called the laryngeal ventricles and saccules are present.

BLOOD SUPPLY OF THE LARYNX

The arterial supply of the larynx is from the *superior* and *inferior laryngeal* arteries. The superior laryngeal artery is a branch of the superior thyroid artery, which runs with the superior laryngeal nerve. It passes deep into the thyrohyoid muscle and pierces the thyrohyoid membrane with the internal branch of superior laryngeal nerve. The inferior laryngeal artery is a branch of the inferior thyroid artery. It passes deep into the inferior constrictor of the pharynx and supplies the lower half of the larynx.

The venous drainage of larynx follows the arteries and have same names. The *Superior laryngeal* vein drains into the internal jugular vein while the *inferior laryngeal* vein drains into the brachiocephalic vein. Some of the venous drainage also goes into the middle thyroid vein.

LYMPHATIC DRAINAGE OF THE LARYNX

The vocal cords are the *complete watershed* separating the supraglottic and subglottic lymphatic drainage. The subepithelial space of the glottic region contains minimal or no lymphatic drainage. That is why the glottic carcinomata metastasizes to the regional lymph node very late. The lymphatic drainage of the supraglottic region accompanies the superior laryngeal vessels and drain into the upper deep cervical lymph nodes. The lymphatic drainage of the subglottic region is very complex and drains into the prelaryngeal, pretracheal and paratracheal lymph nodes.

NERVE SUPPLY OF THE LARYNX

The larynx is supplied by two branches of the vagus nerve, namely the *superior laryngeal* and *recurrent laryngeal* nerves. The superior laryngeal nerve supplies the larynx above the vocal cords with sensory, sympathetic, parasympathetic and motor supply to cricothyroid muscle. Recurrent laryngeal nerve supplies the larynx below the vocal cords with sensory and autonomic nerve supply. It also supplies all intrinsic muscles of the larynx except the cricothyroid.

TRACHEA

The trachea is a membranocartilaginous tube. In adult male, its length varies from 10 to 11.5 cms. Less than half of its total length lies in the neck and more than half lies in the thorax. It extends from the level of lower border of the sixth cervical vertebra and bifurcates at the level of the fifth thoracic vertebra. From above, it is continuous with the larynx and from below, it divides into the right and left principal bronchi.

The trachea has a framework of incomplete rings of cartilage joined by fibrous tissues and smooth muscle fibers. The number of tracheal rings varies from 16 to 20. The cartilages are deficient, posteriorly where the tube is flattened. A fibrous membrane encloses the cartilage into two layers, one outside and the other inside the ring. These layers are joined with each other above and below each ring and posteriorly. The trachea is lined with mucosa, having ciliated columnar epithelium.

The arterial supply is derived mainly from the inferior thyroid artery and the veins drain into the thyroid venous plexus. Lymphatic drainage is to the pretracheal and paratracheal lymph nodes. The nerve supply of the trachea is from the vagus nerve, recurrent laryngeal nerve and sympathetic trunk.

Chapter Summary and Key Points

The larynx is a membrano-fibrocartilaginous box situated in front of the 4th, 5th and 6th cervical vertebrae. There is marked difference between the larynx of a male and female. Anteroposterior diameter is double in males than in females, forming a prominent Adam's apple. Infantile larynx is both absolutely and relatively smaller than the adult larynx and its lumen is disproportionately narrow. Cavity of the larynx is divided into three regions; the supraglottis, glottis and subglottis. Vocal cords are the complete watershed separating the lymphatic drainage of the supraglottis and subglottis. The glottic region itself has minimal or no lymphatic channel, so metastasis in glottic carcinoma is late.

Best Choice Questions

Q1. Larynx is a membrano-fibrocartilaginous box present in front of the cervical vertebrae. What is the level against which it is situated in adult males?

a. 1st, 2nd and 3rd cervical vertebrae.
b. 2nd, 3rd and 4th cervical vertebrae.
c. 3rd, 4th and 5th cervical vertebrae.
d. 4th, 5th and 6th cervical vertebrae.

Q2. The larynx develops from different branchial arches. What is the arch from which the thyroid cartilage develops?

a. third branchial arch.
b. fourth branchial arch.
c. fifth branchial arch.
d. sixth branchial arch.

Q3. Cricoid, arytenoid and corniculate cartilages are the different cartilages of the larynx. From which arch, do these cartilages develop?

a. third branchial arch.
b. fourth branchial arch.
c. fifth branchial arch.
d. sixth branchial arch.

Q4. In adult males, there is a prominence in midline of the neck called the Adam's apple. Which structure is responsible for this prominence?

a. cricoid cartilage.
b. hyoid bone.
c. thyroid cartilage.
d. thyroid gland.

Q5. Most of the cartilages forming the laryngotracheo-bronchial tree are not complete rings. Which of the following is the only cartilage in the form of a complete ring?

a. arytenoid cartilage.
b. cricoid cartilage.
c. thyroid cartilage.
d. tracheal cartilage.

Q6. The arytenoid cartilage is a paired cartilage of the larynx. What is the rough shape of this cartilage in adults?

a. cubical.
b. pyramidal.
c. rectangular.
d. spherical.

Q7. Which of the following cartilages of the larynx are fibroelastic in nature?
a. corniculate and epiglottic cartilages.
b. cricoid and arytenoid cartilages.
c. cricoid and thyroid cartilages.
d. thyroid and corniculate cartilages.

Q8. Which muscle is responsible for maintaining tension in the vocal cord?
a. lateral cricoarytenoid.
b. posterior cricoarytenoid.
c. thyroarytenoid.
d. transverse arytenoid.

Q9. The ligaments of larynx are grouped into extrinsic and intrinsic types. Which of the following ligament is an 'intrinsic' ligament?
a. conus elasticus.
b. hyoepiglottic ligament.
c. lateral thyrohyoid ligament.
d. thyrohyoid ligament.

Q10. If the larynx is cut in a coronal plane, a space is present between the true and false vocal cords. What is the name of this space?
a. anterior commissure.
b. glottis.
c. laryngeal ventricle.
d. pre-epiglottic space.

Q11. Squamous cell carcinoma can spread in the regional lymph node causing nodal metastasis. In which of the following carcinoma, nodal metastasis is usually late?
a. glottic carcinoma.
b. subglottic carcinoma.
c. supraglottic carcinoma.
d. transglottic carcinoma.

Q12. Which of the following muscle is innervated by the superior laryngeal nerve?
a. cricothyroid.
b. lateral cricoarytenoid.
c. posterior cricoarytenoid.
d. transverse arytenoid.

Q13. What is the length of trachea in an adult male?
a. 10 to 11.5 cms.
b. 12 to 13.5 cms.
c. 14 to 15.5 cms.
d. 16 to 17.7 cms.

Q14. Trachea bifurcates into right and left main bronchus at its lower end. At what level does it bifurcate in an adult males?
a. seventh cervical vertebra.
b. first thoracic vertebra.
c. third thoracic vertebra.
d. fifth thoracic vertebra.

Q15. Trachea is formed by multiple 'c' shaped incomplete cartilages. On an average, how many cartilages are present in an adult female?
a. 11–15.
b. 16–20.
c. 21–25.
d. 26–30.

Answers with Explanations

1. d.
2. b.
3. d.
4. c angle of thyroid cartilage.
5. b maintains patency of the airway.
6. b.
7. a.
8. c.
9. a.
10. c saccule is also present.
11. a because of minimal lymphatic channels.
12. a.
13. a.
14. d.
15. b.

Physiology of the Larynx

CHAPTER 42

- Respiratory function
- Protection of the lower respiratory tract
- Phonation
- Fixation of the chest

The functions of the larynx can be grouped into:

1. Respiratory function.
2. Protection of the lower respiratory tract.
3. Phonation.
4. Fixation of the chest.

RESPIRATORY FUNCTION

The larynx is a part of the respiratory tract. Passage of air to and from the lungs is an important function of the larynx. It plays a part in the mechanism of respiration by reflex adjustment of the glottic aperture. This movement of the vocal cords is directly under control of the medullary respiratory center and is accentuated by hypercapnia and all other factors, causing an increase in depth and rate of respiration. In this way, the larynx also controls the acid base balance of the body by regulating the CO_2 retention.

PROTECTION OF THE LOWER RESPIRATORY TRACT

This is the most important function of the larynx and is the earliest one to develop phylogenetically. Several other mechanisms are involved, which include:

1. *Closure of the laryngeal inlet:* During the second phase of swallowing the laryngeal inlet closes by approximation of the aryepiglottic folds with the epiglottis and arytenoid cartilages. The epiglottis lies over the closed inlet. Surgical removal of the epiglottis results in compromised protection but adequate function is eventually achieved by other protective mechanisms.
2. *Closure of the glottis:* Approximation of both the true and false vocal cords occur with closure of the laryngeal inlet during swallowing.
3. *Cessation of respiration:* Cessation of respiration occurs during the second phase of deglutition by a reflex mechanism.
4. *Cough reflex:* If any particle enters the larynx or trachea, cough reflex will be initiated. Coughing as a result, dislodges the particles.

PHONATION

Phonation develops later in the evolution of the larynx and the ability to speak, makes the human being most distinguished among other species. The voice is produced by vibrating vocal cords and is modified by selective amplification from the resonating chambers. The function of the vocal cords is to produce sound, varying only in intensity and pitch. The pitch is controlled by the changes in length and tension of the vocal cords. The intensity of voice is controlled by the amount of air escaping through the glottis and is directly proportional to the force of air blast.

FIXATION OF THE CHEST

Vestibular folds approximate when attempts are made to raise the intra-abdominal pressure through contraction of abdominal muscles as in defecation, micturition, parturition or weight lifting. Laryngeal closure traps the air in lungs and ensures that the force of contraction is devoted to raise intra-abdominal pressure and is not dissipated by ascent of diaphragm. The vocal cords are also called into action during pulling a rope against resistance or in climbing. After total laryngectomy (where the entire larynx is removed), patient experiences problems and difficulties during these activities.

Chapter Summary and Key Points

Protection of the lower respiratory tract is the most important function of the larynx. Entry of food particles, saliva and foreign body into the lower respiratory tract is prevented by the larynx. Closure of the vocal cords is a powerful mechanism, regarding this function, as even after removal of the whole epiglottis, patient can swallow food. Function of the larynx regarding speech is, production of sound by the vibrating vocal cords. After total laryngectomy, speech can be produced by different methods, which is then articulated in the normal way by tongue, palate, mouth and lips.

Best Choice Questions

Q1. The larynx has many important functions in human beings. What is the most important and vital function of the larynx?

a. act as a respiratory passage.
b. control of CO_2 in the blood.
c. production of sound.
d. protection of lower respiratory tract.

Q2. There are many components of human speech which are performed by different body parts. What is the function of the larynx in this relation?

a. pitch determination and resonance of sound.
b. production and articulation of sound.
c. production and pitch determination of sound.
d. resonance and articulation of sound.

Q3. Total laryngectomy was performed on a 55-year-old male patient for extensive carcinoma of the larynx. What are the problems which this patient will experience because of removal of the larynx?

a. deep breathing, weight lifting and micturition.
b. expiration, defecation and deglutition.
c. inspiration, deep breathing and micturition.
d. micturition, defecation and weight lifting.

Q4. One of the important functions of the larynx is pitch determination of the voice. Which of the following factor controls this function?

a. amount of air escaping through glottic aperture.
b. changes in the resonating chambers.
c. force and length of expiration.
d. length and tension of the vocal cords.

Answers with Explanations

1. d.
2. c.
3. d larynx closes and helps in raising intra-abdominal pressure.
4. d.

CHAPTER 43

Symptoms of Laryngeal Diseases

- Hoarseness
- Stridor
- Dyspnea
- Pain in the larynx
- Bleeding or blood stained sputum from the larynx
- Cough
- Neck mass
- Foreign body
- Dysphagia

Hoarseness and stridor are two most important and common symptoms of laryngeal diseases. Dyspnea or difficulty in respiration without stridor may be present sometimes. Other less common symptoms are pain in the laryngeal region, bleeding or blood stained sputum from the larynx, cough, neck mass, foreign body, dysphagia and fever.

Common Symptoms of Laryngeal Diseases

- Hoarseness.
- Stridor.
- Dyspnea.
- Pain in the laryngeal region.
- Bleeding or blood stained sputum.

HOARSENESS

Hoarseness is defined as roughness of voice, which results from an abnormality within the larynx with variation in periodicity, and intensity of consecutive sound waves.

Pathophysiology

For normal production of voice, the vocal cords should be able to approximate properly with each other, have proper size and stiffness and have an ability to vibrate in response to an air column. Any condition that interferes with these functions may cause hoarseness. Loss of approximation may be seen in vocal cord paralysis, fixation of cricoarytenoid joint or any lesion present between the cords, preventing its approximation. Size and stiffness of the vocal cords may change due to paralysis, edema, tumor, fibrosis and partial surgical excision. Cords are unable to vibrate properly in presence of an edema, congestion, submucosal hemorrhage, nodule, polyp or tumor.

Etiology

Hoarseness may be acute (less than few weeks in duration) or chronic (more than few weeks in duration) in type.

The causes of *acute hoarseness* are:

1. Acute inflammation.
   a. Acute laryngitis.
   b. Acute laryngotracheobronchitis.
   c. Laryngeal diphtheria.
2. Trauma.
   a. Vocal abuse.
   b. Foreign body in the larynx.
   c. Inhalation of irritant fumes.
   d. Cut throat.
   e. Intubation and other instrumentation.
   f. External injury to larynx.
3. Sudden paralysis of vocal cords.
   a. After thyroidectomy.
   b. Trauma to recurrent laryngeal nerve.
   c. Other neurological conditions like CVA
4. Laryngeal edema due to allergy.
5. Functional e.g. psychosomatic, hysteria.

The causes of *chronic hoarseness* are:

1. Congenital.
   a. Laryngeal web.
   b. Congenital laryngeal paralysis.
   c. Congenital cysts and tumors.
2. Chronic Inflammation.
   a. Chronic laryngitis.
   b. Laryngeal tuberculosis.
   c. Other chronic inflammations e.g. syphilis.

3. Trauma.
   a. Intubation granuloma.
   b. Vocal nodules.
   c. Causing vocal cords paralysis.
4. Tumors of larynx: benign and malignant.
5. Vocal cord paralysis.
6. Vocal cord polyp.
7. Laryngocoele.

Sometimes *'weakness of voice'* is present, which is not true hoarseness, as in:

1. Myasthenia gravis.
2. General debility.
3. Myxedema.
4. Functional dysphonia.
5. Acromegaly.
6. Convalescence from severe illness.

Management

1. *History:* Mode of onset and duration of illness is very important. Any hoarseness persisting for more than three weeks requires thorough examination and investigation and the malignancy should be excluded first, especially in patients above forty years of age. Patient's occupation, associated complaints, smoking habit, addictions, previous surgeries, vocal abuse and previous history of pulmonary tuberculosis should be noted to find the cause.
2. *Examination:* Examination of the larynx by indirect laryngoscopy or flexible laryngoscopy is very helpful. Examination of the neck, oral cavity, nose and chest must be done thoroughly.
3. *Investigations:* Laboratory and radiological investigations should be done accordingly. Direct laryngoscopic examination and biopsy is required if any lesion or growth is present.

STRIDOR

Stridor is noisy breathing produced by the turbulent airflow through the narrow lumen of larynx and trachea. When stridor is present, complete respiratory obstruction may rapidly supervene and may require emergency tracheostomy. Stridor may be inspiratory, expiratory or biphasic in type. Laryngeal stridor is mostly inspiratory in type. Expiratory stridor is produced by lesions of the thoracic trachea and main bronchi. Biphasic stridor, both in inspiration and expiration is mostly due to subglottic and cervical tracheal lesions.

Etiology

Causes of Stridor in Children

1. Congenital causes.
   a. Laryngomalacia.
   b. Laryngeal web.
   c. Congenital cysts and tumors.
   d. Subglottic stenosis.
   e. Vocal cords paralysis.
2. Acute inflammation.
   a. Acute epiglottitis.
   b. Acute laryngitis.
   c. Acute laryngotracheobronchitis.
   d. Laryngeal diphtheria.
   e. Retropharyngeal abscess.
3. Foreign body in the larynx.
4. Juvenile laryngeal papillomatosis.
5. Laryngeal injuries.

Causes of Stridor in Adults

1. Inflammatory.
   a. Laryngeal tuberculosis.
   b. Retropharyngeal abscess.
   c. Parapharyngeal abscess.
   d. Acute and chronic laryngitis.
2. Trauma.
   a. Foreign body.
   b. Inhaling irritant fumes.
   c. Laryngeal injuries.
   d. Cut throat.
   e. Intubation granuloma.
   f. Subglottic stenosis.
   g. Vocal cords paralysis.
3. Tumors of the larynx.
4. Allergy causing angioneurotic edema of the larynx.
5. Compression of larynx or trachea from outside.
   a. Goiter.
   b. Carcinoma of thyroid gland.
   c. Mediastinal tumors.

Management

1. *History:* Detailed history taking is important regarding the mode of onset, duration, relation to feeding, cyanotic spells, foreign body ingestion and laryngeal trauma. Stridor in children should not be attributed to laryngomalacia without thorough investigations.
2. *Examination:* Whether stridor is inspiratory, expiratory or biphasic, indicates the probable site of obstruction. Stridor is always associated with respiratory distress. Thorough examination of the larynx, pharynx, oral cavity, nose, neck and chest must be done. Examination of the throat in cases of *epiglottitis* may precipitate laryngeal obstruction and sudden respiratory arrest may occur.

Investigations: Direct laryngoscopy is the key investigation in these cases to find out the cause of stridor. Radiological examination including plain X-ray, CT scan, and MRI may be needed. Other laboratory investigations are also needed.

DYSPNEA

Dyspnea or difficulty in breathing may occur due to narrowing of the lumen of larynx and trachea. Dyspnea due to laryngeal and tracheal causes is mostly associated with stridor. The causes of dyspnea due to laryngeal and tracheal lesions are the same as discussed with stridor.

PAIN IN THE LARYNX

Pain in the larynx is a less frequent symptom and occurs in few conditions of the larynx. The important and common causes of pain in the larynx are:

1. Acute laryngitis.
2. Perichondritis.
3. Acute epiglottitis.
4. Laryngeal injuries and cut throat.
5. Foreign body in the larynx.
6. Laryngeal tuberculosis.

BLEEDING OR BLOOD STAINED SPUTUM FROM THE LARYNX

This is also a less frequent laryngeal symptom. The common causes of bleeding from the larynx are:

1. Carcinoma of the larynx.
2. Hemangioma of the larynx.
3. Laryngeal tuberculosis.
4. Laryngeal injuries.
5. Foreign body in the larynx.

COUGH

Whenever there is an irritation in the larynx, cough will be produced to clear the irritant. There are many diseases of the larynx which cause cough, but the important ones are:

1. Acute laryngitis.
2. Acute laryngotracheobronchitis.
3. Chronic laryngitis.
4. Laryngeal tuberculosis.
5. Foreign body in the larynx or trachea.
6. Trauma to the larynx.

In history taking from a patient with complaint of cough, following points are important to note:

- Duration. Acute or chronic in nature.
- Onset.
- Productive or non-productive.
- Severity and character of the cough.
- Effect of posture or diurnal variation.
- Nature and character of the sputum if productive cough.
- Aggravating and relieving factors.
- Associated symptoms like fever, dyspnea, hoarseness etc.
- Occupation and nature of the job.

NECK MASS

Many diseases of the larynx are associated with neck mass or swelling (see chapter 54 for details). The common conditions are:

1. Laryngeal carcinoma.
2. Laryngocele.
3. Mesenchymal neoplasia arising from the laryngeal cartilage or muscles etc.

FOREIGN BODY

See chapter 46 for details.

DYSPHAGIA

Dysphagia may occur due to diseases of the larynx in addition to diseases of the oral cavity, pharynx and esophagus (see chapter 32 for details). Dysphagia in the laryngeal disease occurs due to close association with the hypopharynx and upper esophagus, the disease may spread from the larynx into these areas. Sometimes, chocking attacks may occur during swallowing because of improper closure of the larynx and spillover of the food especially liquid occurs within the larynx. Common causes of dysphagia due to laryngeal diseases are:

1. Laryngeal carcinoma.
2. Laryngeal injury.
3. Laryngeal tuberculosis.
4. Acute epiglottitis.
5. Tracheoesophageal fistula.
6. Vocal cord paralysis.
7. Foreign body in the larynx or trachea.

Chapter Summary and Key Points

Hoarseness and stridor are two most important and common symptoms of laryngeal diseases. Patient having hoarseness for more than three weeks must be examined and investigated thoroughly. Carcinoma of the larynx cannot be excluded in patients having chronic hoarseness, especially above forty years of age with a history of smoking. Stridor due to laryngeal causes is mostly inspiratory in type.

Best Choice Questions

Q1. A patient reports hoarseness of voice for last five to six months with no other significant complaint. What is the most probable site of pathology in this patient?

a. larynx.
b. nasopharynx.
c. oral cavity.
d. oropharynx.

Q2. A 35 year old female primary teacher comes with the complaint of hoarseness for last few months which is usually worst after returning from the school with no other significant complaint. What is the most probable diagnosis in this case?

a. intubation granuloma.
b. laryngomalacia.
c. vocal cord paralysis.
d. vocal nodules.

Q3. An 18-year-old male patient had a road traffic accident and presented supraglottic hematoma. He also had noisy breathing or stridor. What is the likely character of stridor in this patient?

a. on inspiration only.
b. on expiration only.
c. sometimes on inspiration and sometimes on expiration.
d. on deep expiration only.

Q4. A 45-year-old male patient comes with the complaint of inspiratory stridor. What is the most probable site of pathology in this patient?

a. hypopharynx.
b. larynx.
c. main bronchus.
d. trachea.

Q5. A 2-year-old boy was brought in with the complaint of recurrent stridor during exertion since birth. What is the most relevant further investigation in this patient?

a. biopsy/histopathology.
b. laryngoscopy.
c. X-ray chest.
d. X-ray neck (lateral view).

Answers with Explanations

1. a sound is produced by larynx.
2. d also called singer's node.
3. a.
4. b.
5. b to see interior of the larynx.

Direct Laryngoscopy

CHAPTER 44

- Rigid laryngoscopy
  - Indications
  - Procedure
- Microlaryngoscopy
  - Post-operative care
  - Complications
- Fiber-Optic Direct Laryngoscopy (FODL)

Direct laryngoscopy is a direct visualization of inside of the larynx and hypopharynx through an endoscope. Direct laryngoscopy is mainly of two types:

1. Rigid laryngoscopy.
2. Flexible fiber-optic laryngoscopy.

RIGID LARYNGOSCOPY

Rigid laryngoscopy is performed with a rigid type of direct laryngoscope. Two types of rigid direct laryngoscope are available viz. 'anterior commissure type' and 'sliding panel type'. Anterior commissure type is used for examination of the larynx and hypopharynx (Fig. 44.1 and Fig. 44.2), while the sliding panel type of laryngoscope is used in children to pass a bronchoscope through the larynx into the trachea.

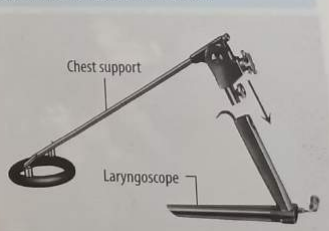
Indications

A. Diagnostic:
1. When indirect laryngoscopy is not possible because of non-cooperation of patient e.g. in infants, young children and anxious adult patients.
2. When indirect laryngoscopy is unsuccessful to examine the larynx properly because of a overhanging epiglottis or excessive gag reflex.
3. To confirm the findings of indirect laryngoscopy.
4. Hidden areas of the hypopharynx and larynx can be examined by direct laryngoscopy, which are difficult to examine by indirect laryngoscopy like anterior commissure, ventricles, base of epiglottis, subglottic region, lower part of the pyriform fossa and floor of the vallecula.
5. For taking biopsy from a laryngeal growth.

B. Therapeutic:
1. Removal of foreign bodies from the larynx and hypopharynx.
2. Removal of benign laryngeal lesions like vocal nodules, papilloma, polyp and cyst.
3. Treatment of congenital anomalies like congenital web and tumors.
4. For endoscopic treatment of laryngeal stenosis, intubation granuloma and vocal cord paralysis.

Fig. 44.1: Anterior commissure type of direct laryngoscope.

Fig. 44.2: Anterior commissure type of direct laryngoscope with chest support for fixation.



Procedure

Direct laryngoscopy is done under general anesthesia. The patient lies supine with flexion of neck on thorax and extension of head at atlanto-occipital joint. A piece of gauze is placed over the upper incisor teeth to protect them. Laryngoscope is held in the left hand and after lubrication, it is inserted by retracting the lips with the right hand. Laryngoscope is introduced by one side of the tongue and when posterior third of the tongue is reached, it is moved to the midline to bring the epiglottis in view. The epiglottis is lifted by passing the scope behind it to visualize the interior of the larynx. Structures of the larynx and hypopharynx are then examined serially. For performing procedures on the larynx, laryngoscope can be fixed or stabilized by the suspension system or chest support (Fig. 44.2 and Fig. 44.3). After the completion of the required procedure, laryngoscope is withdrawn and the oral cavity is examined for any injury.

Microlaryngoscopy

An operating microscope with an objective lens of 400 mm focal length is used with rigid laryngoscope to see and treat laryngeal pathology under magnification (Fig. 44.4). This procedure is called *'microlaryngoscopy'*.

Fig. 44.3: Laryngoscope in position and stabilized by the chest support.

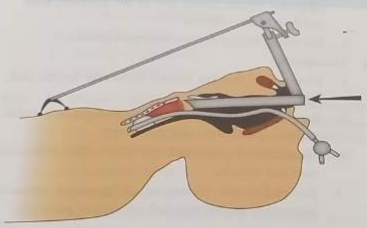


Fig. 44.4: Method of performing microlaryngoscopy.

Post-operative Care

The patient should be kept Nothing Per Orally (NPO) for four to six hours and placed in a left lateral position to prevent aspiration of blood or secretions into the lungs. He should be observed for respiratory rate, cyanosis and laryngeal spasm till he becomes fully conscious. If there is excessive laryngeal trauma during procedure, laryngeal edema may develop and cause respiratory distress. Systemic steroid is given to relieve edema. After the procedure on vocal cords, voice rest should be advised for a few days.

Complications

1. Anesthetic complications.
2. Damage and injury to the lips, teeth, tongue, oral cavity, larynx etc.
3. Injury to a tooth may dislodge it and get impacted in foreign body of aerodigestive tract.

Fig. 44.5: Flexible fiber-optic laryngoscope.

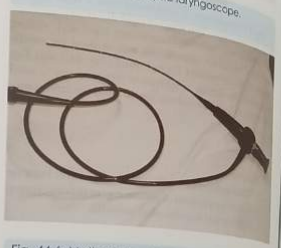
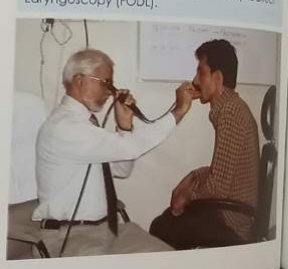


Fig. 44.6: Method of performing Fiber-Optic Direct Laryngoscopy (FODL).



4. Laryngeal edema.
5. Bleeding from biopsied site or from other site of injury.
6. Subluxation of the vertebral joint by forceful manipulation of neck.

FIBER-OPTIC DIRECT LARYNGOSCOPY (FODL)

Flexible Fiber-Optic Direct Laryngoscopy (FODL) is used to examine the interior of the larynx where a flexible fiber-optic laryngoscope is used (Fig. 44.5). This procedure is done under local anesthesia (10% xylocaine spray) as an OPD procedure in a sitting position or normal anatomical position (Fig. 44.6). The laryngoscope can be attached with a camera or TV monitor to see and record the pathology. Another advantage of flexible laryngoscopy is that, vocal cord mobility can be assessed more correctly which is difficult to assess with a rigid type because of general anesthesia and endotracheal intubation. Some flexible laryngoscope has a biopsy channel, through which biopsy can be taken.

Chapter Summary and Key Points

Direct laryngoscopy is direct visualization of the larynx using an endoscope. There are two types, rigid and flexible fiber-optic laryngoscopy. Rigid laryngoscopy is done to examine the larynx as well as to perform surgical procedures in the cavity of the larynx. Operating microscope can be used to see interior of the larynx through direct laryngoscope, called 'microlaryngoscopy'. Flexible laryngoscopy is mainly performed to examine the larynx. It is done under local anesthesia as an OPD procedure. Assessment of the vocal cords for mobility is more accurate with flexible laryngoscopy than rigid laryngoscopy.

Best Choice Questions

Q1. An ENT consultant ordered his registrar to perform indirect laryngoscopy on a 28-year-old male patient. Which instrument is used for this purpose?

a. flexible laryngoscope.
b. laryngeal mirror.
c. rigid laryngoscope.
d. sliding panel laryngoscope.

Q2. What is the main use of 'sliding panel' type of direct laryngoscope?

a. endoscopic treatment of laryngeal stenosis.
b. passing bronchoscope in children.
c. performing microlaryngoscopy in adults.
d. removal of foreign body from the larynx.

Q3. Microlaryngoscopy was planned for a 40-year-old female patient for removal of the vocal nodules. Which of the following objective lens is used in the operating microscope for this purpose?

a. 175 mm.
b. 250 mm.
c. 300 mm.
d. 400 mm.

Q4. While performing house job in the ENT department, you received a 40-year-old male patient from the operation theatre after direct laryngoscopy under general anesthesia. For how long will you keep this patient NPO (Nil Per Orally)?

a. 1 hour.
b. 2 hours.
c. 6 hours.
d. 12 hours.

Q5. A 42-year-old male patient came with the complaint of hoarseness in voice. What is the best method for assessing movements of the vocal cords among the following available tools?

a. flexible laryngoscopy.
b. indirect laryngoscopy.
c. laryngoscopy with anterior commissure type laryngoscope.
d. microlaryngoscopy.

Answers with Explanations

1. b.
2. b directly to pass bronchoscope is difficult.
3. d.
4. c.
5. a as it is done under local anesthesia, vocal cords are not paralyzed.

CHAPTER 45 Congenital Malformations of the Larynx

- Laryngomalacia
- Congenital laryngeal web
- Laryngeal atresia
- Congenital laryngeal paralysis
- Congenital cyst and tumor

There are numerous congenital malformations of the larynx. Important among them are discussed below.

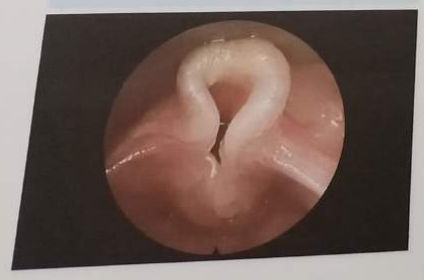
LARYNGOMALACIA

The infantile larynx differs from the adult larynx in many ways. It is small, narrow, high and soft with lax mucosa. In *laryngomalacia*, the larynx is of an exaggerated infantile type. The epiglottis is long and narrow and is folded backwards at each lateral edge. This converts the epiglottis into an almost incomplete cylinder (omega shaped). The aryepiglottic folds are also approximated (Fig. 45.1 and Fig. 45.2). As a result of this, the laryngeal inlet is reduced to a cruciform slit. The larynx is lined with lax and thick mucosa, so the edges of this cruciform laryngeal inlet are sucked inwards on each inspiration.

Clinical Features

Stridor is usually the only symptom. It appears at or soon after birth. It is mainly inspiratory in phase and croaking in character. It is increased on exertion and reduces by rest and sleep. Stridor may reduce spontaneously with periods of quiet breathing intermittently. Voice and cry of the child are unchanged and normal. Ronchi are present sometimes at the bases of lungs.

Fig. 45.1 Laryngomalacia.



Diagnosis

Diagnosis can be made on history and examination. Inspiratory stridor without hoarseness is always suggestive of this condition. Direct laryngoscopy will confirm the diagnosis. Differential diagnosis includes:

1. Congenital web of the larynx.
2. Laryngeal papilloma.
3. Laryngeal cyst.
4. Laryngeal diphtheria.
5. Simple acute laryngitis.

Treatment

Stridor disappears as the child grows, usually between the second and fifth years of life. In majority of the cases only reassurance and explaining its nature to the parents is required. Rarely in severe cases, tracheostomy is needed but it should be avoided as far as possible.

CONGENITAL LARYNGEAL WEB

Congenital laryngeal web consists of a membrane lying in between the two vocal cords. It is always present at the

Fig. 45.2 Laryngomalacia note the omega shaped epiglottis and cruciform laryngeal inlet.

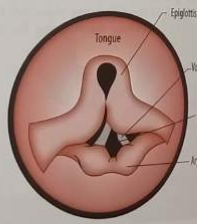


Fig. 45.3: Congenital laryngeal web.

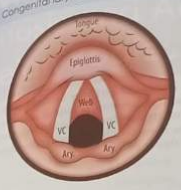


Fig. 45.4: Congenital laryngeal web.

anterior part of the glottis (Fig. 45.3 and Fig. 45.4). The web consists of a fibrous tissue stroma covered by epithelium. The degree of stridor and dysphonia is proportional to the size of web. A small web causes little respiratory difficulty while a larger web produces severe symptoms and should be treated immediately.

Clinical Features

Symptoms vary with the size of web. Hoarseness is usually present with a weak cry in almost all cases. Inspiratory stridor occurs in severe cases, which may be accompanied by dyspnea on exertion. Direct laryngoscopy will show the web, which may be white or pink, thin or very dense.

Treatment

No treatment is required in small webs, which may safely be left until the larynx has stopped growing. In cases where the web is thin, it can be excised endoscopically with micro-scissors or with CO_2 LASER. In severe cases, excision of the web through laryngofissure is advised. Tracheostomy may be needed in emergency to relieve dyspnea in severe cases.

LARYNGEAL ATRESIA

It is in fact a web filling whole of the larynx. It is most common in the subglottic region and represents the ultimate in stenosis (complete closure). It is incompatible with life, unless it is recognized at birth and immediate tracheostomy is performed.

CONGENITAL LARYNGEAL PARALYSIS

This is rare and if present, is associated with other congenital anomalies. Unilateral paralysis of the vocal cord is more common than the bilateral.

Clinical Features

Unilateral vocal cord paralysis causes a weak cry in infants. Bilateral paralysis will produce severe stridor and respiratory distress. Cyanosis may occur in bilateral cases.

Treatment

In unilateral cases, compensation may occur from the other cord and no treatment is needed. For severe unilateral cases and bilateral cases, surgical intervention is required.

CONGENITAL CYST AND TUMOR

Congenital cyst of the larynx occurs as developmental anomalies in the ventricle and saccule. They project into the laryngeal lumen and produce dysphonia and stridor in proportion to the size. These are treated surgically by direct microlaryngeal surgery.

Congenital tumors include *hemangioma* and *lymphangioma*. These are usually found in subglottic region or on vocal cords and can be treated by CO_2 laser. Larger ones may require open surgical removal.

Chapter Summary and Key Points

Laryngomalacia is an exaggerated infantile type of larynx and stridor is usually the only complaint. The condition resolves spontaneously as the child grows. Tracheostomy shou[illegible]avoided as far as possible. In laryngomalacia, voice and cry of the child is normal while in laryngeal w[illegible]s[illegible]always present.

Difficult words

Laryngofissure approach: It is a surgical approach to interior the larynx. The larynx is exposed through a neck incision and opened in the midline.

Best Choice Questions

Q1. A 10-month-old boy was diagnosed with laryngomalacia. What will be the appearance of epiglottis in this patient, on a laryngoscopy?

a. long and broad.
b. long and narrow.
c. short and broad.
d. short and narrow.

Q2. A one-year-old child was diagnosed with laryngomalacia. What is the likely shape of the epiglottis in such patient?

a. beta shape.
b. delta shape.
c. gamma shape.
d. omega shape.

Q3. Direct laryngoscopy was done on a child with complaint of stridor and diagnosed with laryngomalacia. What will be the shape of laryngeal inlet in this patient?

a. circular.
b. cruciform.
c. oblong.
d. oval.

Q4. Laryngoscopy was performed on a one-year-old boy who was clinically diagnosed with laryngomalacia. What will be the appearance of the mucous membrane of larynx in this patient?

a. lax and thick.
b. thin and atrophic.
c. thin and shiny.
d. tight and thick.

Q5. A 6-month-old girl was diagnosed with laryngomalacia. What is the main presenting complaint in such a patient?

a. dyspnea on sleeping.
b. expiratory stridor.
c. hoarseness.
d. inspiratory stridor.

Q6. A 2-year-old girl was brought with the complaint of inspiratory stridor on exertion. There is no stridor during rest or sleep and her voice was normal. What is the best treatment option in this case?

a. arytenoidectomy.
b. reassurance.
c. thyroplasty.
d. tracheostomy.

Q7. A 6-month-old boy was brought in with complaint of stridor and hoarse cry since birth. Direct laryngoscopy was performed, which showed a fibrous membrane between the vocal cords. What is the most likely location of this membrane?

a. anterior part of the glottis.
b. inferior part of the glottis.
c. middle part of the glottis.
d. posterior part of the glottis.

Q8. Differential diagnosis of laryngomalacia and congenital laryngeal web was made clinically in a 6-month-old boy. Which of the following point in history is diagnostic in favor of laryngomalacia?

a. dyspnea on exertion is present in laryngomalacia only.
b. stridor is absent in congenital laryngeal web.
c. voice is hoarse in laryngomalacia.
d. voice is normal in laryngomalacia.

Answers with Explanations

1. b.
2. d laterally curved.
3. b.
4. a.
5. d.
6. b condition resolves spontaneously.
7. a.
8. d as vocal cords and its mobility are normal.

Laryngotracheal Trauma, Stenosis and Aerodigestive Foreign Bodies

CHAPTER 46

- Laryngotracheal trauma
  - Procedure
  - Post-operative care
  - Complications
- Laryngotracheal stenosis
  - Indications
  - Procedure
  - Post-operative care
  - Complications
- Laryngeal and tracheobronchial foreign bodies
  - Pharyngeal and esophageal foreign bodies
  - Esophagoscopy
- Bronchoscopy
  - Indications

LARYNGOTRACHEAL TRAUMA

Respiratory obstruction is one of the important cause ...ath in road traffic accidents and other trauma. Majority ...these deaths are due to respiratory blockage as a result of ...ngeal and tracheal injuries. The laryngeal trauma can ...classified into *blunt trauma* like road traffic accidents and *penetrating trauma* as caused by bullet injuries, stabs or cut ...ound. The structures involved due to injury depend on ...e nature of trauma. The changes resulting from blunt ...uries may be extra-laryngeal or intra-laryngeal or may ...olve cartilages of the larynx. In penetrating injuries, ...e larynx is involved along with damage to other vital ...ructures of the neck.

Pathology

Different types of pathological changes may occur ...s a result of injury, which to a great extent depend on ...e nature and severity of trauma. Blunt or compressed ...uries may lead to:

1. *Submucosal hemorrhage:* Hematoma may form in any ...rt of the larynx, especially the supraglottis and ...praglottic area.
2. *Fracture of the laryngeal cartilages:* The thyroid and cricoid ...rtilage may be involved. Thyroid cartilage is more ...mmonly involved because it is more exposed to ...uma. In addition, calcification and ossification ...curs early in the thyroid cartilage and as a result its ...asticity is lost. A fracture of the cricoid cartilage is ...arly always fatal because of the swelling of subglottic ...gion.
3. *Fracture of the hyoid bone:* It may occur in some cases.
4. *Surgical emphysema:* Due to laryngeal and tracheal inju... ...y air may ...nd collect in the soft tissues of neck, ...face, chest ...ven in severe cases in the abdomen ...
5. *Perichondritis:* This results from secondary bacterial infection following of trauma.
6. *Adhesions and stenosis:* This may occur as a complication of acute trauma, if it is not treated or diagnosed properly.

Clinical Features

The symptoms are mainly because of interference in respiratory passage. It depends on the nature of injury, severity and site of trauma. Dyspnea is sudden in onset and may be very marked with cyanosis. Change of voice is frequently present. Pain and tenderness is variable depending on the trauma. Hemoptysis and dysphagia may be present sometimes. On clinical examination, because of presence of fractured fragments of laryngeal cartilages or hyoid bone, crackling sensation is present. External swelling due to emphysema or hematoma with external bruises may be seen. On indirect laryngoscopy swelling due to submucosal hematoma or edema may be noted. *Schaefer Classification* is usually used for grading purpose and it provides a useful framework for evaluating an acute laryngeal injury.

Clinical Features of Laryngotracheal Trauma

- Dyspnea.
- Cyanosis.
- Change of voice.
- Pain in the neck.
- Hemoptysis.
- Dysphagia.
- Crepitus over fracture site.
- External swelling: emphysema or hematoma.
- Submucosal hematoma or edema.

Diagnosis

History and physical examination of the neck give clues about the nature and severity of the trauma. Radiography including plain X-rays and CT scan is of great help in diagnosing the site, severity and nature of laryngeal injury.

Treatment

Maintenance of airway is the main aim in cases of laryngeal injury. Tracheostomy may be required immediately. Systemic antibiotic should be given in all cases to prevent perichondritis. Systemic steroid is sometimes required to reduce laryngeal edema. Subsequent treatment depends on the nature of trauma. Other supportive treatment like intravenous fluids and nasogastric intubation may be needed. Fracture of the cartilages may need open surgical exploration, repair, reduction and fixation.

Treatment of Laryngotracheal Trauma

- Maintenance of the airway.
- Tracheostomy.
- Prophylactic antibiotic.
- Systemic steroid.
- Intravenous fluids.
- Nasogastric intubation.
- Surgical treatment: exploration, repair, reduction and fixation.

LARYNGOTRACHEAL STENOSIS

Laryngotracheal stenosis may occur as a complication of acute laryngeal injuries. In the developed countries, road traffic accident is the most important cause of laryngotracheal stenosis. Other important causes include prolonged endotracheal intubation, high tracheostomy, partial laryngectomy and chronic granulomatous diseases involving the larynx and trachea. Stenosis may occur at any place in the larynx or adjoining trachea.

Pathology

Stenosis may occur in supraglottis, subglottis or upper tracheal region separately or may involve more than one region. Supraglottic stenosis usually results from organization of the submucous hematoma. Glottic stenosis may occur due to the web formation at the anterior part of vocal cords or due to fixation of arytenoid. Subglottic stenosis may result from injury to the cricoid cartilage. The cricoid cartilage is the only complete ring in the entire respiratory tract and its integrity is essential for normal patency. If cricoid cartilage is damaged, narrowing of the lumen and stenosis results. Upper part of the trachea may be involved in subglottic stenosis.

Clinical Features

Clinical features will depend on the site and severity of stenosis. In majority of cases, decannulation of the tracheostomy tube is not possible after the acute phase is over. Whenever removal of tracheostomy tube is tried, patient develops respiratory obstruction, which is relieved by reinsertion of a tracheostomy tube. In glottic stenosis there may be change of voice or aphonia. Change of voice may also be present in other types of stenosis. Patient is unable to clear his secretions by coughing. On laryngoscopy, narrowing of the supraglottic region, deformity, web formation or vocal cords immobility may be seen. Sometimes narrowing in the subglottis or upper tracheal region may be visible on indirect laryngoscopy.

Diagnosis

Direct laryngoscopic examination is essential to find the nature, site and extent of stenosis. Radiography has a very important role in this respect, CT scan and MRI is of great help.

Treatment

Overall prognosis in laryngotracheal stenosis especially in the subglottis is poor. Sometimes patient needs a permanent tracheostomy for entire life. The results for glottic and supraglottic stenosis are better. Treatment modalities available for laryngeal stenosis are open surgical procedures, endoscopic procedures with a diode or CO_2 laser.

In supraglottic stenosis, excision of the scarred and fibrous tissues can be done surgically with cold knife. Glottic web can be excised surgically by a laryngofissure approach. In arytenoid fixation, it can be removed or fixed in lateral position. In subglottic and tracheal stenosis, surgical excision of the scarred tissues can be done. In severe cases, excision of the whole stenosed portion with reanastomosis is done.

LARYNGEAL AND TRACHEOBRONCHIAL FOREIGN BODIES

Laryngeal foreign bodies are rare. Most of the foreign bodies entering through the mouth pass through the larynx and get lodged in the trachea or mostly in bronchi. Bronchus on the right side is involved more than the left side, because the right bronchus is wider and more in line with the trachea. Very rarely, a foreign body may get stuck up in the glottic or subglottic region. Sharp foreign bodies like paper pins and glass pieces may get impacted in the larynx. Foreign bodies like plastic toys (whistle), piece of chalia (beetle nut), peanuts, artificial teeth, toothpicks and needles etc. usually get impacted in the bronchi.

Clinical Features

It depends on the site of impact, size and nature of the foreign body. In laryngeal foreign bodies, it is large enough

block the respiratory passage, and cause immediate death. Small laryngeal foreign bodies may be compatible with life. Dyspnea, cough, stridor and hoarseness may be present in small laryngeal foreign bodies. Tracheal foreign bodies behave in the same manner, where large foreign body may cause sudden death.

In bronchial foreign bodies, signs and symptoms vary in nature and size of the body. Cough and dyspnea may be present initially at the time of accident. Vegetative foreign bodies like chalia and peanuts produce an intense inflammatory reaction in the mucosa. Symptoms of acute tracheobronchitis may be present. Emphysema, atelactasis, lung abscess, pneumonia or even lung collapse may occur. Non-vegetative foreign bodies like whistle, needle, metallic pieces etc. may remain silent for sometime because of minimal local inflammatory reaction. Atelactasis occurs if the foreign body completely obstructs the lumen. In partial obstruction, obstructive emphysema may develop.

Diagnosis

Radiopaque foreign body may be seen on a plain radiograph (Fig. 46.1). Radiolucent foreign body, especially vegetative may produce changes on radiology due to inflammatory reaction or obstruction. Emphysema, pneumonia, lung collapse and bronchitic changes may be seen.

Treatment

In adults with laryngeal foreign body, the *Heimlich's maneuver* may be life saving. The principle of this maneuver is to dislodge laryngeal foreign body by air pressure from below. The person performing this maneuver stands behind the patient and places his arm around the patient's lower chest and epigastric region (Fig. 46.2). With both of his arms, he gives a sudden thrust directed upwards and backwards below the epigastrium. This compresses the abdomen and as a result air escapes from the lungs and causes dislodgment of the foreign body. Infants or small children are held upside down and a slap is given on his back. This may dislodge a laryngeal foreign body and save his life. Tracheostomy may be needed in a laryngeal foreign body. Removal of the foreign body is then done by direct laryngoscopy under general anesthesia (see chapter 44). Removal of the tracheal and bronchial foreign body is done through a rigid type of bronchoscopy under general anesthesia.

BRONCHOSCOPY

Two types of bronchoscopy procedures are used:

1. Rigid bronchoscopy.
2. Flexible fiber-optic bronchoscopy.

In ENT practice for the removal of foreign body from the trachea or bronchus, rigid type of bronchoscopy is used. Flexible fiber-optic bronchoscopy is mainly used for diagnostic purpose.

Indications

Indications of rigid bronchoscopy are both *diagnostic* and *therapeutic*. For therapeutic purpose, removal of foreign body from the trachea and bronchus is the main indication. For diagnostic purpose, rigid bronchoscopy is rarely performed now.

Procedure

Bronchoscopy is performed under general anesthesia where a small lumen size endotracheal tube is preferred. Patient lies in supine position with flexion at the cervical vertebrae and extension of head at atlanto-occipital joint. This brings the laryngotracheal axis in line with the oral axis (Fig. 46.3). Bronchoscope is held in the right hand and introduced through the mouth into the larynx. In infants and young children, direct introduction of the bronchoscope is difficult, so first, a direct laryngoscopy is performed with sliding panel direct laryngoscope. Vocal cords are seen and bronchoscope is introduced through the laryngoscope. After introducing the bronchoscope,

Fig. 46.1: Plain X-ray chest showing radiopaque foreign body in the left main bronchus.

Fig. 46.2: Heimlich's maneuverer.

Fig. 46.3: Method of performing a rigid bronchoscopy.

laryngoscope is withdrawn by removing its sliding panel. Endotracheal tube is also withdrawn and anesthetic gases are connected directly to the bronchoscope. Bronchoscope is then advanced and the entire tracheobronchial tree is examined. Foreign body can be removed through the rigid bronchoscope by holding it with crocodile forceps. If foreign body is large and is not able to pass through the bronchoscope, the bronchoscope is also withdrawn along with the foreign body.

Post-Operative Care

The patient is kept Nil Per Orally (NPO) for four to six hours. Initially, he is kept in a lateral position so as to prevent aspiration of blood or secretions into the lower respiratory tract. He should be observed for any respiratory distress, stridor, cyanosis or blood stained sputum.

Complications

1. Anesthetic complications.
2. Injury to structures in the mouth, teeth, pharynx and larynx.
3. Laryngeal edema.
4. Hypoxia during the procedure.
5. Bleeding.
6. Laryngeal spasm.

PHARYNGEAL AND ESOPHAGEAL FOREIGN BODIES

Foreign body impact in the pharynx and esophagus is quite common. In the pharynx, an ingested foreign body may lodge in the tonsil, base of the tongue, vallecula and pyriform fossa. In these places, usually sharp objects like fish bones and needles are impacted. The most common site of impact for ingested foreign body is at or above the cricopharyngeus sphincter. The site of impact of the foreign body depends mainly on its size and shape.

Children are most commonly the victims, as they have the tendency to put different objects in the mouth. These objects may get lodged in the aerodigestive tract while playing. In adults, foreign body may get lodged accidentally or in psychotic patients deliberately to commit suicide. Common foreign bodies in the digestive tract are coin, fish bone, meat bolus, chicken bone, dentures, safety pin and needle etc.

Clinical Features

Usually, there is a history of foreign body ingestion especially in adults. In children, history of foreign body ingestion may not be obvious and foreign body may remain symptomless for quite a long period. Pain or discomfort in the throat is the predominant symptom. Dysphagia is present especially in cases of a large foreign body. Patient may have absolute dysphagia i.e. he may not be able to swallow his own saliva. Sometimes, dyspnea and hoarseness may occur when foreign body is impacted near the cricopharynx. Dyspnea may occur in children, when large esophageal foreign bodies may compress the trachea.

On examination, pooling of saliva in the pyriform fossa may be present, as seen by indirect laryngoscopy. Sometimes, foreign body may be visible in the posterior region on indirect laryngoscopy. Localized tenderness in the lower part of the neck may be present. Laryngeal crepitus is lost when foreign body is lodged at cricopharynx or postericoid area.

Clinical Features of Pharyngeal and Esophageal Foreign Bodies

- Obvious history of FB may or may not be present.
- Pain or discomfort in the throat.
- Dysphagia.
- Dyspnea or hoarseness: if causing laryngeal or tracheal compression.
- Pooling of saliva.
- FB may be visible on indirect laryngoscopy.
- Localized tenderness.
- Loss of laryngeal crepitus.

Investigations

Radiography is very important and helpful in cases of foreign body, especially if it is radiopaque (Fig. 46.4 and 46.5). Plain X-rays are taken in lateral, anteroposterior and oblique views. Non-opaque foreign body may be visualized on X-ray barium swallow.

Treatment

Impacted foreign body should be removed as early as possible. In most cases, removal is possible through a rigid endoscope (esophagoscopy). In cases of sharp foreign body which penetrateds through the wall of the esophagus, an

Fig. 46.4: Plain X-ray neck (lateral view) showing a foreign body (bone piece) lodged at postcricoid region

endoscopic removal is not possible. In such cases, open surgical procedure is required to remove the foreign body.

ESOPHAGOSCOPY

Two types of esophagoscopy procedures are used:

1. Rigid esophagoscopy.
2. Flexible fiber-optic esophagoscopy.

In ENT practice for the removal of foreign body from the pharynx or esophagus, rigid type of esophagoscopy is used. Flexible fiber-optic esophagoscopy is mainly used for diagnostic purpose.

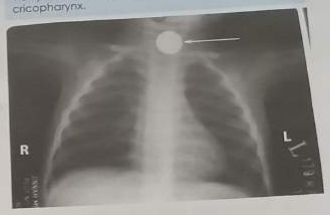
Indications

Indications of rigid esophagoscopy are both diagnostic and therapeutic. For therapeutic purpose, removal of foreign body from the pharynx and esophagus is the main indication. For diagnostic purpose, rigid esophagoscopy is rarely performed now.

Procedure

Rigid esophagoscopy is performed under general anesthesia with endotracheal tubation. Patient lies in supine position with flexion at the cervical vertebrae and extension of head at the atlanto-occipital joint. Esophagoscope is held in the right hand and introduced through the mouth after lubricating it. It is introduced further by keeping it in the midline and the structures are identified like base of the tongue and epiglottis. The scope is then passed behind the epiglottis till the upper esophageal sphincter. Sustained pressure with the scope is maintained on the cricopharyngeous sphincter which causes its opening. Now the scope is further advanced into the esophagus. Foreign body if present is removed using suitable forceps like crocodile forceps. In case of large foreign body, esophagoscope is also withdrawn along with it.

Fig. 46.5: Plain X-ray neck and chest (anteroposterior view) showing a foreign body (a coin) lodged at the cricopharynx.



Post-Operative Care

The patient is kept Nil Per Orally (NPO) for four to six hours. He is observed for any sign and symptom of esophageal perforation post-operatively. The features of esophageal perforation are, chest pain, interscapular region pain, surgical emphysema in the neck or chest, fever and dyspnea. Initially, water sips are allowed and if there is no problem then soft diet can be allowed.

Complications

1. Anesthetic complications.
2. Injury to structures in the mouth, lips, teeth, pharynx and larynx.
3. Esophageal perforation.
4. Hypoxia during the procedure by compression of the trachea.
5. Bleeding.

Chapter Summary and Key Points

Respiratory obstruction is one of the important causes of death in road traffic accidents and other trauma. Maintenance of the airway by performing tracheostomy is required immediately. Laryngotracheal stenosis occurs mostly as a result of acute laryngeal injury, when it is not treated properly. Overall prognosis of laryngotracheal stenosis is poor and sometimes the patient may need permanent tracheostomy. Foreign body in the aerodigestive tract needs immediate removal as early as possible. In majority of cases, these foreign bodies can be removed using a rigid endoscope.

Best Choice Questions

Q1. After a road traffic accident, a 20-year-old man suffered severe injury on his neck. He was immediately shifted to the hospital but before he could reach, he died. What is the most common cause of death in such patient?

a. bleeding from major neck vessels.
b. injury to vagus nerve.
c. respiratory obstruction.
d. spinal cord injury.

Q2. A father brought his 4-year-old son with the complaint that he had ingested a coin two hours ago. After the incident, he was complaining of difficulty in swallowing. What is the most likely site of impact of foreign body in this case?

a. cricopharynx.
b. larynx.
c. esophagus.
d. oropharynx.

Q3. A 30-year-old man came to the ER with the complaint that during lunch, a fish bone got lodged in his throat. What is the most common site of impact of such foreign body?

a. floor of the mouth.
b. gums.
c. soft palate.
d. tonsil.

Q4. A surgeon performed an esophagoscopy and removed a lodged meat bolus from the esophagus. What is the most common age group for impact of such foreign body?

a. infant.
b. children.
c. young adult.
d. old person.

Q5. An 8-year-old boy was brought with the complaint that he had ingested some foreign body which was lodged in his throat. Which of the following sign on clinical examination is most important for diagnosis of an impacted foreign body?

a. congested larynx and pharynx.
b. difficulty in opening the mouth.
c. immobility of the tongue.
d. pooling of saliva on indirect laryngoscopy.

Q6. A foreign body got lodged in the right main bronchus of a 6-year-old boy. Which of the following foreign body is most harmful for this patient?

a. artificial tooth.
b. metallic nail.
c. peanut.
d. plastic whistle.

Q7. Laryngotracheal stenosis was developed in a 38-year-old lady as a complication of some maneuverer undertaken in the hospital for treatment. Which of the following is most likely responsible for such complication?

a. excision of vocal nodule.
b. flexible laryngoscopy.
c. microlaryngoscopy.
d. prolonged endotracheal intubation.

Answers with Explanations

1. c most blunt neck trauma causes laryngeal and tracheal injury.
2. a narrowest part.
3. d.
4. d meat is not chewed properly because of absent teeth and poor muscle power.
5. d it means there is obstruction lower down so even saliva is not going down.
6. c vegetative foreign body causes intense inflammatory reaction.
7. d endotracheal tube should not be kept for more than 72 hours.

CHAPTER 47

Vocal Nodules and Laryngocele

- Vocal nodules
  - Pathology
  - Clinical features
  - Differential diagnosis
  - Treatment
- Laryngocele
  - Clinical features
  - Diagnosis
  - Treatment

VOCAL NODULES

It is a condition which occurs in people who use their voice excessively with straining or faulty production. It is also called *'singer's node'* or *'screamer's node'*. Small nodular thickenings are present on the true vocal cord on both sides at the junction of the anterior one-third and posterior two-thirds of the cord.

Pathology

As the name suggests this condition is seen in singers, teachers, hawkers, actors etc. It is also seen in mothers of young children who shout a lot and people talking to the deaf. These people sometimes squeeze their voice. As a result of this, a small hematoma is formed at the point of maximum impact of vocal cords. Due to repeated straining, this hematoma may organize and forms nodular thickening. These are always bilateral, grayish white in color and at the junction of anterior one-third and posterior two-thirds of the cords (Fig. 47.1).

Clinical Features

The predominant symptom is hoarseness. It may appear quite suddenly after one episode of strain or may appear slowly and insidiously over a period of weeks and months. Vocal fatigue is present. In indirect laryngoscopy or fiberoptic laryngoscopy, nodules are seen on the vocal cords bilaterally and symmetrically.

Fig. 47.1: Vocal nodules.

Differential Diagnosis

This condition has to be differentiated from other causes of chronic hoarseness (see chapter 43).

Treatment

Voice rest is essential and sometimes may cure recent and small nodules. Well-formed nodules are to be removed through direct laryngoscopy under an operating microscope *(micro-laryngeal surgery)* by precise removal without damage to the vocal cords. Vocal nodules can also be removed by laser. Speech therapy is essential to educate the patient about voice production.

LARYNGOCELE

A *laryngocele* is a bulbous air containing expansion of the laryngeal ventricle and the saccule. It is mostly unilateral but sometime a bilateral laryngocele may occur. Expiration against resistance encourages the formation of laryngocele as occurs in glass blowers and trumpeters. It is classified into the following types:

1. Internal.
2. External.
3. Combined internal and external or mixed.

Internal laryngocele is confined to the interior of the laryngeal framework. It is present under the mucosa of vallecula and pharyngo-epiglottic fold and enters the pre-epiglottic space. *External laryngocele* enlarges and herniates to find its way outside the laryngeal framework by passing around the lateral margin of the thyrohyoid membrane and presents in the neck. In combined or mixed type, features of both internal and external laryngocele are present.

Clinical Features

Hoarseness or change of voice is present in almost all cases. In the internal type, a swelling may be seen under the vallecula. In external laryngocele, a swelling in the neck is present, which increases on coughing, blowing or Valsalva's maneuverer (Fig. 47.2). Sometime, a large laryngocele may cause respiratory obstruction and stridor.

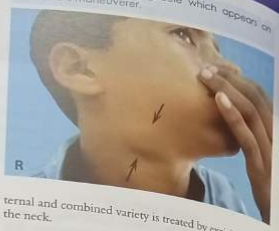
Diagnosis

Plain radiograph of the neck may show aircontaining sac. The sac will increase in size when a radiograph is taken during expiration against resistance (Valsalva's maneuverer). CT scan is helpful in assessing the size and extent of the laryngocele.

Treatment

The internal laryngocele is either excised or marsupialized endoscopically (microlaryngoscopy), while the external and combined variety is treated by excision through the neck.

Fig. 47.2: External laryngocele which appears on Valsalva's maneuverer.



Chapter Summary and Key Points

Vocal nodules or singer's nodes are seen in people who use their voice excessively. Nodules are typically present at the junction of the anterior one-third and posterior two-thirds of the true vocal cords, bilaterally. This condition is treated by excision of the nodules using microlaryngoscopy. Laryngocele is a bulbous air containing expansion of the laryngeal ventricle and saccule.

Best Choice Questions

Q1. Which of the following condition is also called as 'Singer's node'?

a. laryngeal papilloma.
b. vocal cord granuloma.
c. vocal cord polyp.
d. vocal nodule.

Q2. A 45-year-old primary school teacher reported gradually progressing hoarseness of voice for last 1 year. On laryngoscopy, bilateral nodular thickenings are seen on the true vocal cords. What is the most likely location of this lesion on the true vocal cord?

a. close to anterior commissure.
b. close to posterior commissure.
c. junction of anterior one-third and posterior two-thirds.
d. junction of middle one-third and posterior one-third.

Q3. A 40-year-old female school teacher came in OPD with the complaint of gradually progressing hoarseness of voice for last 2 years. Direct laryngoscopy was performed which showed a nodular lesion on the true vocal cord. What is the most likely appearance of this nodular lesion?

a. bilateral and bluish in color.
b. bilateral and grayish white in color.
c. unilateral and grayish white in color.
d. unilateral and purplish red in color.

Q4. A 42-year-old male patient presented a reducible swelling on the right side of his neck. On clinical examination, the swelling appears only while coughing and disappears otherwise. What could be the most likely profession of this patient?

a. glass blower.
b. leather worker.
c. singer.
d. teacher.

Answers with Explanations

1. d also called screamer's nodes.
2. c site of maximum impact.
3. b.
4. a also common in trumpeters.

CHAPTER 48

Inflammatory Diseases of the Larynx

- Acute laryngitis in adults
- Acute laryngitis in children
- Acute laryngotracheobronchitis
- Acute epiglottitis
- Laryngeal diphtheria
- Chronic laryngitis
- Tuberculosis of the larynx
- Perichondritis of the larynx

ACUTE LARYNGITIS IN ADULTS

This is an acute superficial inflammation of the laryngeal mucous membrane.

Etiology

Acute laryngitis occurs either as part of generalized upper respiratory tract infection or as a localized laryngitis. It is primarily a viral infection but secondary bacterial infection may occur. Patient suffering from sinusitis, pharyngitis or tonsillitis is prone to develop laryngitis as well. Bacteria responsible for this condition is same as in other upper respiratory tract infections like the streptococci, pneumococci, hemophilus influenzae, moraxella catarrhalis etc. Smoking, vocal abuse, inhalation of irritant fumes and gases, localized trauma due to intubation or endoscopic examination are all predisposing factors.

Pathology

There are various stages and degrees of inflammation. In the initial stage, the mucosa is congested and reddened. Edema follows soon and the whole laryngeal mucosa is involved including the vocal cords. Sticky mucopurulent exudate may cover the entire laryngeal surface. Due to edema of the vocal cords, the voice will become hoarse and in severe cases even loss of voice may occur.

Clinical Features

The signs and symptoms of the upper respiratory tract infection may be present before involvement of the larynx. Change of voice or hoarseness will be present with involvement of the larynx and vocal cords. Discomfort in the throat is common and even pain may be present in severe cases. An irritating and dry cough is present. Dyspnea is mostly absent in adults. Generalized symptoms like fever, malaise and headache are all present.

On indirect laryngoscopic examination, the entire larynx is found to be reddened and edematous, including the vocal cords. Sticky secretions may be seen in the larynx. Inflammation of other areas of upper respiratory tract may also be present.

Clinical Features of Acute Laryngitis in Adults

- Hoarseness or change of voice.
- Pain or discomfort in the throat.
- Cough: mostly dry and irritating.
- Generalized symptoms: fever, malaise and headache.
- Dyspnea: mostly absent.
- Larynx: congested and edematous.
- Sticky secretions in the larynx.

Treatment

This is a viral infection and the condition usually resolves in a few days. Voice rest is essential with steam inhalation and general rest. Antipyretic, anti-inflammatory and cough suppressant are needed for symptomatic relief. Systemic antibiotic is given in cases of infective origin and sometimes as prophylaxis to prevent secondary bacterial infection.

Treatment of Acute Laryngitis in Adults

- Voice rest.
- Steam inhalation with Tinc. Benzoin Co.
- General: rest.
- Anti-inflammatory and antipyretic drugs.
- Cough suppressant.

ACUTE LARYNGITIS IN CHILDREN

Acute laryngitis in children is a *more serious* condition than in adults. This is because of anatomical variations

in the larynx in infants and children. In addition, spasm of the laryngeal muscles may occur very easily in a child due to infection and he/she is less able to cough out the secretions. The enology and organisms are same as in acute laryngitis in adults.

Clinical Features

The condition is more aggressive in children. Laryngeal spasm may develop suddenly especially during coughing. Dyspnea, cyanosis and stridor may develop as a result of inflammation and laryngeal spasm. When stridor is present, it is inspiratory in type and the condition is called *'laryngitis stridulosa'*. Other features like hoarseness, fever, malaise, pain and cough will be present in varying degree.

Differential Diagnosis

This condition in a child is to be differentiated from laryngeal diphtheria, foreign bodies in respiratory tract and other congenital causes of stridor. In laryngeal diphtheria, the child is very toxic and ill with low-grade fever and characteristic membrane formation in the larynx or pharynx.

Treatment

Treatment includes bed rest and systemic antibiotic is given in full dose. Symptomatic treatment include humidification, anti-inflammatory and antipyretic drugs. Systemic steroid may be needed in severe cases to relieve laryngeal edema. Tracheostomy may be needed in severe cases when there is respiratory obstruction due to edema and spasm.

ACUTE LARYNGOTRACHEOBRONCHITIS

Acute laryngotracheobronchitis occurs usually in infants and young children when there is involvement of trachea and bronchi along with the larynx. This condition is usually caused by *hemolytic streptococci* but *viruses* may be responsible for it. It may occur in epidemics.

The inflammation rapidly spreads to involve the mucous lining of the entire laryngotracheo-bronchial tree. Congestion, edema, cellular infiltration and exudation of the mucous lining soon follow. Due to drying and detachment of crust during coughing, blood stained discharge may be present.

Clinical Features

Clinical features are similar to acute laryngitis in children but the condition is much more severe and aggressive. There is dry and croupy cough with hoarseness and difficulty in respiration. Dyspnea and cyanosis is often very marked with high-grade fever. Exudation is thick and tenacious and when it dries crust may form, which is characteristic in this condition.

On plain X-ray of the neck and chest in anteroposterior view, a characteristic finding known as the 'steeple sign' is present in these cases (Fig. 48.1). Because of the edema in the sub-glottic region, air shadow in the trachea appears like a steeple (tower of a church).

Differential Diagnosis

This condition has to be differentiated from acute laryngitis, which is much less severe and produces no physical signs in the chest. Other differential diagnosis include laryngeal diphtheria, foreign body in the respiratory tract and bronchopneumonia.

Treatment

It is an aggressive condition of emergency and the child has to be admitted in the hospital. Rest and reassurance of the parents is very important. Systemic antibiotics should be started immediately. A systemic steroid is also needed in majority of the cases to relieve edema. Humidification of the inspired air, oxygen therapy and intravenous fluids to prevent dehydration should also be given. Tracheostomy may be necessary in some cases to relieve dyspnea and to clear the thick tenacious secretions from the tracheobronchial tree.

Treatment of Acute Laryngotracheobronchitis

- Hospital admission and rest.
- Reassurance to the parents.
- Systemic parenteral antibiotic.
- Systemic steroid: to relieve laryngeal edema.
- Humidification.
- Oxygen therapy.
- Intravenous fluids.
- Tracheostomy: sometimes.

Fig. 48.1: Plain X-ray neck (AP view) showing steeple sign.

ACUTE EPIGLOTTITIS

It is a special form of acute laryngitis in which inflammatory changes mainly affects mucosa of the epiglottis and surrounding area. This condition is also called as *'supraglottic laryngitis'*. This condition is more common in children than adults. Hemophilus influenzae is the usual organism responsible for this condition.

Clinical Features

Onset of symptoms is sudden and progression is very rapid. Mucosa of the epiglottis is so much edematous that it may obstruct the airway. In children dyspnea and stridor are the main presenting symptoms. Dyspnea is rapidly progressive and alarming especially in children and death may occur within few hours after onset, if the condition is not treated properly. In adults, severe pain on swallowing (odynophagia) is the main presenting symptom, which is so severe that patient is not able to swallow his own saliva. High grade fever is present in all the cases.

If acute epiglottitis is suspected in a patient then during clinical examination, indirect laryngoscopy is better avoided because this can aggravate the condition and can cause complete airway obstruction.

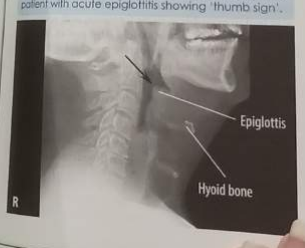
Diagnosis

X-ray soft tissue neck lateral view is diagnostic and shows a prominent and edematous epiglottis. This swollen epiglottis appears as a thumb on plain X-ray so it is called as *'thumb sign'* (Fig. 48.2).

Treatment

Patient needs immediate hospitalization for constant supervision. Intravenous antibiotic must be started immediately, effective against hemophilus influenzae. Systemic steroid may be needed to relieve edema and airway obstruction. In moderate to severe cases, nebulization with 3-5 ml of adrenaline (1:1000) is found to be very effective. Adequate intravenous fluid should be given. In cases of severe stridor and respiratory obstruction, tracheostomy may be needed.

Fig. 48.2: X-ray soft tissue neck (lateral view) in a patient with acute epiglottitis showing 'thumb sign'.



LARYNGEAL DIPHTHERIA

The incidence of diphtheria has decreased during recent years in Pakistan as a result of effective immunization. *Laryngeal diphtheria* is usually an extension of pharyngeal infection. If infection is primarily limited to the larynx, its diagnosis is difficult. The causative organism is *Corynebacterium diphtheriae*. Diphtheria may occur in epidemics, it is a highly contagious disease and spreads through air borne droplets. The incidence is maximum in children under the age of five years but may affect older children and young adults.

Pathology

Diphtheria is a droplet infection with an incubation period of few days. The infected mucosa is necrosed and a false membrane is formed over it. This false membrane is dirty white in color, thick, adherent, bleeds on removal and reforms after removal. Diphtheria bacillus produces a powerful exotoxin which causes myocarditis, nephritis and peripheral nerve palsies. The disease may spread from one region to the adjacent region and sometimes involves the pharynx, tonsils, nose and even the trachea. Cervical lymph nodes are often enlarged and very tender.

Clinical Features

The onset of condition is usually insidious and undramatic. The local signs and symptoms depend on the region of involvement. In laryngeal diphtheria, the first symptom to appear is usually cough which is hoarse and croupy in nature. Stridor may soon follow which is accompanied with dyspnea and cyanosis. Other general symptoms of diphtheria will be present including a low-grade fever (rarely above 100°F) with weak and rapid pulse. The child looks very ill, toxaemic and exhausted. On examination a false membrane may be seen, but if the infection is limited to larynx, it is difficult to see the laryngeal membrane. Marked cervical lymph node enlargement is present, which is usually tender.

Diagnosis

Diagnosis is established by identifying the diphtheria organism in the swab taken from the membrane. The swab is very difficult to obtain if only larynx is involved, in such cases laryngoscopy is needed to obtain a sample. The condition is to be differentiated from acute laryngotracheobronchitis, acute laryngitis and foreign body of the respiratory tract.

Treatment

In severe and emergency cases where dyspnea and cyanosis are present, immediate maintenance of the

airway is needed either by endotracheal intubation or a tracheostomy. After a throat swab is taken, systemic penicillin is started immediately through the parenteral route. After report of the swab is available, Anti-Diphtheric Serum (ADS) through the parenteral route should be given according to severity of infection and age of the patient. The dosage varies from 20,000 to 100,000 units. Supportive therapy including oxygen, suction, intravenous fluids and antipyretic drug should be given.

Treatment of Diphtheria

- Systemic penicillin.
- Anti-Diphtheric Serum (ADS).
- Supportive treatment: oxygen, I/V fluids, suction and antipyretic.
- Maintenance of airway: tracheostomy or intubation.

CHRONIC LARYNGITIS

The etiology of chronic laryngitis is not exactly known. It may follow an acute attack and in some cases repeated attacks of acute laryngitis will cause a chronic state to occur. Vocal abuse by over straining or excessive force is the most important factor in causation of this condition. Other factors which predispose to this condition include, excessive smoking, occupational pollution, dust or irritant fumes, excessive alcohol intake, GERD and infection in the tonsils, sinuses or teeth.

Pathology

Hyperemia and congestion of the mucous membrane of the larynx especially of the vocal cords is present. Edema of the mucous membrane may also be present sometimes even in the absence of hyperemia. Excessive thick secretion may result from increased activity of the mucous glands. Myositis of the intrinsic laryngeal muscles may occur. Different types are recognized and described according to the laryngeal appearances. Three types of laryngeal appearances are significant.

1. *Hyperemia:* In this type, the cords are congested and stiffened in appearance. In severe cases, the cords are deep red in color and appear round.
2. *Hypertrophic:* In this type, there is thickening of tissues of the vocal cords, ventricular bands, arytenoids, interarytenoid space and sometimes subglottic region.
3. *Edematous (Reinke's edema):* In this type, the true cords are swollen and pale.

The important diagnostic point in chronic laryngitis is that all these changes are bilateral and symmetrical.

Clinical Features

The most important symptom in all types is hoarseness. It is intermittent in the initial phase and then becomes continuous. Aphonia is very rare; cough may be present which is usually slight, dry and irritating. Soreness in the throat is a common complaint. Pain and mild fever may be present sometimes. On indirect laryngoscopy examination, different types of changes in the larynx are seen as mentioned before.

Treatment

Voice rest is an important part of the treatment especially in cases where vocal abuse is present. Speech therapy may supplement and correct the faulty use of voice. Avoidance of any predisposing or irritating factor should be advised such as dust, tobacco, smoking, occupational irritants, excessive alcohol intake etc. Systemic antibiotic infection. Other symptomatic treatments should be used like use of mucolytic agents if the secretion is thick and tenacious. Surgical treatment include stripping of the vocal cords, which is performed endoscopically in resistant cases of chronic edematous and hypertrophic laryngitis.

TUBERCULOSIS OF THE LARYNX

Laryngeal tuberculosis is almost always secondary to pulmonary tuberculosis. Most of the cases of laryngeal tuberculosis are *sputogenic* in origin i.e. the larynx is involved because of coughing and expectorating infected sputum. Few cases are *hematogenic* in origin i.e. organisms are carried through blood streams. Very rarely few cases are *lymphatogenic* in origin i.e. the organisms are carried through the lymph channels. The incidence of tuberculous laryngitis has decreased dramatically. Both sexes are affected equally and peak incidence is between 20 to 40 years of age.

Pathology

Intact laryngeal mucosa is affected first and then submucosal layer becomes infected with round cell infiltration. One or more surface nodules may appear which cseate and lead to mucosal ulceration. Progress of the disease may lead to granulation tissue formation with edema. The lesions are usually asymmetrical. Any part of the larynx may be affected but the posterior one-third is frequently involved. The clinical presentation has also changed dramatically.

Due to the involvement of different structures by these pathological changes, different clinical pictures are seen e.g. *turban epiglottis, mouse nibbled vocal cords, interarytenoid granulation* etc. At a later stage there is involvement of the underlying cartilages leading to perichondritis and cartilage necrosis.

...linical Features

...Hoarseness of the voice with periods of aphonia is often ...earliest symptom. Hoarseness soon follows with cough ...sometimes pain. On indirect laryngoscopy examina... ...different types of lesions are seen like ulceration on ...vocal cords (mouse nibbled vocal cords), edema of the ...cords (turban epiglottis), swollen arytenoids, interar... ...granulations, subglottic granulations and impair... ...of vocal cord mobility.

...iagnosis

...Manifestations of laryngeal tuberculosis may mimic ...sarcoma or syphilis of the larynx. Biopsy is essential for ...diagnosis.

...reatment

...Treatment is essentially the same as tuberculosis in ...other parts of the body. Four drug combination is routinely ...used for initial two months followed by three drugs regi... ...then. Four drugs regime includes rifampicin, ethambutol, ...isoniazid and pyrazinamide.

PERICHONDRITIS OF THE LARYNX

Perichondritis is the inflammation of the perichondrium covering the laryngeal cartilages. The causes of perichondritis of the larynx are:

1. *Inflammatory:* Mostly occurs due to tuberculosis, syphilis and lupus of the larynx. It can also occur in acute laryngitis, diphtheria and typhoid fever.
2. *Traumatic:* Perichondritis results from cut throat injuries, penetrating foreign bodies and high tracheostomy. Perichondritis after radiotherapy is one of the common causes.
3. *Neoplastic:* Perichondritis may develop in advanced laryngeal cancer due to secondary bacterial infection.

The perichondrium becomes infected and separates from the underlying cartilage. Exudate collects between the perichondrium and the underlying cartilage to form an abscess. If the abscess is not drained, necrosis of the underlying cartilage may occur. Subsequent resolution leads to deformity and stenosis due to replacement by fibrous tissues.

Clinical Features

The condition may be sudden or insidious in onset depending on the cause. Local pain is always present which may radiate to the ears. Local tenderness and swelling over the larynx is present. Other symptoms include cough, hoarseness, fever, malaise and dyspnea.

Treatment

Antibiotic should be started immediately. If there is abscess formation, incision and drainage is required immediately. Fragments of the necrotic cartilage are also to be removed. Tracheostomy may be needed, if there is respiratory distress and it should be done as low as possible. If stenosis develops later on, it should be treated accordingly.

Chapter Summary and Key Points

Acute laryngitis in children is more serious and aggressive than in adults. Acute laryngotracheobronchitis occurs usually in infants and young children. This is an aggressive and emergency condition and the child has to be admitted in the hospital. Incidence of laryngeal diphtheria has decreased during recent years in Pakistan due to effective immunization against diphtheria. Laryngeal tuberculosis is nearly always secondary to pulmonary tuberculosis, where laryngeal involvement is mainly sputogenic in origin. Incidence of laryngeal tuberculosis has also decreased in recent years because of early diagnosis and effective treatment of pulmonary tuberculosis.

Best Choice Questions

Q1. Which condition is also known as 'supraglottic laryngitis'?

a. acute epiglottitis.
b. acute laryngitis.
c. acute laryngotracheobronchitis.
d. laryngeal diphtheria.

Q2. A 6-year-old boy came in emergency (ER) with fever, rapidly progressing dyspnea and stridor since a day. Plain X-ray soft tissue neck (lateral view) was done, which showed positive Thumb sign. What is the most likely organism responsible for this condition?

a. hemophilus influenzae.
b. proteus mirabilis.
c. pseudomonas aeruginosa.
d. staphylococcus aureus.

Q3. A patient was diagnosed with acute epiglottitis. What is the most likely age group for this patient?

a. children.
b. teenage.
c. young adult.
d. middle age.

Q4. A 4-year-old boy was brought with complaints of dyspnea, stridor and fever for last 2 days. Plain X-ray neck (lateral view) was done which showed positive Thumb sign. What is the most likely diagnosis in this patient?

a. acute epiglottitis.
b. acute laryngotracheobronchitis.
c. foreign body in the larynx.
d. laryngeal diphtheria.

Q5. A 35-year-old male patient who was a known case of pulmonary tuberculosis, now reported laryngeal tuberculosis. What is the most common route of spread of this disease from the lungs?

a. hematogenic.
b. lymphatogenic.
c. neurogenic.
d. sputogenic.

Q6. Direct laryngoscopy was performed on a 36-year-old male patient which showed a characteristic turban like appearance of the epiglottis (Tiarban epiglottis). What is the most likely diagnosis of this patient?

a. acute laryngitis.
b. chronic laryngitis.
c. syphilitic laryngitis.
d. tuberculous laryngitis.

Q7. A 27-year-old male patient was diagnosed with tuberculous laryngitis. What drug regimen will be used for his antituberculous therapy?

a. two drugs for the whole period.
b. three drugs for the whole period.
c. initially three drugs and then two drugs.
d. initially four drugs and then three drugs.

Answers with Explanations

1. a.
2. a.
3. a.
4. a swollen epiglottis appears as thumb.
5. d mycobacterium reach, larynx through coughed out infected sputum.
6. d due to edema of epiglottis, it looks like a turban.
7. d.

CHAPTER 49
Neoplasia of the Larynx

- Papilloma
  - Single or solitary papilloma
  - Multiple papillomata
- Fibroma
- Chondroma
- Hemangioma
- Vocal cord polyp
- Keratosis of the larynx
- Malignant tumors
- Squamous cell carcinoma
- Voice restoration after total laryngectomy
  - Esophageal speech
  - Tracheoesophageal fistula with voice prosthesis
  - Electrolarynx

Neoplasia of the Larynx

- Benign:
  - Papilloma.
  - Fibroma.
  - Chondroma.
  - Hemangioma.
  - Neurofibroma.
  - Rhabdomyoma.
  - Neurilemmoma.
  - Vocal cord polyp.
- Malignant:
  - Squamous cell carcinoma.
  - Adenocarcinoma.
  - Basal cell carcinoma.
  - Adenoid cystic carcinoma.
  - Verrucous carcinoma.
  - Lymphoma.
  - Fibrosarcoma.
  - Chondrosarcoma.
  - Rhabdomyoma.

PAPILLOMA

Papilloma is a benign neoplasm arising from the laryngeal epithelium. Two clinical varieties are seen:

1. Single or solitary.
2. Multiple.

SINGLE OR SOLITARY PAPILLOMA

This type is commonly seen in adults and rarely in children. A single or solitary papilloma, which may be sessile or pedunculated, is present. The usual site is the anterior commissure and the anterior half of the vocal cords. Less often the false vocal cords are involved. It is twice more common in males than females. Histologically, it is squamous cell papilloma. It is liable to recur and may undergo malignant change.

Clinical Features

Hoarseness is the usual presenting symptom. A pedunculated papilloma may be sucked down between the cords during inspiration and then blown up again to rest on the vocal cords during phonation. So there is a change in character of hoarseness depending on the movement of papilloma.

Treatment

Papilloma can be removed by direct laryngoscopy under operating microscope by surgical or laser excision. The patient should be followed up regularly as recurrence is common and it may undergo malignant change. Rarely, when the papilloma is very large and cannot be removed by direct laryngoscopy, open laryngofissure approach is needed.

MULTIPLE PAPILLOMATA

These are usually found in infants and young children and are rare in adults (also called *juvenile laryngeal papillomatosis*). They may be present at or soon after birth more commonly arise around the age of two years. The exact etiology is unknown but 'Human Papilloma Virus' (HPV-6 and HPV-11) is considered to be responsible for this condition, similar to skin warts elsewhere in the body. The vocal cords and the ventricular bands are the usual site but may spread any where in the larynx, trachea and bronchi.

Clinical Features

Hoarseness is present when it affects vocal cords. Dyspnea may occur due to obstruction produced by papilloma. The symptoms depend on the size, position and number of papilloma. On examination by direct laryngoscopy, papillomata looks like bunches of wart like projections, pink to white in color. They are always multiple and may be sessile or pedunculated.

Treatment

The principle of treatment is to remove the papilloma without damaging the underlying larynx and to wait for normal resolution of the condition. Papillomata can be removed endoscopically by diathermization, taking care not to cause submucosal scarring. Tracheostomy to relieve airway obstruction should be avoided as it causes implantation of papilloma lower down in the respiratory tract. Now laser surgery seems to be promising for removal of papillomata as the submucosal scarring is minimal. Previously radiotherapy has been tried but it is associated with malignant change in papilloma and is not advised anymore. A number of other agents have been tried to prevent its recurrence, including vaccine therapy and local application of antiviral agents.

Treatment of Laryngeal Papillomatosis

- Endoscopic surgical excision or diathermization.
- Laser excision: better results.
- Tracheostomy: if respiratory distress.
- Radiotherapy: not used because of malignant change.
- Local application of antiviral agents after removal.
- Vaccination.

FIBROMA

Most of these tumors result either from the organization of a submucosal hematoma or are of inflammatory origin and thus they are not true neoplasms. Rarely, a laryngeal neurofibroma is seen in generalized neurofibromatosis. The usual symptom is hoarseness and is treated by endoscopic removal under an operating microscope.

CHONDROMA

This is a rare laryngeal tumor. Generally it arises from the cricoid cartilage but sometimes may arise from other cartilages of the larynx. Hoarseness is caused by encroachment of tumor in the laryngeal lumen, which may be followed by dyspnea in later stages. It is removed by open surgical procedures.

HEMANGIOMA

This tumor should be regarded as a malformation and not a neoplasm. Hoarseness and hemoptysis are the usual presenting symptoms. On examination, a bluish or purplish swelling is seen in the larynx. It is best treated by CO_2 laser therapy.

VOCAL CORD POLYP

Polyp is not a true neoplasm, rather it is a pedunculated swelling arising from the laryngeal mucosa (Fig. 49.1). Its exact etiology is not understood. Probably it may be a response of traumatic abrasion or unresolved infection. Hoarseness is the usual symptom. It is treated by endoscopic excision under an operating microscope (microlaryngoscopy).

KERATOSIS OF THE LARYNX

It is a localized form of epithelial hyperplasia characterized by *'leukoplakia'* raised patches on the vocal cords. This is a rare condition and occurs commonly in males. Its exact etiology is still unknown but the condition may result from vocal abuse, excessive smoking, alcohol intake, exposure to irritant fumes or vitamin A deficiency. There is hyperplastic change in the epithelium leading to excessive cornification, together with extension of the papillae into the corneum. The basement membrane remains intact.

Clinical Features

Hoarseness is present, which is gradual in onset, progressive and persistent. On indirect laryngoscopy, raised white patches may be seen on vocal cords. Mobility of the vocal cords is normal. The condition must be considered as a premalignant lesion and carcinoma in-situ frequently supervenes.

Treatment

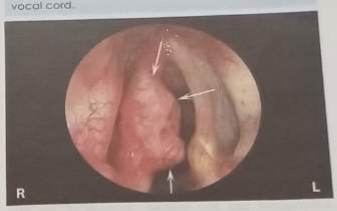
Stripping of the keratotic patches is done under operating microscope through direct laryngoscopy. This is a surgical procedure in which superficial layers over the true vocal cord are removed. The condition can also be treated by CO_2 laser excision. Constant supervision is essential to detect early malignant change.

MALIGNANT TUMORS

Majority of the malignant neoplasms of larynx are *squamous cell carcinoma*. Other malignant neoplasms are rare which include both epithelial and mesenchymal origin tumors. Among the epithelial origin are adenocarcinoma, basal cell carcinoma, and adenoid cystic carcinoma. Verrucous carcinoma, a variant of squamous cell carcinoma, makes up a small proportion of all laryngeal carcinomas. Morphologically, it has a warty appearance. Metastasis is rare and overall prognosis is good. Among the mesenchymal origin are lymphoma, fibrosarcoma, chondrosarcoma etc.

Fig. 49.1: Vocal cord polyp arising from the right true vocal cord.

Fig. 49.2: Glottic carcinoma arising from the left true vocal cord.



SQUAMOUS CELL CARCINOMA

Squamous cell carcinoma of the larynx is common and it is among the list of top ten most common malignancies in Pakistan. It has a high rate of cure and a good prognosis. Early diagnosis and correct treatment gives better chances of survival.

Incidence

Laryngeal carcinoma has a definite male preponderance but the sex incidence varies worldwide. In western countries the incidence of laryngeal carcinoma in females is increasing, probably because of smoking habits. The peak age of presentation is between forty and sixty years. Laryngeal carcinoma in childhood is a rare.

Etiology

Like most of the other malignancies, the etiology of laryngeal carcinoma is unknown. A number of possible etiological factors have been described.

Smoking is considered as the most important etiological factor. The risk is directly proportional to the number of cigarettes smoked per day, duration of smoking and use of filter. Tobacco in other forms like hukka, berri, tobacco chewing etc. also has the same effect. Alcohol consumption is another important causative factor especially in western countries. Other factors, which are associated with the increasing incidence of laryngeal carcinoma include environmental pollution, vocal abuse, radiation to the neck and occupational exposure to asbestos and certain other metals. In childhood laryngeal carcinoma radiation is important, as malignant change may occur in juvenile laryngeal papillomatosis treated with radiation.

Pathology

The squamous cell carcinoma develops not only from areas normally covered by squamous epithelium but it may also arise from areas that are lined by ciliated columnar and transitional epithelium. According to the site of origin and involvement, laryngeal carcinoma is classified as:

1. Supraglottic.
2. Glottic.
3. Subglottic.
4. Transglottic.

Glottic carcinoma comprises about 76% of total cases and rises from the true vocal cords (Fig. 49.2). Anterior half of the vocal cord is more commonly involved than the posterior half. Supraglottic carcinoma arises from any part of the supraglottis and comprises about 19%. Those that arise from the subglottic region are subglottic carcinomata, these are uncommon and comprise about 1 to 5% of the total cases. Transglottic carcinomata are glottic lesions that invade both the supraglottic and subglottic regions of the larynx. These tumors have deep extension, which cross the laryngeal ventricle vertically to involve two or more anatomical areas.

Microscopically, squamous cell carcinoma is classified into:

1. Well differentiated carcinoma.
2. Moderately differentiated carcinoma.
3. Poorly differentiated carcinoma.

This histological grading system is simpler and practical than that described by *Broader's* where squamous cell carcinoma is classified into four grades:

1. Grade I: more than 75% cells are differentiated.
2. Grade II: 51–75% cells are differentiated.
3. Grade III: 26–50% cells are differentiated.
4. Grade IV: less than 25% cells are differentiated.

Spread of Laryngeal Carcinoma

Laryngeal carcinoma can spread by the following routes:

1. Direct Spread

The growth and spread of laryngeal carcinoma is determined to a great extent by the site of origin. Important factor in determining the direction and extent of tumor spread is the anatomical barrier produced by the laryngeal compartments. Most of the glottic carcinoma originates from free margin of the vocal cords with predilection for the anterior half of the cord. These tumors can extend directly in all three planes. In the glottic plane it can extend anteriorly and posteriorly, in vertical plane, it can extend above or below the vocal cords and in deep horizontal plane, to involve the deeper structures. Vertical extension above seems to occur more frequently than extension to the opposite side.

Most of the supraglottic tumors are exophytic, well differentiated and less invasive. Invasion of the preepiglottic space is a prominent feature of supraglottic carcinoma especially on the laryngeal surface of the epiglottis. Supraglottic carcinoma may extend cranially to involve the vallecula and base of tongue. Subglottic carcinoma usually grows circumferentially and involves both sides. It can spread anteriorly to the cricothyroid membrane or may invade the trachea caudally.

2. Lymphatic Spread

Carcinoma can spread through the lymphatic channels to the regional lymph nodes. As the glottic area has minimal lymphatic drainage, the incidence of regional lymph node involvement in these tumors is very low. Supraglottic and subglottic regions have different lymphatic drainage, these tumors can spread to regional lymph nodes accordingly. Various factors like site, size, degree of differentiation, nature of tumor, margins and invasiveness of the tumor determine the metastasis to regional lymph nodes.

3. Hematogenous Spread

The tumor spreads through the blood into distant regions (distant metastasis). Lung is the most common site for distant metastasis followed by liver, bones, kidneys and brain.

Classification and Staging

TNM system of classification takes into consideration the characteristics of the primary tumor (T), regional lymph nodes (N) and distant metastasis (M). Following is the AJCC classification and staging system.

T-Primary Tumor

Supraglottis

T_1 Tumor limited to only one subsite of supraglottis with normal vocal cord mobility.

T_2 Tumor invades mucosa of more than one subsite of supraglottis or mucosa of any of the following structures without vocal cord fixation: glottis, medial wall of pyriform sinus, vallecula or base of tongue.

T_3 Tumor limited to the larynx with vocal cord fixation and/or involvement of any following structures: postericoid area, preepiglottic or paraglottic space, or inner cortex of thyroid cartilage.

T_{4a} Tumor invades the thyroid cartilage and any of the following extralaryngeal structures: esophagus, trachea, thyroid, infrahyoid strap muscles, or tongue muscles.

T_{4b} Tumor involves prevertebral space, mediastinum or encasing of carotid artery.

Glottis

T_1 Tumor involves only vocal cords, anterior or posterior commissure with normal vocal cord mobility.

T_{1a} Tumor involves only one vocal cord with normal vocal cord mobility.

T_{1b} Tumor involves both vocal cords with normal vocal cord mobility.

T_2 Tumor spreads to the supraglottis or subglottis with or without impaired vocal cord mobility.

T_3 Tumor limited to larynx with vocal cord fixation and/or involvement of any following structures: paraglottic space, or inner cortex of thyroid cartilage.

T_{4a} Tumor invades the thyroid cartilage and any of the following extralaryngeal structures: esophagus, trachea, thyroid, infrahyoid strap muscles, or tongue muscles.

T_{4b} Tumor involves prevertebral space, mediastinum or encasing of carotid artery.

Subglottis

T_1 Tumor limited to subglottis with normal vocal cord mobility.

T_2 Tumor spreads to glottis with or without impaired vocal cord mobility.

T_3 Tumor limited to larynx with vocal cord fixation

T_{4a} Tumor invades cricoid or thyroid cartilage and any of the following extralaryngeal structures: esophagus, trachea, thyroid, infrahyoid strap muscles, or tongue muscles.

T_{4b} Tumor involves prevertebral space, mediastinum or encasing of carotid artery.

N-Regional Lymph Nodes

N_0 no clinically positive node.

N_x minimum requirement to assess the regional nodes cannot be met.

N_1 involvement of single ipsilateral lymph node, 3 cm less in greatest dimension.

N_{2a} involvement of a single ipsilateral lymph node more than 3 cm but not more than 6 cm in greatest dimension.

N_{2b} involvement of multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension.

N_{2c} involvement of bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension

N_3 involvement of lymph nodes more than 6 cm in greatest dimension.

M-Distant Metastasis

M_0 no known distant metastasis.

M_x minimum requirement to assess presence of distant metastasis cannot be met.

M_1 distant metastasis present.

Staging

Stage 0	$T_{is} N_0 M_0$
Stage I	$T_1 N_0 M_0$
Stage II	$T_2 N_0 M_0$
Stage III	$T_3 N_0 M_0$ or $T_{1-3} N_1 M_0$
Stage IVA	$T_{4a} N_{0-1} M_0$ or $T_{1-4a} N_2 M_0$
Stage IVB	$T_{4b} N_{0-3} M_0$ or $T_{1-4} N_3 M_0$
Stage IVC	$T_{1-4} N_{0-3} M_1$

Clinical Features

The clinical features of laryngeal cancers are not different from those of any space occupying lesions of the larynx and depend on the site and extent of the lesion. Glottic carcinoma usually presents itself early when the lesion is small. The earliest symptom of glottic carcinoma is progressive and unremitting hoarseness. As the glottic lesion increases and encroaches to other areas, it will give rise to other symptoms. Dyspnea and stridor develop late when the tumor is extensive, obliterating the respiratory passage. Dysphagia is relatively rare and indicates the invasion and involvement of the pharynx. Pain is a relatively uncommon and is a late symptom. Other symptoms include cough, irritation in the throat, hemoptysis, anorexia, weight loss and swelling in the neck due to regional metastasis.

Supraglottic carcinoma usually presents itself late when the tumor is already well advanced. Dysphagia for solids and change of voice are the usual symptoms. Subglottic carcinoma also presents late. Dyspnea and stridor are usually the earliest symptoms in a subglottic carcinoma. On indirect laryngoscopic examination, growth will be seen. The site, extent and the mobility of vocal cords should be assessed on indirect laryngoscopy.

Clinical Features of Laryngeal Carcinoma

- Hoarseness of voice.
- Dyspnea.
- Stridor.
- Dysphagia.
- Cough.
- Irritation in the throat.
- Hemoptysis.
- Anorexia and weight loss.
- Neck swelling.
- Growth visible on laryngoscopy.

Investigations

The aims of investigations are first, to established histological diagnosis. Second, to find out the extent of the disease i.e. stage of the diseases and third, to rule out any other concurrent diseases for surgical and anesthesia fitness.

1. *Radiology:* Radiological investigations are done to find out the extent of primary lesions and regional or distant metastasis. It includes plain X-ray, CT scan, MRI and barium swallow.
2. *Direct laryngoscopy:* By direct laryngoscope precise location, size and extent of the lesion can be assessed. In addition, biopsy can be taken for histopathology.
3. *Histopathology:* Histopathological examination of the specimen obtained by biopsy will confirm the diagnosis, in addition to histological grading.
4. *Fine Needle Aspiration Cytology (FNAC):* It is very helpful in diagnosing regional lymph node metastasis when patient presents neck swelling.

Treatment

Following are the treatment modalities available for treating carcinoma of the larynx:

1. Surgery.
2. Radiation therapy.
3. Chemotherapy.
4. Laser therapy.

Surgery

Surgery is effective in almost all cases where the lesion can be encompassed. Different types of surgical procedures are present for the treatment of carcinoma of larynx ranging from conservation laryngeal surgery to extended total laryngectomy. In conservation laryngectomy, some portion of the larynx is conserved. Partial resection of the larynx may maintain its normal functions. Some of the conservation laryngectomy procedures are *cordectomy, hemilaryngectomy, fronto-lateral partial laryngectomy, epiglottectomy, supraglottic partial laryngectomy* and *subtotal laryngectomy*.

Fig. 49.3: Specimen of the larynx after total laryngectomy.

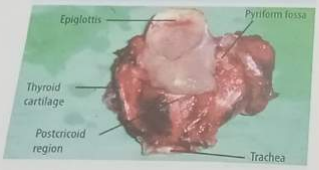


Fig. 49.4: Patient with permanent tracheostome after total laryngectomy.

Total laryngectomy is the removal of the entire larynx including the hyoid bone and the pre-epiglottic space (Fig. 49.3). After removal of the larynx, the trachea is brought to the skin surface and a permanent tracheostome is made in the neck (Fig. 49.4 and 49.5). The patient has to breathe through this tracheostome for the rest of his life. The voice is lost after total laryngectomy and different methods for restoration of voice after total laryngectomy will be required.

In *extended total laryngectomy*, along with the entire larynx neighboring structures like pharynx, trachea, esophagus, tongue and thyroid gland if involved by the tumor are also removed.

Radiation Therapy

Radiation therapy is chosen either in small lesion where a cure is likely with preservation of functions or is used for palliation. It may also be used in circumstances where surgery is contraindicated due to other reasons or refused by the patient. It can be combined with other modalities of treatment in advanced tumors. Post-operative radiotherapy is administered where risk of local or regional recurrence is high.

Chemotherapy

Chemotherapy has become an integral component to manage carcinoma, although in realistic term it is predominantly a palliative therapy. Chemotherapy prior to surgery in locally advanced tumor is given to produce considerable tumor regression. In advanced tumors, chemotherapy can be combined with radiation therapy in a variety of ways.

Laser Therapy

Laser can be used for treatment of small localized tumors. The CO_2 laser has been used successfully for early glottic and supraglottic carcinoma.

Selection of Treatment

The selection of modality of treatment for carcinoma of larynx depends on a number of factors. These include site, extent, staging, type of tumor, age of the patient, profession of the patient, other concurrent diseases, follow-up compliance and treatment facilities available in the specific situation. Small T_1 lesion of the glottic area is best treated by radiation therapy or laser therapy. T_1 and T_2 lesions of supraglottis and T_2 lesions of glottis are treated by radiation or conservation laryngeal surgery. T_3 and T_4 lesions are treated by partial, total or extended total laryngectomy. In advanced laryngeal cancers, combined treatment by surgery, radiotherapy and chemotherapy seem to offer the best control rates.

Treatment for Nodal Metastasis

Treatment of nodal metastasis depends on the 'N' status. N_1 and N_2 are treated by surgery where radical neck dissection is carried out. N_3 nodes are usually considered as a contraindication for curative surgery. Palliative radiotherapy or chemotherapy is advised in these cases.

Treatment for Distant Metastasis

A primary tumor and distant metastasis is considered as two separate entities and both should be treated accordingly. Treatment depend on the site and extent of the disease and all forms of treatment modalities including surgery, radiotherapy, chemotherapy and combination therapy is used.

VOICE RESTORATION AFTER TOTAL LARYNGECTOMY

Though total laryngectomy saves the life of an individual, it deprives him of natural means of communication. In general, the options for restoration of voice are:

1. Esophageal speech.
2. Tracheoesophageal fistula with voice prosthesis.
3. Electrolarynx.

Fig. 49.5: Schematic diagram showing tracheostome after total laryngectomy.

Esophageal Speech

After removal of the larynx, voice cannot be produced, but other articulating structures are still intact. In *esophageal speech*, the patient is trained to store air in the esophagus and sound is produced by the vibrating cricopharyngeus muscle. Sound produced by the vibration of cricopharyngeus muscle is then articulated in the same way by the tongue, palate, lips etc. The advantages of esophageal speech are that it is cost effective, no prosthesis or no electromagnetic device is required, no aspiration of food occurs and no additional surgery is required. The obvious disadvantages are that it is difficult and time consuming to learn, needs specialized training and patient can speak only short sentences.

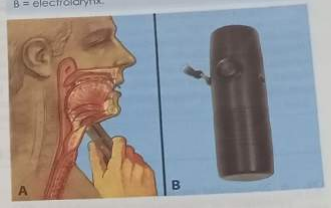
Esophageal Speech

- Advantages:
  - Cost effective.
  - No prosthesis required.
  - No electromagnetic device required.
  - No aspiration of food or saliva.
  - No additional surgery required.
- Disadvantages or shortcomings:
  - Difficult and time-consuming to learn.
  - Needs specialized training.
  - Patient can speak only short sentences.

Tracheoesophageal Fistula with Voice Prosthesis

The basic aim is to develop a shunt between the trachea and esophagus and the air from the lungs is diverted through this shunt into the esophagus. Different types of voice prosthesis are available, which can be fitted into this tracheoesophageal fistula. When the air passes through this prosthesis, it produces sound. This prosthesis acts like a one way valve allowing air to pass from the trachea into the esophagus but prevents food and saliva to enter into the trachea. Voice prosthesis available includes, Bloom Singer's, Panje's button, Provox prosthesis, Singh's prosthesis etc.

Fig. 49.6: A = method of using hand held electrolarynx. B = electrolarynx.



Electrolarynx

Electrolarynx is a hand-held external electromagnetic vibrator, which produces sound (Fig. 49.6). This sound is then articulated in a normal way to produce speech.

Chapter Summary and Key Points

Benign tumors are less common than malignant tumors in the larynx. Two clinical types of laryngeal papilloma are recognized, single and multiple papillomata. Vocal cord polyp is not a true neoplasm. Majority of the malignant tumors of larynx are squamous cell carcinoma. About 76% of all carcinoma of the larynx arise from the glottic region. Symptoms are produced early in this type and the metastasis is late, so overall prognosis of this cancer is good. Surgery is usually the treatment of choice in most cases. In late and advanced tumors combined treatment including surgery, radiation therapy and chemotherapy is used. After total laryngectomy, voice is lost and different methods of voice restoration are used. Esophageal speech is a cost effective method with no chances of aspiration. Aspiration of saliva and food is usually the main problem in tracheoesophageal fistula with or without voice prosthesis.

Best Choice Questions

Q1. A 20-year-old male patient came with the complaint of hoarseness of voice for last 3 to 4 months. On direct laryngoscopy, a single papilloma was seen in the larynx. What is the most usual site of origin for this type of lesion?

a. anterior half of the true vocal cord.
b. middle of the aryepiglottic fold.
c. posterior part of subglottic region.
d. tip of the epiglottis.

Q2. In which of the following demographic group, solitary papilloma of the larynx is most common?

a. adult female.
b. adult male.
c. female child.
d. male child.

Q3. In which of the following age group, multiple papillomatosis of the larynx is the most common?

a. children.
b. adolescents.
c. adults.
d. middle aged persons.

Q4. A 4-year-old boy presented gradually progressing hoarseness of voice and dyspnea. Direct laryngoscopy was done which showed multiple papilloma in the larynx. Which of the following virus is considered as an etiological factor of this condition?

a. EBV.
b. ECHO virus.
c. HIV.
d. HPV.

Q5. A 61-year-old male patient, chronic smoker, had a growth in the larynx which on histopathology, confirmed to be malignant. What is the most likely possibility regarding the type of malignancy among the following?

a. adenocarcinoma.
b. adenoid cystic carcinoma.
c. squamous cell carcinoma.
d. verrucous carcinoma.

Q6. Squamous cell carcinoma was diagnosed on histopathology of a growth in the larynx in a 58-year-old male patient. Which of the following site is most common for origin of such tumor?

a. aryepiglottic fold.
b. subglottic region.
c. tip of the epiglottis.
d. true vocal cord.

Q7. A 54-year-old male patient had a growth on the true vocal cord on the right side, which on histopathology showed squamous cell carcinoma. What is the most common site of origin of this type of tumor?

a. anterior commissure.
b. anterior half of the vocal cord.
c. posterior commissure.
d. posterior half of the vocal cord.

Q8. A 61-year-old male patient was diagnosed with squamous cell carcinoma of the larynx involving the right vocal cord and supraglottis with fixed vocal cords. He also has a single ipsilateral lymph node of less than 3 cm with no distant metastasis. What is the clinical TNM staging of tumor in this patient?

a. $T_2 N_1 M_0$.
b. $T_2 N_2 M_0$.
c. $T_1 N_1 M_0$.
d. $T_1 N_2 M_0$.

Q9. A 58-year-old male patient was diagnosed with laryngeal carcinoma with N_1 nodal metastasis. What is the treatment of choice for his nodal metastasis?

a. excision of whole group of lymph nodes.
b. radiation therapy.
c. radical neck dissection.
d. supraomohyoid neck dissection.

Q10. A 60-year-old male patient was diagnosed as a case of glottic carcinoma of the larynx. What is the earliest presenting symptom of this patient?

a. cough.
b. hoarseness of voice.
c. irritation in the throat.
d. pain in the throat.

Q11. A 65-year-old male patient was diagnosed as a case of glottic carcinoma. What is the significance of pain in the throat in such patient?

a. it is usually the earliest symptom.
b. it is present in all patients.
c. it is common and usually moderate to severe.
d. it is relatively uncommon and late symptom.

Q12. CO_2 laser therapy was advised to a 54-year-old male patient, who was diagnosed with squamous cell carcinoma of the larynx. In which of the following tumor, this modality of treatment is most effective?

a. all advanced stage carcinoma.
b. all stages of subglottic carcinoma.
c. early glottic carcinoma.
d. late supraglottic carcinoma.

Q13. A consultant advised fine needle aspiration cytology to a 59-year-old male patient of laryngeal carcinoma. What is the most common role of this investigation in such case?

a. to detect advanced vocal cord lesion.
b. to detect distant bone metastasis.
c. to detect early subglottic lesion.
d. to detect lymph node metastasis.

Q14. Total laryngectomy was done to treat an advanced laryngeal carcinoma in a 60-year-old male patient. What will be the effect on patient's voice after this operation?

a. it takes a long time to become normal.
b. it will be lost permanently.
c. it will be permanently hoarse.
d. it will become normal in few months.

Q15. A 59-year-old male patient underwent total laryngectomy for the treatment of laryngeal carcinoma and learned esophageal speech after sometime. Which of the following muscle is used for vibration to produce sound in such patient?

a. cricopharyngeus.
b. cricothyroid.
c. lateral cricoarytenoid.
d. thyroarytenoid.

Q16. A 64-year-old male patient underwent total laryngectomy for laryngeal carcinoma and after surgery he was advised for esophageal speech to restore his voice. What is the main disadvantage of this method?

a. a complex phonosurgery is required for this.
b. aspiration of food in the respiratory passage can occur.
c. it is difficult and time consuming to learn.
d. repeated surgeries are required to maintain its quality.

Answers with Explanations

1. a.
2. b.
3. a.
4. d human papilloma virus type band II
5. c in larynx, malignant tumors are more common.
6. d about 76%
7. b.
8. c.
9. c.
10. b.
11. d.
12. c laser is good for early and superficial lesions.
13. d.
14. b needs some method for restoration of voice.
15. a upper esophageal sphincter.
16. c needs specialized training to attain esophageal speech.

CHAPTER

50 Vocal Cord Paralysis

- Unilateral recurrent laryngeal nerve paralysis (unilateral abductor paralysis)
- Bilateral recurrent laryngeal nerve paralysis (bilateral abductor paralysis)
- Unilateral combined paralysis of recurrent and superior laryngeal nerve (unilateral adductor paralysis)
- Bilateral combined paralysis of recurrent and superior laryngeal nerve (bilateral adductor paralysis)
- Unilateral superior laryngeal nerve paralysis
- Bilateral superior laryngeal nerve paralysis

The larynx is supplied by the branches of vagus nerve namely the *superior laryngeal* and *recurrent laryngeal* nerves. Root of the vagus nerve emerges from the pons and medulla and exit the skull through jugular foramen. The superior laryngeal nerve divides into external and internal branches. The recurrent laryngeal nerve arises from higher up the chest on the right side, loops around the subclavian artery and then runs upwards in the tracheoesophageal groove. On the left side, recurrent laryngeal nerve goes lower down on the right side and loops around the aortic arch, it then runs upwards in the tracheoesophageal groove. It enters the larynx below the cricoid cartilage and origin of the cricopharyngeus muscle. All the intrinsic laryngeal muscles except cricothyroid are supplied by recurrent laryngeal nerve. Cricothyroid muscle which is mainly a tensor and adductor of the vocal cord is supplied by the external branch of superior laryngeal nerve. Sensory nerve supply to mucous membrane above the vocal cords is by the internal branch of superior laryngeal nerve while sensory supply below the vocal cords is by recurrent laryngeal nerve.

Pathology

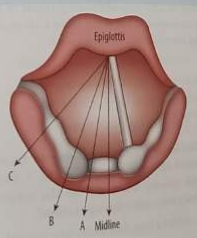
Depending on the cause, vocal cord paralysis may be *unilateral* or *bilateral, complete* or *incomplete* and *abductor* or *adductor* in type. Vocal cord paralysis may occur due to a lesion anywhere in the central nervous system, vagus nerve, recurrent laryngeal nerve, superior laryngeal nerve or laryngeal muscles. As the left recurrent laryngeal nerve has a longer course, it can be affected by a pathology in the mediastinum while involvement of both the sides can occur due to a pathology in the neck. Some of the important causes of vocal cord paralysis are following:

1. *Malignant diseases (30%):* especially malignancies of the bronchus, esophagus, thyroid and nasopharynx.
2. *Iatrogenic (25%):* it includes surgery of the thyroid gland, parathyroid, esophagus, pharynx and left lung.
3. *External trauma (15%):* like road traffic accidents, sports injuries, stab or gunshot injuries.
4. *Idiopathic (15%):* where no definitive cause is identified and may be related to infection with neuropathic viruses.
5. *Other (15%):* this includes neurological disorders, myopathy and inflammatory diseases.

Depending on the cause and nature of the lesion, paralyzed cord may lie either in the *paramedian* or *cadaveric* position. In paramedian position cord lies nearer to the midline while in cadaveric position cord lies in mid position between full abduction and adduction (Fig. 50.1). There are two theories for describing positions of the vocal cords in cases of paralysis, but neither of these theories are entirely satisfactory:

1. *Semen's law:* It states that for any lesion affecting the recurrent laryngeal nerve, fibers supplying the abductors are more susceptible to injury. Additionally in progressive organic lesions of the center or main

Fig. 50.1: Positions of the vocal cords. A = paramedian; B = cadaveric; C = full abduction.



trunk of recurrent laryngeal nerve, the nerve fibers supplying the abductor muscles are involved much earlier than adductor muscles and also late to recover. Then position of the vocal cords depends on duration of the lesion.

2. *Wilson-Grossman theory:* It proposes that a lesion affecting only recurrent laryngeal nerve, the cords will be in the adducted position (paramedian position) because the cricothyroid muscle is spared, which has an adductor effect. However lesions affecting both superior laryngeal and recurrent laryngeal nerve, the cord will lie in the cadaveric position.

UNILATERAL RECURRENT LARYNGEAL NERVE PARALYSIS (UNILATERAL ABDUCTOR PARALYSIS)

In this type of paralysis, abduction of the vocal cord is not possible and the cord lies in the paramedian or median position. Bronchogenic carcinoma is the most common cause of this type of paralysis on the left side. Thyroid surgery is another important cause which can affect any side.

Change of voice will be minimum because the other cord will come in contact with the paralyzed cord. Also, there will be no difficulty in respiration because the other cord can abduct normally. For this type of paralysis, no treatment is required as the voice and respiration are both near to normal. Speech therapy may be helpful in such cases.

BILATERAL RECURRENT LARYNGEAL NERVE PARALYSIS (BILATERAL ABDUCTOR PARALYSIS)

This type of vocal cord paralysis is uncommon and both the vocal cords are present in the paramedian or median position. Thyroidectomy is one of the important cause for this. A narrow slit is present between the vocal cords and sometimes patients can breathe through it without stridor, but in most cases, it is an emergency situation, where breathing through a narrow slit is difficult and stridor is present. A slight exertion may produce severe stridor and difficulty in respiration. Voice quality is fairly good in such patients.

Tracheostomy may be needed in emergency to relieve respiratory obstruction. Tracheostomy with a speaking valve may be needed permanently for the whole life. A number of surgical procedures have been described, according to the need and symptom of the patient in this type of paralysis, like endoscopic laser cordectomy, laser arytenoidectomy, thyroplasty type II and other lateralization procedures for the vocal cords.

UNILATERAL COMBINED PARALYSIS OF RECURRENT AND SUPERIOR LARYNGEAL NERVE (UNILATERAL ADDUCTOR PARALYSIS)

In this type, adduction of one vocal cord is not possible and the cord lies in the cadaveric position. Thyroid surgery and neurological disorders are the common causes for this type. During phonation, approximation of the cords does not occur and air leaks through the glottis. Secondly, aspiration of liquid may occur during swallowing. At this stage, patient may present complete aphonia. There is no difficulty in respiration as there is no obstruction to the air flow. After sometime, the opposite cord crosses the midline on phonation as a compensatory effect and the voice begins to return to near normal. The quality of voice at this stage is harsh and hoarse and the normal voice will never return spontaneously.

The voice can be improved by speech therapy and by bringing the paralyzed vocal cord in the midline. This can be done by injecting teflon paste, so that the edges of the vocal cords come near to the midline. Certain other surgical procedures to medialize the vocal cords can also be used like thyroplasty type I, posterior thyroplasty or arytenoidoplasty.

BILATERAL COMBINED PARALYSIS OF RECURRENT AND SUPERIOR LARYNGEAL NERVE (BILATERAL ADDUCTOR PARALYSIS)

In this type of paralysis, both the cords are present in the cadaveric position with total anesthesia of the larynx. This type of paralysis is much less common and common cause is a neurological myopathic disorder. There will be complete aphonia and the voice will not recover with time. As the vocal cords cannot be closed on swallowing, inhalation of food into the respiratory tract may occur, leading to lower respiratory tract infection.

Tracheostomy may be needed in this type to clear secretions from the tracheobronchial tree and to prevent inhalation of food. Very rarely in severe cases, total laryngectomy may be required to protect the lower respiratory tract.

UNILATERAL SUPERIOR LARYNGEAL NERVE PARALYSIS

Only the cricothyroid muscle with supraglottic anesthesia on one side will be present. Isolated involvement of superior laryngeal nerve is uncommon and often unnoticed. There will be loss of tension in the vocal cord and voice will be weak and low pitched with no problem in the airway.

BILATERAL SUPERIOR LARYNGEAL NERVE PARALYSIS

The same features as described above in the unilateral superior laryngeal nerve paralysis, are present but on both the sides. Voice is weak along with inhalation of food or secretions into the lower respiratory tract, causing coughing and choking attacks. Tracheostomy and epiglotopexy is needed in some cases where there is marked aspiration problem.

Chapter Summary and Key Points

Motor supply of the intrinsic laryngeal muscles is through superior laryngeal and recurrent laryngeal nerves. All intrinsic muscles of the larynx are supplied by the recurrent laryngeal nerve except the cricothyroid muscles, which is supplied by the superior laryngeal nerve. Paralysis involving only the superior laryngeal nerve is rare and may escape notice because of minimal effect on voice. Isolated involvement of recurrent laryngeal nerve is rare and may escape recurrent laryngeal and the superior laryngeal nerve is common. Depending on the cause and nature of the lesion, vocal cord paralysis may be unilateral or bilateral, incomplete or complete and abductor or adductor in type. Bilateral abductor paralysis is an emergency situation where both vocal cords are present in paramedian position and the patient has respiratory distress.

Best Choice Questions

Q1. Which of the following cranial nerve gives recurrent laryngeal nerve?

a. accessory nerve.
b. glossopharyngeal nerve.
c. trigeminal nerve.
d. vagus nerve.

Q2. Superior laryngeal nerve supplies only one intrinsic muscle of the larynx. What is the name of that muscle?

a. cricothyroid.
b. lateral cricoarytenoid.
c. oblique arytenoid.
d. thyroarytenoid.

Q3. The courses of right and left recurrent laryngeal nerves are different. What is the structure around which the left recurrent laryngeal nerve loops?

a. aortic arch.
b. common carotid artery.
c. pulmonary vein.
d. subclavian artery.

Q4. A 60-year-old male patient was diagnosed as a case of bronchogenic carcinoma, presenting with vocal cord paralysis. Which of the following nerve is most likely involved in this case?

a. left recurrent laryngeal nerve.
b. left superior laryngeal nerve.
c. right main trunk of vagus nerve.
d. right recurrent laryngeal nerve.

Q5. Type I thyroplasty was advised to a 28-year-old female patient who had laryngeal paralysis. What is the most likely type of laryngeal paralysis in this patient?

a. bilateral abductor paralysis.
b. bilateral adductor paralysis.
c. unilateral abductor paralysis.
d. unilateral adductor paralysis.

Answers with Explanations

1. d.
2. a.
3. a.
4. a it goes lower down in the mediastinum and loops around the aortic arch.
5. d. vocal cord is medialized (medialization procedure).

Airway Management and Tracheostomy

CHAPTER 51

- Airway management
  - Jaw thrust and head tilt-chin lift
  - Oropharyngeal airway
  - Endotracheal intubation
  - Transtracheal jet ventilation
- Tracheostomy
  - Indications
  - Types of tracheostomy
  - Types of tracheostomy tubes
  - Operative procedure
  - Post-operative care
  - Complications
- Mini tracheostomy
- Percutaneous Tracheostomy (PCT)

AIRWAY MANAGEMENT

Airway management in emergency is often required when the patient has an airway obstruction because of any reason. Critical action within a limited time frame is necessary in such situation. Healthcare workers must be capable to rapidly assess the patient and also simultaneously implement appropriate intervention. The goal is to organize oxygenation and ventilation while minimizing the risk of complications such as aspiration. Following are the options that can be tried to restore airways depending upon the different clinical situations.

1. Jaw thrust and head tilt-chin lift maneuverer.
2. Oropharyngeal airway.
3. Laryngeal mask airway.
4. Endotracheal intubation.
5. Transtracheal jet ventilation.
6. Tracheostomy.
7. Mini tracheostomy.
8. Percutaneous tracheostomy.

Jaw Thrust and Head Tilt-Chin Lift Maneuverer

Jaw thrust and head tilt-chin lift maneuverers are done in emergency to relieve airway obstruction caused by the base of tongue. The operator stands at the head end of the patient and tilts the head by placing one hand at the forehead and other hand at the chin. Then, fingers of both hands are placed under the mandible and it is pushed upward so that lower incisors are at a higher level than upper incisors (Fig. 51.1).

Oropharyngeal Airway

Oropharyngeal airway is also used when the tongue is falling back and causing an airway obstruction (Fig. 51.2). It displaces the tongue and soft tissues anteriorly, thus relieves obstruction. After inserting oropharyngeal airway, ventilation can be done with a face mask or Ambo bag.

Fig. 51.1: A: Head tilt-chin lift maneuverer; B: Jaw thrust maneuverer.

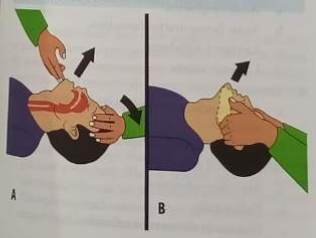


Fig. 51.2: A: Oropharyngeal airway; B: Oropharyngeal airway after insertion in mouth.

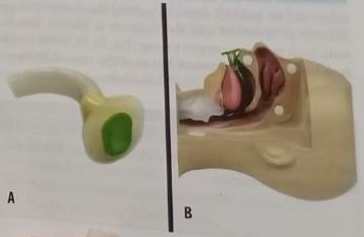
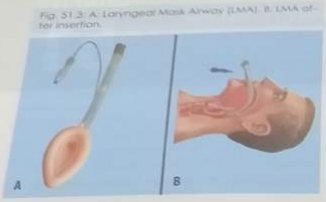


Fig. 51.3: A: Laryngeal Mask Airway (LMA). B: LMA after insertion.



Laryngeal Mask Airway (LMA)

Laryngeal Mask Airway (LMA) is a supraglottic airway device, initially designed for anesthesia purpose but can be used in emergency for ventilation purpose. It is like a large endotracheal tube with an elliptical mask on the distal end (Fig. 51.3 A). When it is inflated with air, this mask fits perfectly at the laryngeal inlet (Fig. 51.3 B).

Endotracheal Intubation

Endotracheal intubation is one of the most rapid and secure method for maintaining airway (Fig. 51.4). It can be used for anesthesia purpose as well as in emergency situation. Laryngeal inlet is visualized with anesthetist's laryngoscope and endotracheal tube is passed. Cuff is inflated and tube is secured properly.

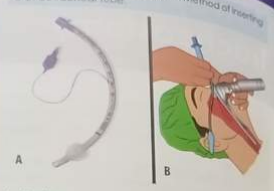
Transtracheal Jet Ventilation

This method is similar to mini-tracheostomy where airway is established through the cricothyroid membrane and also known as *'Needle Cricothyroidectomy'*. A wide bore intra-venous-catheter is used for this purpose. Neck is palpated and cricothyroid membrane is identified. The catheter attached with a syringe is introduced in the midline, directed caudally through the cricothyroid membrane into the airway. Correct position is confirmed when the air bubbles come by pulling the syringe plunger. Needle is removed and the catheter is placed, attached with high pressure oxygen tubing (Fig. 51.5). 100% oxygen is delivered in intermittent bursts at the rate of 20 bursts/minute and pressure of 50 PSI in adults.

TRACHEOSTOMY

Tracheostomy is an operation where a hole is made in the trachea and is converted into a stoma on the skin surface, then a tube is inserted.

Fig. 51.4: A: Endotracheal tube. B: Method of inserting a endotracheal tube.



Indications

A tracheostomy is performed for the following purposes:

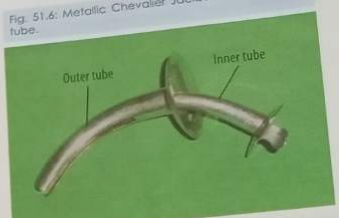
1. To relieve airway obstruction.
2. To perform bronchial toilet.
3. To decrease dead space.
4. To assist artificial ventilation.
5. As elective procedure in major head and neck surgeries.

To Relieve Airway Obstruction

1. Congenital:
   a. Bilateral choanal atresia.
   b. Laryngeal web or cyst.
   c. Upper tracheal stenosis.
   d. Tracheoesophageal anomalies.
2. Trauma:
   a. Laryngeal injuries.
   b. Cut throat.
   c. Laryngeal foreign bodies.
   d. Corrosive swallowing.
3. Infection:
   a. Acute epiglottitis.
   b. Acute laryngotracheobronchitis.
   c. Laryngeal diphtheria.
   d. Ludwig's angina.
4. Tumors:
   a. Malignancies of larynx, pharynx, tongue, thyroid gland etc.
   b. Benign tumors: e.g. papilloma.
5. Bilateral vocal cord palsy:
   a. After thyroidectomy.
   b. Bulbar palsy.
   c. Fixation in rheumatoid arthritis.

Fig. 51.5: Transtracheal jet ventilation.

Fig. 51.6: Metallic Chevalier Jackson tracheostomy tube.



To Perform Bronchial Toilet

To perform bronchial toilet and protection of tracheobronchial tree. This may occur in central depression of respiratory centers or by neurological problems. It includes:

1. Coma (due to any reason).
2. Cerebrovascular accidents.
3. Head injuries.
4. Drug over dosage.
5. Poliomyelitis.
6. Cervical cord lesions.
7. Tetanus.

To Decrease Dead Space

Tracheostomy reduces the dead space occupied by upper respiratory tract and thus improves respiratory efficacy.

To Assist Artificial Ventilation

Whenever artificial ventilation is prolonged for more than 72 hours, it is advisable to perform a tracheostomy rather than an endotracheal intubation.

Elective Procedures in Major Head and Neck Surgeries

In all major head and neck surgeries, it is advisable to perform elective preoperative tracheostomy. It serves the purpose of maintaining the airway during and after surgery and also protects the lower respiratory tract from hemorrhage and blood aspiration.

Types of Tracheostomy

1. *Elective tracheostomy:* Tracheostomy is performed as a planned procedure. This is usually done in general anesthesia but can be performed in local anesthesia. Example is a tracheostomy done as a safety measure in major head and neck surgeries.
2. *Emergency tracheostomy:* Tracheostomy is done in emergency usually to relieve airway obstruction e.g. large laryngeal tumors causing severe respiratory distress, acute epiglottitis, laryngeal injuries etc. It is usually done in local anesthesia.
3. *Temporary tracheostomy:* Tracheostomy is performed for a limited time period and tracheostome is closed after the condition is settled e.g. acute epiglottitis, laryngeal foreign bodies etc.
4. *Permanent tracheostomy:* After total laryngectomy i.e. removal of the whole larynx, the trachea is brought to the surface to make a permanent tracheostome in malignant tumors of the larynx.

Types of Tracheostomy Tubes

Different types of tracheostomy tubes are available, which include both metallic and soft non-metallic tubes. Chevalier Jackson or Fuller tracheostomy tubes are metallic tubes and consist of an inner and outer tube (Fig. 51.6). The advantage of inner tube is that it can be removed for cleaning purposes without disturbing the outer tube. A phonation hole is present in this tube, so patient can speak by putting his finger on the outer opening of tracheostomy tube. The main disadvantage of metallic tube is the absence of cuff, that is why blood can trickle down in the trachea and bronchi. In addition, radiation therapy, radiography, CT scan or MRI scan can not be performed with metallic tube in position.

Portex and Shilley's tracheostomy tubes are soft non-metallic tubes available with or without cuff, with or

Types of Tracheostomy Tubes

- Metallic or Non-metallic
- Cuffed or Un-cuffed
- With or without Fenestration (Phonation hole)
- Single lumen or double lumen

Fig. 51.7: Portex tracheostomy tube with cuff. Stent helps in insertion of tube into the trachea.

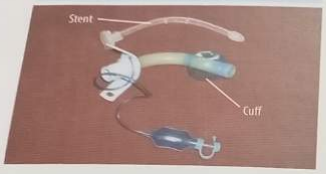


Fig. 51.8: Shilley's tracheostomy tube with inner and outer tube with cuff.

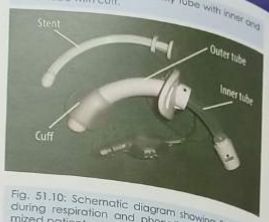
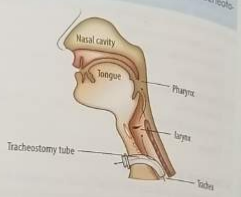


Fig. 51.9: A patient with Portex tracheostomy tube in place.

Fig. 51.10: Schematic diagram showing flow of air during respiration and phonation in a tracheostomized patient.



without phonation hole and with or without inner tube (*Fig. 51.7* and *51.8*). If the cuff is inflated, it prevents trickling down of blood and other secretions into the trachea and bronchi.

Operative Procedure

Tracheostomy can be performed in general as well as in local anesthesia depending on the situation. The patient is positioned supine with a sand bag under the shoulder and neck extended, so the trachea is pulled upward and becomes more superficial. A *horizontal* skin incision is given two fingers above the sternum. A *vertical* skin incision is used in emergency cases extending from the cricoid cartilage to just above the suprasternal notch. The strap muscles are retracted and thyroid isthmus is divided in midline. The rings of trachea are identified and an incision is made either between third and fourth or between second and third tracheal rings and an opening is made. The appropriate size of tracheostomy tube is inserted and the wound is closed (*Fig. 51.9* and *51.10*). High tracheostomy involving first tracheal ring should be avoided as this may cause perichondritis of the cricoid cartilage and later on stenosis. The only indication for high tracheostomy is carcinoma of the larynx where total laryngectomy is planned later on. Trachea in the lower neck is much deeper and is difficult to pass tracheostomy tube or retain in proper position, so low tracheostomy should be avoided as well.

Post-operative Care

After tracheostomy, constant attention is essential for the first 24 to 48 hours and an experienced nurse to understand the care of tracheostomy should be available all the time. The position of the patient must be supine and upright in the bed. Tracheostomy tube must be properly secured in place. Regular suction cleaning of the tracheostomy tube with aseptic technique by passing a sterile catheter into the trachea is done. This is done because excessive secretions occur after tracheostomy as the trachea is exposed to cold and dry air with irritation of the trachea by the tube. Humidification is essential to prevent crusting of secretions in the trachea. Humidification is done by using humidifier along the bedside or by putting a moistened gauze piece over the tracheostomy tube. Tracheostomy tube should not be disturbed for the first 48 hours and there after tube should be changed and cleaned regularly. The cuff should be deflated for few minutes after a regular interval to prevent pressure necrosis of the tracheal mucosa. Aseptic dressing should be done daily.

Decanulation of the tube in adult is done when the patient is comfortable for at least 24-48 hours with corked metallic tracheostomy tube. Decanulation in children may cause problems especially if the tube has been present for a long time. Gradual reduction in size of the tube and then complete sealing may be needed before decanulation.

Post-operative Care after Tracheostomy

- Proper nursing.
- Regular suction cleaning.
- Proper humidification.
- Cleaning and changing of the tube.
- Care of the cuff.
- Proper position of the tube and patient.
- Prevention of crusting.
- Daily dressing.
- Corking before decanulation.

Complications

1. *Hemorrhage:* It occurs if hemostasis is not properly secured during surgery. Sometimes tracheostomy tube can erode a blood vessel and causes hemorrhage.
2. *Displacement of the tube:* Tube may come out from the trachea accidentally. If displacement is complete it must be reinserted at once after adequate opening of the trachea.
3. *Surgical emphysema:* It is more common in children. For prevention of surgical emphysema, the wound must not be tightly closed after tracheostomy.
4. *Pneumothorax:* It may occur accidentally, leading to lung collapse.
5. *Perichonditis and stenosis:* Perichondritis of the cricoid cartilage may occur due to high tracheostomy. The first tracheal ring must not be damaged in any case. If cricoid cartilage is affected, it will lead to stenosis later on.
6. *Blockage of tracheostomy tube:* It is more likely to occur with a portex tube, when the crusts block the tube. The tube should be changed and cleaned regularly to avoid blockage.
7. *Dysphagia:* This is fairly common in the first few days after a tracheostomy. This occurs because the swallowing movement is uncoordinated when the tracheostomy tube is in place as the movement of larynx is restricted.
8. *Damage of important structures:* During surgery other structures of the neck may be damaged accidentally e.g. esophagus, cervical pleura, recurrent laryngeal nerve, thyroidima artery etc.
9. *Difficult decanulation:* Decanulation is removal of tracheostomy tube and closure of the hole when purpose for which tracheostomy was performed, is fulfilled. Difficulty in decanulation occurs because of tracheal stenosis as a result of high tracheostomy. Decanulation is also difficult in children due to psychological reasons.
10. *Infections:* Local wound infection with surrounding cellulitis can occur. In addition infection of the trachea, bronchus and lung tissues can occur.
11. Poor wound healing with hypertrophic scar or keloid formation.

MINI TRACHEOSTOMY

This procedure is also called as *'cricothyrotomy'* or *'laryngotomy'*. It is done in emergency to restore obstructed airway quickly when there is no time for proper tracheostomy to save life of a patient. It is a life saving procedure where cricothyroid membrane is cut transversely to open the respiratory tract.

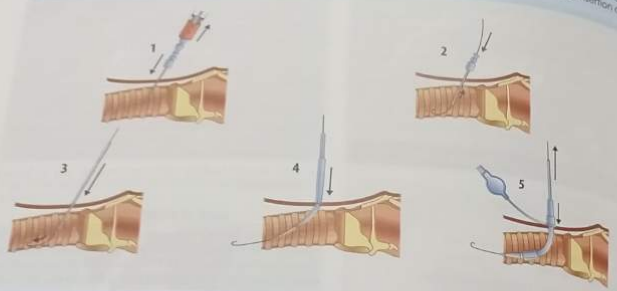
Patient is positioned as same as in tracheostomy. Lower border of thyroid and cricoid cartilages are identified and in between these two cartilages, a small incision is given on the skin. Deep to this is cricothyroid membrane which is cut to open, the airway and a small bored tracheostomy tube is inserted. If tracheostomy tube is not available, then anything like handle of scalpel is placed in such a way that airway remains patent. Once condition of the patient stabilizes, tracheostomy is performed in the usual way as described before and the cricothyrotomy wound is closed.

PERCUTANEOUS TRACHEOSTOMY (PCT)

Percutaneous Tracheostomy (PCT) has been described decades before it gained acceptance in the mid 80's as an alternative to standard tracheostomy. In this technique, first a guide wire is introduced percutaneously into the trachea and then dilators of progressive thickness are introduced through this guide wire so as to make a bigger hole. Finally, when the hole is large enough tracheostomy tube is passed (Fig. 51.11).

PCT is mainly performed in comatosed patients in ICU's. Advantages of PCT are that there is no need of Operation Theatre (OT), hazards of shifting such patients to OT can be avoided, smaller and more aesthetic wound, decreased operative bleeding and decreased rate of wound infection. This procedure is hazardous and contra-indicated in patients having short and thick neck, goiter, patients below 15 years of age, previous tracheostomy patients and previous laryngeal or neck surgery patients.

Fig. 51.11: 1: Insertion of catheter and checking for air bubbles. 2: Insertion of guide wire and removal of catheter. 3: Advancement of guide wire and guiding catheter. 4: Insertion of dilator on guide wire. 5: Insertion of a tracheostomy tube and removal of guide wire.



Chapter Summary and Key Points

Tracheostomy is the operation where the trachea is opened and a tube is inserted so that air can flow directly bypassing the upper respiratory tract. Trachea is opened between the third and fourth or second and third tracheal rings. Cricoid cartilage is the only complete ring in the entire respiratory tract. High tracheostomy can cause perichondritis of the cricoid cartilage and subsequent stenosis.

Best Choice Questions

Q1. A 40-year-old male patient is planned for a major oral cancer surgery and a preoperative elective tracheostomy. Which of the following incision will be used in this patient?

a. horizontal incision at the level of cricothyroid membrane.
b. horizontal incision two fingers above the suprasternal notch.
c. vertical incision from cricoid cartilage to suprasternal notch.
d. vertical incision from hyoid bone to first tracheal ring.

Q2. What is the maximum time duration after which tracheostomy in any patient should be closed?

a. 7 days.
b. 2 weeks.
c. 10 weeks.
d. no time limit.

Q3. Tracheostomy was performed in emergency for airway relief in a 35-year-old female patient and shifted to the ward. Which of the following position will be preferred in the ward for this patient?

a. coma position.
b. left lateral position.
c. supine with head end raised.
d. supine with sand bag under the shoulders.

Q4. Tracheostomy was performed on a comatosed patient in ICU, who was on artificial respiration. What is the usual time duration for change of tracheostomy tube in this patient?

a. after every 6 hours.
b. on alternate days.
c. whenever required.
d. never change.

Q5. Tracheostomy was performed on a 40-year-old female patient and a double lumen tube (with outer and inner tube) was inserted. What is the main advantage of such tracheostomy tube?

a. change of tracheostomy tube is not required.
b. cleaning of retained secretion is easier.
c. its insertion is easier during surgery.
d. patient's speech is not affected.

Q6. An ENT consultant advised percutaneous tracheostomy in a patient. Which type of patient is most suitable for performing this type of tracheostomy?

a. children where conventional tracheostomy is difficult.
b. comatosed patient in ICU.
c. patients of road traffic accident in emergency.
d. patients undergoing major head and neck surgery.

Q7. A 40-year-old male patient had a planned elective tracheostomy. During surgery, what is the ideal place for opening the airway?

a. immediately below cricoid cartilage.
b. between first and second tracheal rings.
c. between third and fourth tracheal rings.
d. any visible tracheal ring.

Q8. Decanulation was planned for a 35-year-old male patient who was on ventilator for last 12 days. What is the minimum time duration for corking the tracheostomy tube before removal in this patient?

a. 1 hour.
b. 2 hours.
c. 6 hours.
d. 24 hours.

Q9. After tracheostomy operation, a 35-year-old female patient developed perichondritis of the cricoid cartilage. What could be the most common reason for this?

a. antibiotic and anti-inflammatory drug was not prescribed after surgery.
b. high tracheostomy was performed.
c. regular suction cleaning of the tube was not done.
d. the tracheostomy tube has displaced accidentally.

Q10. A 50-year-old male patient came to the ER with respiratory distress and cyanosis. Attending doctor immediately performed mini-tracheostomy. In which part of the airway incision is made during this procedure?

a. cricoid cartilage.
b. cricothyroid membrane.
c. cricotracheal ligament.
d. thyrohyoid membrane.

Answers with Explanations

1. b between two sternocleidomastoid muscles.
2. d tracheostomy may be permanent.
3. c.
4. c.
5. b inner tube can be removed, washed and reinserted.
6. b where shifting of patient to OT is difficult.
7. c.
8. d if patient has no respiratory distress for 24 hours.
9. b.
10. b cricothyroid membrane is cut horizontally.

SECTION V

Head and Neck and General ENT

Contents

CHAPTER

52 Clinical Examination of the Cranial Nerves

The examination of all the cranial nerves is of utmost importance in oto-rhino-laryngology as so many diseases can involve one or more cranial nerves. The following are the number and name of the cranial nerves:

1. Olfactory
2. Optic
3. Oculomotor
4. Trochlear
5. Trigeminal
6. Abducent
7. Facial
8. Vestibulocochlear
9. Glossopharyngeal
10. Vagus
11. Accessory
12. Hypoglossal

OLFACTORY NERVE

The olfactory nerve is the first cranial nerve and its function is olfaction or smell. The olfactory system represents one of the oldest sensory modalities in the phylogenetic history of mammals. The olfactory epithelium lies on the roof of the nose and adjoining medial and lateral wall of the nose. The olfactory receptors are actually bipolar neurons. The small unmyelinated axons of these bipolar neurons combine to form thin filaments which traverse the cribriform plate of the ethmoid and enter the olfactory bulb. These first order axons form synapses in the olfactory bulb with the second order neurons. The axons of the second order neuron from the olfactory tract which send impulses to the olfactory cortex in the brain.

Smell Test

Examination for the sense of smell is already described in chapter 20.

OPTIC NERVE

The optic nerve is the second cranial nerve and its function is vision. During ENT clinical examination assessment of the vision is important as many diseases of the paranasal sinuses can alter vision by affecting the optic nerve or the orbital contents.

The visual pathway consists of retina, optic nerve, optic chiasma, optic tract, lateral geniculate body, optic radiation and visual cortex. The optic nerve is a pure sensory nerve and its fibres leave the eye ball at the optic disc. Soon after leaving the optic disc, the nerve fibres are myelinated. The optic nerve exits from the orbit through the optic canal and immediately join together to form optic chiasma where the fibres from the medial side decussate and form the optic tracts which in turn terminate in lateral geniculate body. The optic radiation then passes through the posterior part of the internal capsule and terminate in the occipital visual cortex. The clinical examination of the optic nerve includes visual acuity, visual field and colour vision.

Visual Acuity

Visual acuity is assessed by Snellen's chart but in busy ENT outpatient clinic, it can be assessed by asking the patient to count the fingers.

Visual Field

Clinically a rough estimate about the loss in visual field can be made. Sit in front of the patient and ask the patient to look into your eyes. First stretch your right hand far above and lateral to the eye level. With a slight movement of the index finger, bring your hand closer to the eye slowly and ask the patient to notify whenever he visualizes your index finger. Compare patient's response with yourself to assess loss in visual field.

Colour Vision

Colour vision is assessed by Ishihara's chart but can be assessed by asking the patient to identify different colours.

Pupillary Light Reflex

The pupillary light reflex should also be assessed. It is constriction of both the pupils in response to bright light put in one eye (direct and consensual pupillary light reflex). It is a reflex where the afferent is carried by the optic nerve and efferent is carried by the oculomotor nerve. Intact pupillary light reflex shows normal and intact second and third cranial nerves. Ask the patient to look at a distance and bring a light from a torch from the lateral side to in front of one pupil and look for constriction of the pupil in both eyes (fig. 52.1). If the optic nerve is damaged on one side, then it will cause absence of both direct and consensual light reflex on that side while both direct and consensual light reflex will be present on the other side.

Fig. 52.1: Checking for pupillary light reflex.

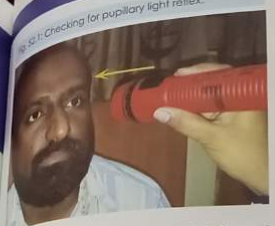


Fig. 52.2: Checking for eye movements.

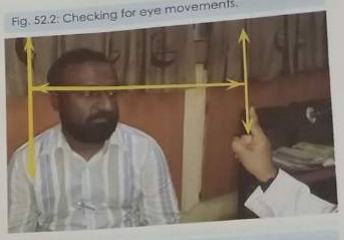
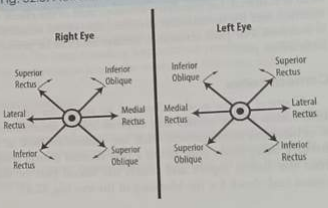


Fig. 52.3: Actions of extra-ocular muscles.



OCULOMOTOR, TROCHLEAR AND ABDUCENT NERVE

The oculomotor, trochlear and abducent nerves are the third, fourth and sixth cranial nerves respectively. All are motor nerves to the extra-ocular muscles. The oculomotor nerve supplies all the extra-ocular muscles except lateral rectus and superior oblique. In addition, it also provides visceral efferent or parasympathetic supply to the intrinsic ocular muscles and motor supply to the levator palpabrae superioris. The trochlear nerve gives motor supply to the superior oblique muscle while the abducent nerve is motor innervation of the lateral rectus muscle.

Eye Movement

The eye movement is checked to assess integrity of all these three nerves together. Sit in front of the patient, put your index finger at a distance of about a foot and ask the patient to see and follow your finger with his eyes without moving his head. Classically, the finger is moved in a 'H' pattern and the eye movement is checked (fig. 52.2). The different extra ocular muscles required for each movement are shown in fig. 52.3. The convergence of the eyes is checked by moving the index finger from a distance towards the nose of the patient.

Ptosis

The function of the levator palpebrae superioris is assessed by checking the ptosis in each eye.

Pupillary Light Reflex

In addition, innervation to the intrinsic ocular muscle is checked by pupillary light reflex as mentioned before. If the efferent arm of this reflex arc (oculomotor nerve) is damaged, then direct light reflex will be absent, and the consensual light reflex will be present on the affected side. Similarly, if the light reflex is checked on the other eye, the, direct reflex will be present but consensual light reflex will be absent.

TRIGEMINAL NERVE

The trigeminal nerve is the fifth cranial nerve and as the name suggests, it has three divisions; ophthalmic, maxillary and mandibular. It is the largest and most complex among all the cranial nerves. It is a mixed nerve with both sensory and motor components. The sensory innervation is to the skin of the whole face and head, conjunctiva, cornea, mucosa of the paranasal sinuses, nasal and oral cavity, dura mater etc. The motor component supplies muscles of mastication including masseter, temporalis, medial and lateral pterygoids. In addition, it also supplies to anterior belly of digastric, mylohyoid, tensor veli palatini and tensor tympani muscles.

Sensory Component

The sensory component of the trigeminal nerve is assessed by checking skin sensations in the area of all the three divisions of the nerve. Ask the patient to close his eyes and with the help of a cotton wisp touch on the skin of his face and forehead and ask the patient to localize the area

Fig. 52.4: Checking for corneal reflex

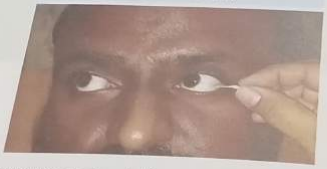


Fig. 52.5: Checking for trapezius muscle

of touching. For the ophthalmic division, skin of the fore head is touched, for maxillary division, skin of the cheek is touched and for mandibular division, skin of the mandible is touched. For pain sensation, similar area can be pricked with a fine pin.

Corneal Reflex

Corneal reflex is also checked to assess the sensory innervation of the cornea and efferent motor innervation to orbicularis oculi muscle. Ask the patient to look at a distance away from you. Bring a fine twisted cotton wisp from the lateral aspect and touch the lateral part of the cornea and check for the blinking of the eye (fig 52.4).

Motor Component

The motor component is checked by assessing functions of the masticatory muscles. Ask the patient to clench his teeth and palpate masseter and temporalis muscles for contraction. Also ask the patient to open the jaw with and without resistance against it. If the pterygoid muscles are paralyzed on one side, then the jaw will deviate to the effected side on mouth opening.

FACIAL NERVE

The facial nerve is the seventh cranial nerve and it is a mixed nerve contains motor, sensory and secreto-motor fibres. The clinical examination of the facial nerve is already described in chapter 15.

VESTIBULOCOCHLEAR NERVE

The vestibulo-cochlear nerve is the eight cranial nerve and it has two components; vestibular and cochlear. The detailed clinical examination of both hearing and balance is described in chapter 4.

GLOSSOPHARYNGEAL NERVE

The glossopharyngeal nerve is the ninth cranial nerve and it is a mixed motor, sensory and secreto-motor nerve. The motor supply is to stylopharyngeus muscle and isolated contraction of this muscle is difficult to test clinically. The general sensory supply is to mucosa of the pharynx, tonsils, eustachian tube and middle ear while special sensory is for taste sensations to the posterior one third of the tongue. The secreto-motor supply is to the parotid gland and again it is difficult to test clinically. Isolated lesion of the glossopharyngeal nerve is rare because of its proximity with the vagus and accessory nerve.

Gag Reflex

It is a reflex where touching the mucosa of the pharynx causes contraction of the palatal and pharyngeal muscles. The afferent of the gag reflex is through the glossopharyngeal nerve while the efferent is through the vagus nerve. If the gag reflex is intact it means both nerves are intact.

Taste Sensation

The taste sensation on the posterior one third of the tongue is difficult and it is mostly not tested during the clinical examination.

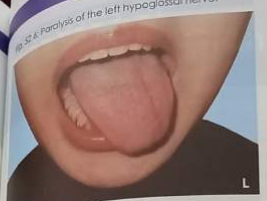
VAGUS NERVE

The vagus nerve is the tenth cranial nerve and it is mainly a motor nerve with small sensory component. The motor supply is to muscles of the pharynx, palate and intrinsic muscles of the larynx. Sensory component is very little with general sensation to the posterior half of the tympanic membrane, posterior wall of the external auditory canal and dura mater of the posterior cranial fossa.

Palatal Movement

The contraction of the palatal muscles is checked by asking the patient to open the mouth and say 'aah'. Normally the movement on both the sides should be symmetrical. Paralysis of the vagus on one side will cause no movement of the palate on the respective side.

Fig. 52.6: Paralysis of the left hypoglossal nerve.



Gag Reflex

As mentioned above gag reflex is checked for integrity of both glossopharyngeal and vagus nerve.

Laryngoscopy

Indirect laryngoscopy or flexible fiberoptic direct laryngoscopy is done to assess the movement of the vocal cords and intrinsic muscles of the larynx. See chapter 44 for details.

ACCESSORY NERVE

The accessory nerve is the eleventh cranial nerve and it is a purely motor nerve to trapezius and sternocleidomastoid muscles. The trapezius muscle is checked by asking the patient to shrug his shoulders and apply downwards pressure by standing behind the patient (52.5). Compare the strength of the muscles on both the sides. The sternocleidomastoid muscle is checked by asking the patient to turn the neck on one side against resistance and compare the strength of muscle on each side.

HYPOGLOSSAL NERVE

The hypoglossal nerve is the twelfth and last cranial nerve and it is the motor nerve to the intrinsic and extrinsic muscles of the tongue.

Tongue Movements

The tongue movement is checked by asking the patient to protrude his tongue out and move it in all directions. The paralysis of the hypoglossal nerve on one side will cause the tongue to deviate towards the same side because of the action of genioglossus muscle of the opposite side (52.6). In long standing hypoglossal paralysis, atrophy of the tongue muscle may be visible on the same side.

Fasciculation

Ask the patient to open his mouth without protruding his tongue and observe the spontaneous contraction of the intrinsic tongue muscles resulting in fasciculation. It is seen in upper motor neuron paralysis of the hypoglossal nerve.

Chapter Summary and Key Point

The examination of all the cranial nerves is of utmost importance in oto-rhino-laryngology as so many diseases can involve one or more cranial nerves. The olfactory nerve is the first cranial nerve and olfaction or smell represents one of the oldest sensory modalities in the phylogenetic history of mammals. The optic nerve is the second cranial nerve its assessment is important as many diseases of the paranasal sinuses can alter vision by affecting the nerve or the orbital contents. As the orbital contents are involved, assessment of oculomotor, trochlear and abducent nerves becomes important. Trigeminal is the fifth cranial nerves and it is the main sensory supply of the face and motor supply to the muscles of mastication. Facial nerve is mainly involved in the diseases of the ear and parotid gland. Vestibulo-cochlear nerve carries the special sensation of hearing and balance. Glosso-pharyngeal nerve is the main sensory supply to the pharynx and posterior tongue. The vagus nerve is the tenth cranial nerve and it is the main motor supply is to muscles of the pharynx, palate and intrinsic muscles of the larynx. The accessory nerve is the eleventh cranial nerve and it is a purely motor nerve to trapezius and sternocleidomastoid muscles. The hypoglossal nerve is the twelfth and last cranial nerve and it is the motor nerve to the intrinsic and extrinsic muscles of the tongue.

Best Choice Questions

Q1. Corneal reflex was performed in a patient and found intact. Which cranial nerves are assessed in it?
a. Oculomotor and facial
b. Oculomotor and trigeminal
c. Optic and oculomotor
d. Optic and trigeminal
e. Trigeminal and facial

Q2. Motor part of the trigeminal nerve is assessed by checking:
a. Extra-ocular muscles
b. Facial muscles
c. Masticatory muscles
d. Pharyngeal constrictor muscles
e. Tongue muscles

Q3. A 30-year-old man was assessed for pupillary light reflex. It showed absence of both direct and consensual reflex on the right side and intact direct and consensual reflex on the left side. Which of the nerve has pathology?
a. Left oculomotor
b. Left optic
c. Right oculomotor
d. Right optic
e. Right trochlear

Q4. Which nerve carries the afferent part of the Gag reflex:
a. Accessory
b. Glossopharyngeal
c. Hypoglossal
d. Trigeminal
e. Vagus

Q5. Which nerve carries the efferent part of the Gag reflex?
a. Accessory
b. Glossopharyngeal
c. Hypoglossal
d. Trigeminal
e. Vagus

Q6. During clinical examination of a 32-year-old man, the tip of the tongue was deviated to the right when he was asked to protrude his tongue. Which nerve is paralyzed in this patient?
a. Left glossopharyngeal
b. Left hypoglossal
c. Right glossopharyngeal
d. Right hypoglossal
e. Right vagus

Answers with Explanations

1. c Trigeminal is the sensory or afferent nerve while the facial is the efferent or motor nerve for this reflex.
2. c trigeminal nerves supplies the muscles of mastication.
3. d Optic nerve is the afferent part for this reflex. If it is paralyzed both direct and consensual reflex will be lost on that side.
4. a Glossopharyngeal nerve is the sensory supply of the pharynx and carries the afferent for gag reflex.
5. e Vagus is the motor supply to the muscles of the pharynx, palate and larynx.
6. d When right hypoglossal nerve is paralyzed, on tongue protrusion, it is deviated to the right because of the unopposed action of genioglossus muscle of the other side.

CHAPTER 53

Diseases of the Salivary Glands

- Anatomy of the salivary glands
- Salivary calculus
- Sjogren's syndrome
- Viral parotitis
- Bacterial parotitis
- Neoplasia of the salivary gland
  - Pleomorphic adenoma
  - Warthin's tumor
  - Oncocytoma
  - Adenoid cystic carcinoma
  - Mucoepidermoid carcinoma

ANATOMY OF THE SALIVARY GLANDS

Salivary glands include three pairs of large glands and a number of small minor submucosal glands. The minor salivary glands are scattered all over in the cheek mucosa, palate and tongue. All salivary glands are ectodermal in origin. The three pairs of large salivary glands are:

1. Parotid gland.
2. Submandibular gland.
3. Sublingual gland.

Parotid is the largest salivary gland, serous in type and secretes watery saliva. It is divided into a superficial and a deep lobe by the main branches of the facial nerve. It has three surfaces, superficial, anteromedial and posteromedial. The parotid duct is 5 cm long, arises from the anterior border of the gland and passes over the masseter muscle. It then turns around its anterior border and pierces the buccinator muscle to open in vestibule of the mouth at the level of second upper molar tooth.

Submandibular gland is a mixed gland with both serous and mucous secretions. It is also divided into two lobes, superficial and deep. Superficial part of the gland lies in the digastric triangle of the neck, while the deep part of the gland lies deep to the mylohyoid muscle. Submandibular duct passes through the deep part lying above the lingual nerve and opens in the floor of the mouth at either side of frenulum of the tongue.

Sublingual salivary gland is the smallest with mixed serous and mucous alveoli. It lies in the floor of the mouth where it produces the sublingual fold. Its duct drains into the submandibular duct.

SALIVARY CALCULUS

Stone formation can occur in the duct or within the salivary gland as a result of calcium deposition on any epithelial debris, mucous or organic matrix. Stone formation is much common in the submandibular duct (90%) as compared to the parotid duct. There are several reasons for more incidence of stone formation in submandibular duct. Submandibular secretion is mainly mucous and thick as compared to serous and thin secretion of the parotid gland. In addition the calcium content of the submandibular secretion is higher.

The stones of parotid gland are usually of low density and radiolucent while the submandibular stones are of high density and radiopaque.

Clinical Features

The patient typically complains of pain and swelling of the gland during a meal especially on taking citrus food. Swelling remains for few minutes to hours or sometimes to few days. The gland is painful and tender when it is swollen and pain subsides as the swelling reduces. This intermittent swelling and pain occurs because of obstruction to the salivary out flow. Sometimes, the stone may dislodge spontaneously and relieves the symptoms.

Investigations

1. *Plain X-ray:* Majorty of the stones are radiopaque, therefore they are visible on plain X-ray. To demonstrate stone in the submandibular or sublingual duct, plain X-ray floor of the mouth (occulusal view) is recommended (Fig. 53.1).
2. *Sialography:* A radiopaque dye is injected into the gland's duct through a cannula and X-rays are taken (Fig. 53.2). The entire duct system becomes visible and radiolucent stones appear as a filling defect.
3. *Ultrasonography:* Ultrasound of the salivary gland can show the enlargement of the gland as well as calculus in it.
4. *CT scan or MRI:* It is sometimes needed and is of great help in diagnosis.

Fig. 53.1: A = Plain X-ray floor of mouth (occlusal view) showing two radiopaque stones in the submandibular duct. B = Removed stones after surgery.

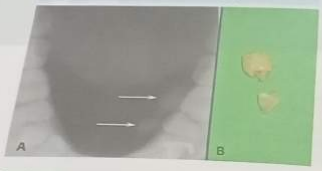
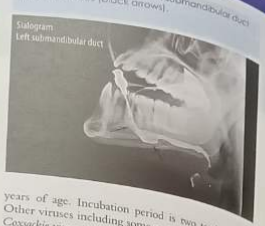


Fig. 53.2: Sialogram of the left submandibular duct showing stones (black arrows).



Treatment

Sometimes the small stone may dislodge spontaneously or by use of sialogogues. Stone in the submandibular or parotid duct can be removed intra-orally by giving incision on the duct. Stones which are deep seated or within the substance of submandibular gland are difficult to remove. In such cases, excision of the entire submandibular gland is done.

SJOGREN'S SYNDROME

Sjogren's syndrome is a multisystem autoimmune disorder involving almost every system in the body. It is classified into two forms:

1. *Primary Sjogren's disease (sicca syndrome).*
2. *Secondary Sjogren's syndrome.*

Primary Sjogren's disease consist of xerostomia and xerophthalmia i.e. involvement of salivary and lacrimal glands without any associated connective tissue disorder. These patients are often upset by dryness of the mouth.

Secondary Sjogren's syndrome, a triad of xerophthalmia, xerostomia and connective tissue disorder which in half of the cases is rheumatoid arthritis. 30% of the patients have involvement of the parotid gland in the form of recurrent parotitis.

On laboratory investigations, there will be raised ESR, positive RA factor, positive Antinuclear Antibodies (ANA), positive Ribonucler Antibodies (SS-A and SS-B) and raised immunoglobulins levels. Definitive diagnosis is made on histopathology by taking a sublabial biopsy of minor salivary glands. Treatment of the condition is mainly symptomatic.

VIRAL PAROTITIS

Viral parotitis is one of the common infectious diseases of childhood. It is mostly caused by the *mumps virus* which is a paramyxovirus and usually affects children under 15 years of age. Incubation period is two to three weeks. Other viruses including some strains of *ECHO* virus and *Coxsackie* virus may also cause viral parotitis. It spreads by droplet infection. One episode of mumps gives rise to life long immunity against the disease.

Clinical Features

There is severe pain in the parotid region with fever which is usually of high grade. It is associated with systemic disturbances like general malaise and bodyache. Pain is much worse by opening the mouth and the mouth is dry. In severe cases, there is trismus due to spasm of masseter muscle. On examination, parotid gland of both the sides are diffusely enlarged and tender (Fig. 53.3). Opening of the parotid duct in the mouth also shows congestion and swelling.

Clinical Features of Viral Parotitis

- Pain: parotid region.
- Fever: high grade.
- Trismus.
- General malaise.
- Parotid gland enlarged and tender.
- Dry mouth.
- Parotid duct opening: swollen and congested.

Investigations

Diagnosis of viral parotitis is usually made clinically on history and examination. There will be raised total white cell count with predominance of lymphocytes on blood picture. Viral antibody titer against mumps or other virus can be measured and found to be raised.

Complications

Mumps infection can cause epididymo-orchitis, pancreatitis, encephalitis and sensorineural hearing loss.

Fig. 53.3: Mumps.

Fig. 53.4: Bacterial parotitis involving one side only.

Treatment

In viral parotitis, symptomatic treatment is given. Bed rest, good oral hygiene, soft and liquid diet, analgesic and local heat fomentation is advised. Antibiotic is given in cases where bacterial superadded infection is suspected.

BACTERIAL PAROTITIS

Bacterial parotitis is commonly seen in adult patients. The cause of bacterial parotitis is an ascending infection along the parotid duct in dehydrated patients who lack resistance to infection. It can also occur secondary to obstruction of the duct by stone, epithelial debris or stenosis. The usual causative organism is staphylococcus, but other organisms including gram positive, anaerobes and sometimes mixed organisms may be the cause.

Clinical Features

Clinical features are very similar to viral parotitis. Bacterial parotitis is mostly present on one side in contrast to viral parotitis which mostly affects bilaterally (Fig. 53.4). In severe cases of bacterial parotitis, abscess formation with collection of frank pus may occur within the substance of parotid gland. Fluctuation on abscess formation is not prominent due to thick fibrous capsule of the gland. This abscess may burst through the capsule and extend into the cheek, subcutaneous tissues and parapharyngeal space. On examination of the mouth, pus may be seen coming out from the parotid duct on pressing the gland.

Investigations

On blood picture, there will be raised total white cell count with predominance of neutrophils. Pus is sent for culture and sensitivity. Pus is obtained either from the parotid duct or during incision and drainage of the pus.

Treatment

In the initial stage of the inflammation, broad spectrum parenteral antibiotic should be started immediately, which can be changed later on according to the C/S report. Clindamycin is the antibiotic that is secreted in the saliva and can be used accordingly. When there is abscess formation, incision and drainage is done to evacuate the pus. Other supportive treatment as described in viral parotitis should also be given.

NEOPLASIA OF THE SALIVARY GLAND

Although the incidence of salivary gland tumor varies in different geographical regions, these tumors in general are uncommon. Approximately 80% of all salivary tumors are located in the parotid, 10% in the submandibular and rest of the 10% in sublingual and minor salivary glands. In the parotid gland, most of the tumors (about 80%) are benign whereas in submandibular gland, 60% are benign tumors. In minor salivary glands, malignant tumor are more common than benign tumor. Little is known about the etiology of salivary gland tumors but exposure to radiation is considered as an important etiological factor. Following neoplasia are found in salivary glands.

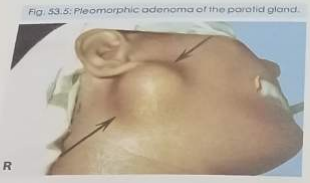
A. Benign Neoplasia

1. Epithelial Neoplasia:
   a. Pleomorphic adenoma.
   b. Warthin's tumor.
   c. Oncocytoma.
   d. Adenoma.
2. Mesenchymal Neoplasia:
   a. Hemangioma.
   b. Lymphangioma.
   c. Neurofibroma.

B. Malignant Neoplasia

1. Epithelial Neoplasia:
   a. Adenoid cystic carcinoma.
   b. Mucoepidermoid carcinoma.
   c. Adenocarcinoma.
   d. Acinic cell tumor.
   e. Malignant mixed tumor.

Fig. 53.5: Pleomorphic adenoma of the parotid gland.



2. Non-Epithelial Neoplasia.
   a. Lymphoma.
   b. Sarcoma.

Pleomorphic Adenoma

This is most common of all benign tumors of the salivary glands (Fig. 53.5). It is characterized by slow growth and clinically a benign course. It is essentially an epithelial tumor of complex morphology, with both epithelial and myoepithelial tissues. That is why it is called mixed tumor or pleomorphic. The epithelial and myoepithelial elements are arranged in various patterns. It is surrounded by a false capsule, which is formed in response to expansion of tumor. This false capsule of compressed parotid tissue varies in thickness and tumor may extend into the capsule in a lobulated or pseudopod pattern. That is why removal of the tumor through its capsule may lead to recurrence thus it is treated by removal of whole superficial lobe. It is usually seen in third and fourth decade with a slight female preponderance.

Warthin's Tumor

This is also called 'adenolymphoma' or 'papillary cyst adenoma lymphomatosum'. This tumor is primarily seen in males of old age (between fifth and seventh decade). It is occasionally bilateral and often more than one tumor is found in one gland. Histologically, it is made up of areas of lymphoid tissues intermingling with cystic spaces lined by a tall tubular or papillary epithelium.

Oncocytoma

It is also known as oxyphil cell adenoma. This tumor is composed of large, monomorphic eosinophilic cells similar to the oncocytes seen in aging salivary glands. It is a rare benign tumor which may rarely transform into malignancy.

Adenoid Cystic Carcinoma

This is the most common malignant salivary gland tumor. It may arise from any salivary tissue but commonly it is present in the minor salivary glands. The maximum incidence is in the sixth decade with equal sex preponderance.

Mucoepidermoid Carcinoma

This is the second most common malignant salivary gland tumor. It is also a slow growing tumor and local recurrence is common. Histologically it is composed of two distinct cell types, epidermoid and mucous cells. Both of these cell types show varying degree of differentiation. Mucous is secreted into the stroma giving rise to partially cystic appearance. This tumor is graded according to its cellular element. High grade tumor has more epidermoid cellular element, while the low grade tumor has more cystic spaces.

Clinical Features

Benign tumors are usually slow growing tumors. Patient reports swelling of the gland. Rapid increase in size and pain demonstrate the malignant nature of the tumor. Facial nerve paralysis in parotid tumors is also a feature of malignancy.

Treatment

Benign tumors of the parotid gland are treated with *superficial parotidectomy*. In malignant tumors *total parotidectomy* is done with or without preservation of facial nerve. Neoplasms of submandibular gland are treated by complete removal of the gland.

Chapter Summary and Key Points

Viral parotitis is one of the common infectious disease of childhood. One episode of mumps gives rise to life long immunity. Mumps can give rise to some serious complications like pancreatitis, epididymo-orchitis, encephalitis and sensorineural hearing loss. Stone formation is much more common in submandibular than parotid ducts. 80% of the salivary stones are radiopaque and visible in plain radiography. Benign tumors are much more common than malignant in major salivary glands. Pleomorphic adenoma is the most common benign tumor of salivary gland. Among the malignant variety, adenoid cystic carcinoma is the most common.

Difficult words

- *Sialogogues:* Any agent that stimulates the flow fo saliva like lemon juice, chewing gum or parasympathomimetic drugs.

Best Choice Questions

Q1. A 38-year-old male patient was diagnosed with salivary calculus. What is the most common site for this calculus formation?
a. deep lobe of parotid.
b. sublingual gland.
c. submandibular gland and its duct.
d. superficial lobe of parotid gland and its duct.

Q2. A 38-year-old female patient presented with xerophthalmia, xerostomia and connective tissue disorder. What is the most likely diagnosis?
a. primary Sjogren's syndrome.
b. rheumatoid arthritihis.
c. secondary Sjogren's syndrome.
d. viral parotitis.

Q3. A 30-year-old female patient with xerophthalmia, xerostomia and connective tissue disorder. What is the most important and definitive diagnostic test for this condition?
a. ANA factor.
b. orthopantomogram.
c. RA factor.
d. sublabial biopsy.

Q4. What is the incubation period of mumps virus?
a. 1 week.
b. 2–3 weeks.
c. 4–5 weeks.
d. 6–7 weeks.

Q5. A 40-year-old female patient with a swelling in the right parotid gland which on fine needle aspiration came to be malignant. What is the most likely possibility among the following?
a. adenocarcinoma.
b. adenoid cystic carcinoma.
c. lymphoma.
d. mucoepidermoid carcinoma.

Q6. Which of the following antibiotic is secreted in salivary secretions?
a. amoxicillin.
b. cephradine.
c. clindamycin.
d. erythromycin.

Q7. What is the incidence of benign neoplasia among the all parotid gland tumors?
a. 20%.
b. 40%.
c. 60%.
d. 80%.

Q8. A 36-year-old male patient with a mass in the left parotid gland for last 6 years which is slowly increasing in size. On fine needle aspiration cytology, it appeared to be a benign lesion. What is the most likely possibility regarding the type of tumor?
a. neurofibroma.
b. oncocytoma.
c. pleomorphic adenoma.
d. Warthin's tumor.

Q9. What is the age group when pleomorphic adenoma of the parotid gland is most commonly seen?
a. children between 4 to 10 years.
b. teenagers between 11 to 19 years.
c. between third and fourth decades.
d. between fifth and sixth decades.

Q10. In which of the following demographic group, Warthin's tumor of the salivary gland is most commonly seen?
a. adolescent females.
b. adolescent males.
c. females between 35–50 years.
d. old age male patients.

Answers with Explanations

1. c. about 90%.
2. c.
3. d.
4. b.
5. b.
6. c so commonly used in salivary gland infections.
7. d.
8. c.
9. d.
10. d.

CHAPTER

54 Diseases of the Thyroid Gland

- Development of the thyroid gland
- Anatomy of the thyroid gland
- Goiter
- Examination of the thyroid gland
- Examination for the functional thyroid status
- Multinodulargoiter(MNG)
- Solitary thyroid nodule
- Graves' disease

DEVELOPMENT OF THE THYROID GLAND

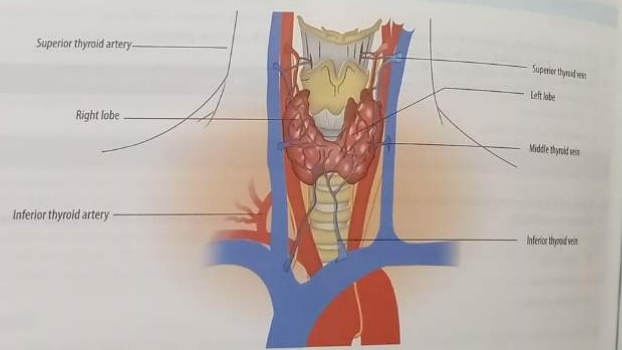
During the fourth week of gestation, foramen caecum develops as an endodermal thickening in the floor of primitive pharynx at the junction of first and second pharyngeal pouches to form thyroid primodium. This primitive thyroid tissues penetrate the underlying mesenchymal tissues and descend anterior to laryngeal cartilages. During its descent, it is first spherical but soon it becomes bilobed as it grows caudally. The proximal portion of the thyroglossal duct ultimately atrophies but if any portion persists, it may give rise to a thyroglossal cyst.

ANATOMY OF THE THYROID GLAND

The thyroid gland is composed of right and left lobes that are positioned anterolateral to the larynx and trachea (Fig. 54.1). These two lobes are connected to each other by a isthmus, which is present just below the cricoid cartilage. The normal thyroid gland weighs between 15 and 25 grams in an adult. Each lobe is approximately 4 cm in length, 2 cm in width and 2 to 3 cm in thickness. The superior pole of each lobe lies lateral to the inferior constrictor muscle of the pharynx and posterior to sternothyroid muscle. The lower pole of each lobe extends upto the fifth or sixth tracheal rings. From the surgical point of view, there are few critical and important anatomical structures that lie in close proximity to the thyroid gland. They include recurrent laryngeal nerves, superior laryngeal nerves and two pairs of parathyroid glands.

The blood supply of the thyroid gland is derived mainly from two arteries, superior thyroid and inferior

Fig. 54.1: Relations and blood vessels of the thyroid gland as seen from the front.



thyroid artery on each side. The superior thyroid artery is the branch of external carotid artery and run along the inferior constrictor muscle, accompanying superior thyroid vein (Fig. 54.1). The inferior thyroid artery is a branch of thyrocervical trunk and enters into the gland near its lower pole. Thyroidima artery is inconsistently present and supplies the thyroid gland near midline. The venous drainage of the gland is through superior, middle and inferior thyroid veins. Lymphatic channels usually follow the veins; those travelling with the superior thyroid vein drain into upper deep cervical, with middle thyroid vein drain into middle deep cervical and with inferior thyroid vein drain into lower deep cervical, supraclavicular, prelaryngeal and pretracheal lymph nodes.

EXAMINATION OF THE THYROID GLAND

The examination of the thyroid gland includes examination of the gland itself and all the signs of hyper or hypothyroidism in rest of the body. The thyroid gland is examined for size and nodularity. An enlarged thyroid gland is referred to as Goiter. There is no direct relationship of the size and function of the thyroid gland, a patient with huge goiter may be euthyroid, hypothyroid or hyperthyroid. The examination of the thyroid gland includes inspection, palpation, auscultation and percussion.

Inspection

The inspection of the thyroid gland is done in sitting position in front of the patient and examining from the anterior and lateral aspect of the neck. Normal sized thyroid gland is barely visible. Inspect the thyroid region and ask patient to swallow a sip of water and observe the upward movement of the gland. If there is a swelling or generalized enlargement of the thyroid gland, then note all points on inspection as mentioned in chapter 33 (under the heading of examination of the swelling). In a midline neck swelling which moves on deglutition, patient is asked to protrude the tongue and upward movement of the swelling is noted, which is seen in thyroglossal duct cyst (see chapter 33). Pemberton's maneuverer is performed in patients with huge goiter to assess retrosternal extension. The patient is asked to elevate both arms straight sideways so both arms are touching the side of the head for more than one minute. The thoracic inlet is already narrowed by the retrosternal extension of the goiter. When the arms are elevated, thoracic inlet is further narrowed by movement of the clavicles and causes obstruction in the flow of blood in the major veins at the thoracic inlet. It leads to congestion, cyanosis and dilatation of the veins in the head and neck region (Pemberton's sign).

Palpation

The palpation of the thyroid gland is also done from the front and back of the patient. Palpation from the back is done by standing behind the patient and putting both hands on the anterior and lateral aspect of the neck and asking the patient to swallow (Fig. 54.2). Normal sized thyroid with normal texture is barely palpable. Any change in the size, consistency or texture of the gland, make it palpable. First the isthmus is palpated and then hands are moved laterally to palpate both lobes on the sides. If any swelling or enlargement of the thyroid gland is present, it should be palpated from the front and all points as mentioned in chapter 33 must be noted. Nodularity within the gland must be noted in generalized enlargement of the thyroid.

The trachea should be assessed for any deviation by the thyroid swelling. Put your index and ring finger respectively on each sternal end of the clavicle and with your middle finger feel the trachea by moving your finger above downwards from cricoid cartilage to the upper border of the sternum (Fig. 54.3).

Auscultation

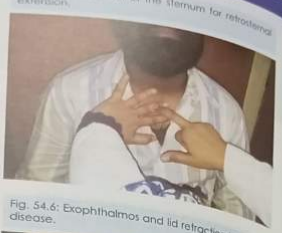
Enlarged thyroid gland or swelling within it must be auscultated with the bell side of the stethoscope putting over it (Fig 54.4). Abnormally, increased blood flow in the thyroid is audible as a bruit.

Fig. 54.2: Palpation of the thyroid gland from behind.

Fig. 54.3: Examination for tracheal deviation.

Fig. 54.4: Auscultation of the thyroid gland.

Fig. 54.5: Percussion of the sternum for retrosternal extension.



Percussion

Percussion on the sternum is a quite good clinical maneuverer to assess the retrosternal extension of the goiter (Fig. 54.5).

EXAMINATION FOR THE FUNCTIONAL THYROID STATUS

General Examination

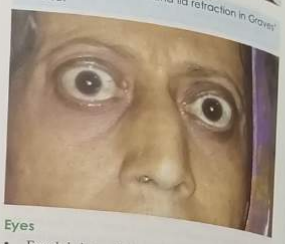
During general physical examination, following are the important clinical signs to assess the functional thyroid status:

- Behavior of the patient: Anxiety and agitation is seen in hyperthyroidism while dull and slow behavior is seen in hypothyroidism.
- Built of the patient: Patient is lean in long standing hyperthyroidism while obese in hypothyroidism.
- Pulse rate: Assess the radial pulse for rate and rhythm. It is rapid in hyperthyroidism (tachycardia) and slow in hypothyroidism (bradycardia). In thyrotoxicosis, pulse is irregular and rapid due to atrial fibrillation.

Hands

- Feel the skin of the patient's hand with your hand. Sweating is seen in hyperthyroidism while the hands are dry in hypothyroidism.
- Inspect the palm for erythema which is seen on thenar and hypothenar eminences in hyperthyroidism.
- Thyroid acropachy: It is the overgrowth of phalangeal bone and is seen in patients of Graves' disease.
- Fine tremors: Ask the patient to spread the fingers and put both hands outstretched and straight in front with palm facing downwards. Keep a piece of paper on the fingers and observe for fine tremors which is seen in hyperthyroidism.

Fig. 54.6: Exophthalmos and lid retraction in Graves' disease.



Eyes

- Exophthalmos: It is the anterior displacement of the eyes and it is seen in Graves' disease (Fig. 54.6).
- Lid retraction: The upper sclera is visible between the pupil and the eye lid and it is seen in patients with Graves' disease (Fig. 54.6).
- Lid lag: Check for lid lag by asking the patient to follow your finger. First keep your finger in front of the patient in midline much higher than his head and suddenly move your finger downwards and observe the eye movement. If lid lag is present, the upper lid will be lagging behind the eye movement downwards and upper sclera will be seen as well.
- Eye movements: Check the eye movement by moving your finger in H shaped manner in front of the patient. Eye movement is restricted in Graves' disease due to deposition of abnormal connective tissues in the orbit and around extraocular muscles.

Face and Head

- Inspect the face and head for sweating (hyperthyroidism) or dryness (hypothyroidism).

- Alopecia and hair thinning is seen in both hyperthyroidism and hypothyroidism.
- Face flushing is seen in hyperthyroidism.

- Pretibial myxedema: The other term is thyroid dermopathy and it due to localized deposition of hyaluronic acid. It is mostly seen in the pretibial region and it is seen in Graves' disease. Press the skin with your thumb for a little while and observe for non-pitting edema.
- Proximal myopathy: Both hyper and hypothyroidism can cause myopathy (thyrotoxic myopathy and hypothyroid myopathy). Ask the patient to rise from the chair using his hands for support. Patient will not be able to stand without hand support in proximal myopathy.
- Tendon reflexes: Check for the knee jerk and ankle jerk. It will be exaggerated in hyperthyroidism and decreases in hypothyroidism.

GOITER

Goiter is the term used to describe enlargement of the thyroid gland and it comprises a variety of conditions. Goiter can be classified into toxic and nontoxic, diffuse or nodular and solitary or multiple. The following are the common etiological factors that can cause enlargement of the thyroid gland:

1. Iodine deficiency.
2. Excessive use of goitrogen: It is a substance that causes enlargement of the thyroid gland e.g. cabbage, rapeseed etc.
3. Stimulation of TSH by pituitary tumors, pituitary thyroid hormone resistance, and thyroid-stimulating immunoglobulins.
4. Inborn errors of metabolism causing defects in biosynthesis of thyroid hormones.
5. Thyroid hormone resistance.
6. Autoimmune thyroiditis: It includes Hashimoto's thyroiditis, postpartum thyroiditis, subacute lymphocytic thyroiditis (De Quervain's thyroiditis), Graves' disease etc.
7. Infectious thyroiditis including post-viral and bacterial thyroiditis.
8. Granulomatous diseases.
9. Fibrous or Riedel's thyroiditis.
10. Thyroid neoplasia.

MULTINODULAR GOITER (MNG)

Multinodular Goiter (MNG) is a commonly used term describing a chronically enlarged thyroid gland with multiple areas of nodularity (Fig. 54.7 and 54.8). Worldwide, multinodular goiter is the most common endocrine disorder where iodine deficiency is often the culprit.

Pathology

The etiology of multinodular goiter is not known exactly. In iodine deficient areas there is decreased formation of thyroid hormone, which in turn stimulates secretion of more TSH from the anterior pituitary gland. TSH in turn stimulates the growth of thyroid gland tissues. Initially, there is diffuse hyperplasia that later on is followed by colloid storage, where the follicles of various sizes are present, giving a nodular appearance. These follicles are morphologically and functionally identical to normal thyroid tissues. Genetic influences also plays a role in formation of the multinodular goiter.

The growth of thyroid tissues continue and sometimes areas of increased functioning may progress to hyperthyroidism or toxic MNG. Sometimes multinodular goiter may harbor occult malignancy, although true incidence has been disputed.

Fig. 54.7: Patient with multinodular goiter.

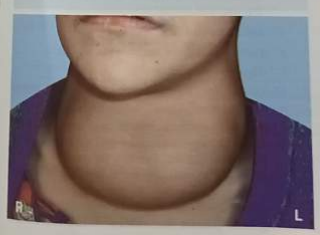


Fig. 54.8: Thyroid gland after thyroidectomy in a patient with MNG.

Clinical Features

Patient usually presents with an obvious neck swelling causing a cosmetic deformity of front site of the neck (Fig. 54.7). Sometimes, patient is completely unaware of the problem until diagnosed by a physician on routine examination or during evaluation of some other disease. Sometimes, patient may present with symptoms of hyperthyroidism or hypothyroidism. Large and long standing multinodular goiter may produce compressive symptoms at upper aerodigestive system causing dysphagia, sensation of something in the throat, recumbent dyspnea, dyspnea on exertion or hoarseness of voice.

On examination, diffuse enlargement of the thyroid gland, which moves on deglutition, having multiple nodules of different sizes is seen. In case of hyperthyroidism or hypothyroidsim, signs related with each condition are present.

Clinical Features of Multinodular Goiter

- Neck swelling.
- Compression symptoms.
  - Dysphagia.
  - Dyspnea.
  - Hoarseness of voice.
- Sign and symptoms of hyperthyroidism or hypothyroidism.

Investigations

1. *Thyroid functions test:* Once a multinodular goiter is suspected, further laboratory studies are necessary to find the functional status of the thyroid gland. It includes serum TSH, T3 and T4 levels. Serum TSH offers the most specific and sensitive means of defining euthyroidism.
2. *Ultrasound imaging:* It is a very helpful investigation to find out presence, number, consistency and size of the nodules. Ultrasound can detect a nodule of only few millimetres in size.
3. *Fine Needle Aspiration Cytology (FNAC):* It is usually performed to find out the histopathologic diagnosis of suspicious nodule. In multinodular goiter, it is indicated when MNG harbors a dominant nodule or single rapidly enlarging nodule.
4. *Thyroid scintigraphy:* Thyroid scintigraphy or scan with technetium 99m pertechnate (Tc-99m) provides information about the functional status of the nodule in relation with the surrounding thyroid tissues. A hyperfunctioning nodule will appear as 'hot' while a hypofunctioning nodule will appear as 'cold'. Now thyroid scan is considered to have very limited role in investigating a patient of mutinodular goiter.

Treatment

Medical treatment of MNG in the form of suppression therapy with thyroxine to suppress TSH, has a very limited role. The mainstay of treatment is surgical removal of the gland in the form of total, near total or subtotal thyroidectomy. The extent of surgery, either total thyroidectomy or subtotal thyroidectomy depends on the situation where normal thyroid tissue can be left behind or not. For surgery, patient must be euthyroid before surgery. In case of hyperthyroidism or toxic MNG, first medical treatment in the form of antithyroidal drugs is recommended until the patient is euthyroid.

Treatment of Multinodular Goiter

- **Medical**
  - Limited role.
  - To make patient euthyroid before surgery.
- **Surgical:** Thyroidectomy.
  - Total.
  - Near total.
  - Subtotal.

SOLITARY THYROID NODULE

Thyroid nodule is a common clinical entity and prevalence of clinically palpable thyroid nodule is estimated to be around 1% to 7%. Regardless of the incidence, the critical question is whether the detected nodule is malignant or not. Thus, differential diagnosis of a solitary thyroid nodule is broadly classified into benign and malignant:

1. Benign: Most solitary thyroid nodules are benign and include:
   a. Thyroid adenoma: It is further classified into follicular and papillary type. Follicular adenoma is much more common than papillary type.
   b. Colloid nodule.
   c. Thyroid cyst: It is often caused by cystic degeneration of thyroid tissues, hemorrhage or trauma.
   d. Infectious nodule.
   e. Granulomatous or lymphocytic nodule.
   f. Hyperplastic nodule.
2. Malignant: The various types of malignant thyroid tumors are:
   a. Papillary carcinoma: It is the most common type of thyroid cancer and has the best prognosis among all thyroid cancers. Females are more commonly affected than males and the average age at the time of diagnosis is around 40 years. It arises from the follicular cells and it is characterized by a papillary growth pattern that exhibit distinctive nuclear

features. Lymphatic metastasis to the regional lymph nodes is very common in these patients.
   b. Follicular carcinoma: It exhibits a pattern of growth that resembles normal thyroid follicles. In fact the follicles of a hyperplastic adenoma are indistinguishable from those of follicular carcinoma. It is the presence or absence of invasiveness that determines the malignant potential of a follicular neoplasm. Regional nodal metastasis is less common than papillary carcinoma but distant hematogenous metastasis is much more common in follicular carcinoma.
   c. Hurthle cell carcinoma: It is also called as 'oncocytic carcinoma' and is characterized by presence of Hurthle cells (oncocytes), which are large, polygonal cells with abundant cytoplasm and mitochondria. The behavior of Hurthle cell carcinoma is highly variable and depends on the histological features of the tumor.
   d. Medullary carcinoma: It is a rare malignant tumor and arises from parafollicular C cells of the thyroid gland and hence comes in the category of neuroendocrine neoplasia. It is a biochemically active neoplasm that secrets calcitonin.
   e. Anaplastic carcinoma: It is an uncommon malignant tumor but shows an aggressive and rapid growth with local tissue invasion. It is commonly seen in elderly patients.
   f. Thyroid lymphoma: Although thyroid gland does not contain native lymphoid tissues but may acquire through pathological conditions. Majority of them are of B cell origin but T cell lymphoma may occur in the thyroid gland.
   g. Squamous cell carcinoma: It is an extremely rare malignant thyroid tumor.
   h. Sarcoma.

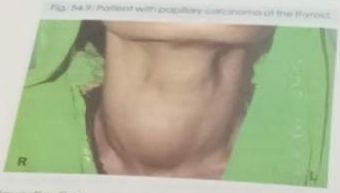
Clinical Features

The usual presentation of a thyroid nodule is an asymptomatic mass in the neck (Fig. 54.9) which is noticed by the patient, relatives or a physician on routine check-up. Patient may present with symptoms of compression or invasion like dysphagia, dyspnea, dysphonia or hoarseness of voice, hemoptysis. The neck mass moves on swallowing but not on tongue protrusion. Factors that increase the suspicion of malignancy include rapid growth of the nodule, extremes of age, previous radiation therapy in head and neck region, symptoms of compression or invasion and family history of thyroid cancer.

TNM classification for Differentiated and Anaplastic Thyroid Carcinoma

Primary tumor 'T' staging	
T1 =	Tumor size ≤ 2 cm in greatest dimension and is limited to the thyroid
T1a =	Tumor ≤ 1 cm, limited to the thyroid
T1b =	Tumor > 1 cm but ≤ 2 cm in greatest dimension, limited to the thyroid
T2 =	Tumor size > 2 cm but ≤ 4 cm, limited to the thyroid.
T3 =	Tumor size > 4 cm, limited to the thyroid or any tumor with gross extrathyroidal extension invading only strap muscles
T3a =	Tumor size > 4 cm, limited to the thyroid
T3b =	Any size tumor with gross extrathyroidal extension invading only strap muscles (eg, extension to sternothyroid, sternohyoid, thyrohyoid, or omohyoid muscles)
T4a =	Any size tumor with gross extrathyroidal extension invading subcutaneous soft tissues, larynx, trachea, esophagus, or recurrent laryngeal nerve
T4b =	Any size tumor with gross extrathyroidal extension invading prevertebral fascia or encasing the carotid artery or mediastinal vessels
Nodal metastasis 'N' staging	
N1a =	Metastases to level VI or VII (pretracheal, paratracheal, or prelaryngeal/Delphian or upper mediastinal) lymph nodes. This can be unilateral or bilateral disease.
N1b =	Metastases to unilateral, bilateral, or contralateral neck lymph nodes (levels I, II, III, IV, or V) or retropharyngeal lymph nodes
Distant metastasis 'M' staging	
M0 =	No distant metastasis is found
M1 =	Distant metastasis is present

Fig. 54.9: Patient with papillary carcinoma of the thyroid.



Investigations

1. *Thyroid functions test:* The functional status of the thyroid gland has to be evaluated when working up a solitary thyroid nodule. It includes serum TSH, T_3 and T_4 levels.
2. *Ultrasound imaging:* It is a widely used imaging technique for evaluation of a thyroid nodule. It can detect a nodule of few millimetres size and can also differentiate between a solid or a cystic nodule. Predominantly, a solid nodule carries a higher risk of malignancy. The other features suggestive of malignancy in a solitary nodules on ultrasound are; ill-defined margins, irregular shape, hypo-echogenicity, halo sign, calcification, increased vascularity and invasion to surrounding tissues. It is also helpful in assessing nodal metastasis in the neck nodes.
3. *Fine Needle Aspiration Cytology (FNAC):* It is performed to find out the histopathologic diagnosis of the nodule and is now considered as a gold standard in evaluation of a thyroid nodule.There are two systems for reporting of FNAC in thyroid nodule; Thy and Bethesda classification. In Thy classification, there are 5 grades from Thy 1 to Thy 5 while in Bethesda classification there are 6 grades (see table).
4. *Thyroid scintigraphy:* It provides information about the functional status of the nodule in relation with the surrounding thyroid tissues. A hyperfunctioning nodule will appear as 'hot' while a hypofunctioning nodule will appear as 'cold'.
5. *CT scan or MRI:* CT scan is very helpful for assessing neck nodes and for assessing extension and invasion of the thyroid cancer into the surrounding tissues. MRI has a minor role in evaluation of a thyroid nodule. A contrast agent (gadolinium) can be used during MRI.
6. *Serum thyroglobulin:* Serum thyroglobulin level is used in follow-up cases of thyroid cancers after surgery and it is raised in cases of tumor recurrence.
7. *Serum calcitonin:* It is done in cases where medullary carcinoma of the thyroid is suspected.

Thy Classification

- Thy 1: Non-diagnostic
- Thy 2: Non-neoplastic
- Thy 3: All follicular lesions
- Thy 4: Abnormal, suspicious for malignancy
- Thy 5: Diagnostic of malignancy

Bethesda Classification

- I: Non-diagnostic or Unsatisfactory
- II: Benign
- III: Atypia of undetermined significance
- IV: Follicular lesion
- V: Suspicious for malignancy
- VI: Malignant

Treatment

Treatment of a thyroid nodule depends on the results of FNAC and other investigations. In small and benign thyroid nodules, suppression therapy with thyroxine may reduce the size. Nodules not responding to medical treatment or increasing in size, suspicious nodules and malignant nodules are treated by surgery. Benign and suspicious nodules are treated by lobectomy and isthmusectomy. If histopathology shows malignant tumor completion thyroidectomy with or without neck dissection is done. In case of malignant disease on FNAC, total thyroidectomy with or without neck dissection is advised.

GRAVES' DISEASE

Graves' disease is named after Robert J. Graves and it is an autoimmune disease characterized by hyperthyroidism due to circulating thyroid stimulating autoantibodies. These thyroid-stimulating immunoglobulins (TSIs) bind to and activate the thyrotropin receptors in the thyroid gland and thus causes the gland to grow and increase synthesis of thyroid hormone. The increased level of circulating T3 and T4 has a negative feedback effect causing decrease in secretion of thyroid stimulating hormone (TSH).

Clinical Features

The clinical features of Graves' disease are related with hyperthyroidism and thyrotoxicosis on multiples organs of the body. It includes weight loss, fatigue, weakness, increased appetite, heat intolerance, restlessness, anxiety, irritability, insomnia, palpitation, increased heart rate, increased sweating, warm and moist skin, increased bowel movements, menstrual irregularity, fine tremors etc. Eye changes (ophthalmopathy) and skin changes (dermopathy) are very unique in Graves' disease and are not present in

other forms of hyperthyroidism. Eye changes include exophthalmos, lid retraction, lid lag and restricted eye movements (see page 289 and fig. 54.6).

Investigations

1. *Thyroid functions test:* There is raised levels of free T3 and T4 and decreased level of TSH.
2. *Ultrasonography:* Diffuse enlargement of the thyroid gland with increased vascularity is usually present.
3. *Thyroid scintigraphy:* It is done to rule out presence of functioning adenoma (hot nodule) in the thyroid gland.
4. *Thyroid stimulating immunoglobulin assay:* It is raised and is the diagnostic test for Graves' disease.
5. *Other thyroid antibodies assay:* Anti-thyroglobulin antibodies and anti-thyroidal peroxidase antibodies are sometimes raised in Graves' disease.

Treatment

Following are the available options for treatment of Graves' disease depending upon severity and other factors:

1. Beta blocker drugs for adrenergic hyperfunction.
2. Anti-thyroid drugs like carbamizole.
3. Radioactive iodine ablation.
4. Thyroidectomy.
5. Glucocorticoids especially if Graves' disease is associated with other autoimmune disorders.

Chapter Summary and Key Points

Thyroid gland is composed of right and left lobe and connected in the midline with isthmus. Goiter is a general term used to describe an enlarged thyroid gland. Multinodular Goiter (MNG) is the most common endocrine disorder where there is enlargement of the entire thyroid gland with multiple areas of nodularity. MNG is treated with either subtotal or total thyroidectomy. Majority of the solitary thyroid nodules are benign. The greatest challenge in the management of a solitary thyroid nodule is to differentiate between a benign or malignant disease. Extent of surgery in case of a solitary nodule depends on the FNAC and other investigative findings.

Best Choice Questions

Q1. Which of the following vessel gives the superior thyroid artery?

a. external carotid artery.
b. facial artery.
c. subclavian artery.
d. thyrocervical trunk.

Q2. What is the weight of a normal thyroid gland in an adult male?

a. 15 to 25 grams.
b. 50 to 60 grams.
c. 90 to 100 grams.
d. 120 to 150 grams.

Q3. Lobectomy was planned for a 35-year-old woman who presented with a solitary thyroid nodule in the right lobe. Which of the following structure is at most risk for damage during surgery?

a. external carotid artery.
b. esophagus.
c. recurrent laryngeal nerve.
d. vagus nerve.

Q4. A 40-year-old woman with progressively increasing thyroid swelling for last 4 years. On examination, it was found to involve the entire thyroid gland with multiple areas of nodularity. Her thyroid function tests were within normal limits. What is the most likely diagnosis?

a. Graves' disease.
b. Hashimoto's thyroiditis.
c. multinodular goiter.
d. Riedel's thyroiditis.

Q5. A 42-year-old male patient was diagnosed with a multinodular goiter. What is the most sensitive and specific serum test for assessment of his thyroid functional status whether he is euthyroid or not?

a. free T4.
b. serum T3.
c. serum T4.
d. serum TSH.

Q6. A 48-year-old female patient with rapidly increasing thyroid swelling. Her serum calcitonin level was markedly raised. What is the most likely diagnosis?

a. anaplastic carcinoma.
b. follicular carcinoma.
c. Hurthle cell carcinoma.
d. medullary carcinoma.

Q7. Lobectomy was performed on a patient with a solitary thyroid nodule and the specimen was sent for histopathology. Report showed presence of large polygonal cells with abundant cytoplasm and mitochondria. What is the most likely diagnosis in this case?

a. anaplastic carcinoma.
b. follicular carcinoma.
c. Hurthle cell carcinoma.
d. medullary carcinoma.

Answers

1. a.
2. a.
3. c.
4. c.
5. d.
6. d.
7. c.

CHAPTER

55

Neck Mass

- Triangles of the neck
- Causes
- Clinical workup
- Investigations
  - Cervical lymphadenopathy
    - Tuberculosis
    - Lymphoma
    - Metastatic lymph nodes
  - Neck dissection
  - Thyroglossal cyst
  - Branchial cyst

A mass in the neck is a common clinical entity that may be present in patients of any age group. The differential diagnosis may be extremely broad. Although most masses are due to benign disease, malignant diseases must not be overlooked. It is important to develop a systematic approach for diagnosis and management of a patient with a neck mass. The first consideration in a patient with a neck mass is the patient's age. For this purpose, it is classified into three age groups:

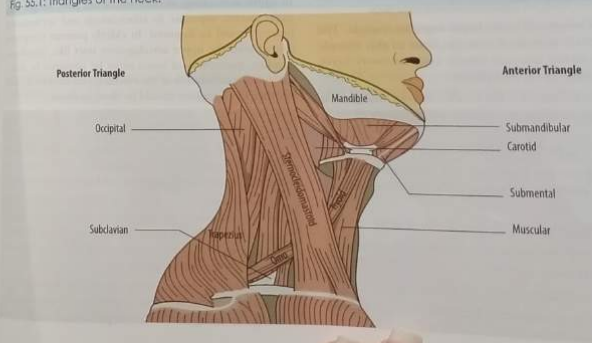
1. 0 to 15 years (pediatric age group).
2. 16 to 40 years (young adult age group).
3. Above 40 years (late adult or old age group).

In pediatric and young adult age groups, most of the causes are inflammatory or congenital while in late adults or old age group neoplastic causes are more common. The next important consideration in such patients is the location of the mass. It is particularly important in cases of congenital origin because such lesions are consistent in their location. For this purpose, the neck is divided into different triangles (Fig. 55.1). For metastatic neck mass, their location may be the key to identification of the primary tumor.

TRIANGLES OF THE NECK

For description purpose, neck is divided into different triangles anatomically. Firstly, sternocleidomastoid muscle divides the whole neck into two called "Anterior" and "Posterior" triangle of the neck (Fig 55.1). The boundaries of the anterior triangle of the neck are; anterior boarder of sternocleidomastoid muscle laterally, inferior boarder of

Fig. 55.1: Triangles of the neck.



the mandible superiorly and midline of the neck anteriorly from the chin to suprasternal notch. Similarly, the posterior triangle of the neck is bounded by the posterior boarder of the sternocleidomastoid muscle anteriorly, anterior boarder of the trapezius muscle posteriorly and middle one-third of the clavicle inferiorly.

Both these triangles are further subdivided into different smaller triangles. The anterior triangle of the neck is divided into:

1. *Submental triangle:* It is bounded by the anterior belly of the digastric muscle laterally, midline of the neck medially and hyoid bone inferiorly. The floor of this triangle is formed by the mylohyoid muscle and it contains submental lymph nodes.
2. *Submandibular triangle:* It is bounded by the anterior belly of digastric anteriorly, posterior belly of digastric posteriorly and inferior margin of the mandible superiorly. It contains submandibular salivary gland, submandibular lymph nodes, facial artery and facial vein. Marginal mandibular nerve passes superficial to this triangle.
3. *Carotid triangle:* It is bounded by the posterior belly of digastric superiorly, anterior boarder of sternocleidomastoid postero-laterally and superior belly of omohyoid inferiorly. The main contents of this triangle are carotid artery which divides into internal and external carotid, internal jugular vein, hypoglossal nerve, vagus nerve and deep cervical lymph nodes.
4. *Muscular triangle:* It is bounded by superior belly of omohyoid superolaterally, sternocleidomastoid muscle inero-laterally and midline of the neck medially and part of hyoid bone superiorly. It contains infrahyoid muscles, thyroid and parathyroid glands.

The posterior triangle of the neck is further subdivided by the inferior belly of digastric muscle into two:

1. *Occipital triangle:* It is the larger superior triangle. The prevertebral muscles forms the floor of this triangle and it contains external jugular vein, accessory nerve and branches of cervical plexus.
2. *Subclavian triangle:* It is the smaller inferior triangle and it contains distal portion of the subclavian artery.

CAUSES OF NECK MASS

Following are the important and common causes of neck mass or swelling according to the site of origin and etiology:

1. Thyroid swellings: (see chapter 53 for details).
2. Salivary gland swellings: (see chapter 52 for details).
3. Lymph node swellings:
   a. acute lymphadenitis e.g. bacterial, viral.
   b. chronic granulomatous lymphadenitis e.g. tuberculosis, sarcoidosis etc.
   c. metastatic nodes.
   d. neoplastic e.g. lymphoma, leukemia.
   e. autoimmune disorders.
4. Congenital and developmental swellings:
   a. thyroglossal cyst.
   b. branchial cyst.
   c. dermoid and epidermoid cyst.
5. Skin and subcutaneous tissues swellings:
   a. sebaceous cyst.
   b. lipoma.
6. Neurogenic tumors.
7. Vascular and lymphatic tumors:
   a. hemangioma.
   b. lymphangioma.
   c. cystic hygroma.
   d. aneurysm.
8. Mesenchymal tumors originating from muscles, bone, cartilages etc.
9. Infective or pyogenic:
   a. Ludwig's angina (see chapter 55).
   b. parapharyngeal abscess (see chapter 55).
10. Laryngocoele (see chapter 47).
11. Carotid body and glomus tumors.

CLINICAL WORKUP

Evaluation of a patient with a neck mass must begin with a careful and complete history and thorough examination. A thorough review of developmental time course of the mass, associated symptoms, personal habits, prior trauma, radiation or surgery is very important in history. In addition smoking, alcohol use, fever, pain, weight loss, night sweats, exposure to tuberculosis and occupational history should be inquired. In elderly patients symptoms related with the upper aerodigestive tract like, dysphagia, dyspnea, hoarseness of voice must be inquired in detail. Complete examination of the swelling (see chapter 33) and all other ENT regions should be done in detail.

INVESTIGATIONS

Choice of investigation depends on the findings on history and clinical examination. The following investigations are very helpful for evaluating a neck mass:

1. *Ultrasonography:* It is useful in differentiating a solid from a cystic mass. In addition, the size, site and extent can be assessed accurately. Tissue of origin e.g. a lymph node or thyroid gland or salivary gland etc. can also be assessed by this investigation.
2. *Fine needle aspiration cytology:* It can differentiate an inflammatory mass from a neoplastic mass either benign or malignant. It can be performed safely with

virtually no contraindication. It can be performed on children as well.
3. *CT scan:* It is a very helpful tool in evaluating difficult cases. It can distinguish cystic from solid lesions, define the origin and extent of a deep seated lesion. In addition, contrast medium can be used to delineate vascularity and blood flow.
4. *MRI scan:* It provides almost same information as a CT scan but is much superior for soft tissue mass. It is good for vascular delineation and may even substitute for angiography in pulsatile mass or mass with a bruit.
5. *Other investigations:* Depending on the history, clinical examination and findings of above mentioned tests, other investigations are required like thyroid scan, sialogram, serological tests, angiography etc.

CERVICAL LYMPHADENOPATHY

Cervical lymph nodes are affected in a number of diseases including those which cause generalized lymphadenopathy. Only few important and common causes of cervical lymphadenopathy are discussed here.

Tuberculosis

Tuberculous cervical lymphadenopathy is a common clinical entity in our region. The characteristic appearance of the lymph nodes are multiple, firm in consistency and matted together (Fig. 55.2). Necrosis in the center may occur giving it a soft consistency. Sometimes abscess formation occurs which bursts on the overlying skin leading to a discharging sinus. Fine needle aspiration cytology is the first line investigation which may suggest features of tuberculosis like presence of lymphocytes, giant cells, caseous necrosis etc. Open biopsy can be done if the FNAC is non-diagnostic. Treatment is mostly medical with initially four and then three antituberculous drugs.

Fig. 55.2: Patient of tuberculous cervical lymphadenopathy.

Lymphoma

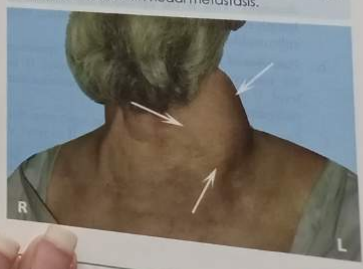
Lymphoma can occur in any age group but it is a common cause of cervical lymphadenopathy in children and young adults. Progressive and often painless enlargement of lymph nodes in the neck is the only sign of disease in most patients. Systemic signs of fever, hepatomegaly, spleenomegaly and generalized lymphadenopathy should be specifically looked for. The characteristic appearance of cervical lymph nodes on palpation is discrete, rubbery and non-tender. Fine needle aspiration cytology is the first line diagnostic test in such cases. If FNAC suggests lymphoma, an open biopsy for histopathology is advisable for architecture and other details. Treatment of lymphoma is mainly radiation or chemotherapy.

Metastatic Lymph Nodes

Metastatic lymph node may be present in a patient with known malignancy in the head and neck region (Fig. 55.3) or in a patient with occult primary. If the clinical evaluation of a neck mass does not lead to a definitive diagnosis, malignancy must bear in mind and should be excluded. An asymptomatic neck mass is the presenting complaint in many patients with malignancy in the head and neck region, having no complaints regarding their primary neoplasia. Majority of the metastatic lymph nodes are squamous cell carcinoma. The characteristic features of metastatic lymph nodes are firm to hard in consistency and fixity to the underlying structures or overlying skin. The important areas for a primary tumor in a case of occult primary are nasopharynx, base of the tongue, pyriform fossa, subglottic region, supraglottic area and thyroid gland. According to TNM classification, following is the staging of nodal metastasis (N status):

N_0 = no clinically positive node.
N_x = minimum requirement to assess the regional nodes cannot be met.
N_1 = involvement of single ipsilateral lymph node, 3 cm or less in greatest dimension.

Fig. 55.3: Patient of squamous cell carcinoma of the left pyriform fossa with nodal metastasis.



N_{2a} = involvement of a single ipsilateral lymph node more than 3 cm but not more than 6 cm in greatest dimension.

N_{2b} = involvement of multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension.

N_{2c} = involvement of bilateral or contralateral lymph node, none more than 6 cm in greatest dimension.

N_3 = involvement of lymph nodes more than 6 cm in greatest dimension.

In cases of metastatic lymph nodes, now the area where it is situated is described according to the level (level I to level VII, see chapter 33 for details). The surgical treatment for nodal metastasis is neck dissection.

NECK DISSECTION

Neck dissection is a surgical procedure for removal of metastatic cervical lymph nodes and surrounding structures. According to the lymph nodes and other structures removed, neck dissection is classified into following types:

1. *Radical neck dissection:* This is the operation for removal of all ipsilateral lymph nodes from level I to level V along with sternocleidomastoid muscle, internal jugular vein and spinal accessory nerve.
2. *Extended radical neck dissection:* This is the operation where all the structures mentioned for radical neck dissection are removed with some additional group of lymph nodes or other non-lymphatic structure or both.
3. *Modified radical neck dissection:* This is the operation for removal of all ipsilateral lymph nodes from level I to level V (as in radical neck dissection) but with preservation of any or all non-lymphatic structure (sternocleidomastoid muscle, internal jugular vein or spinal accessory nerve).
4. *Selective neck dissection:* This is the operation for removal of selective groups of lymph nodes. It is further classified into following four sub-types:
   a. *Supraomohyoid neck dissection (anterolateral neck dissection):* This is the operation for removal of lymph nodes from level I to level III along with submandibular salivary gland.
   b. *Posterolateral neck dissection:* This is the operation for removal of lymph nodes from level II to level V along with occipital and postauricular (retroauricular) group.
   c. *Lateral neck dissection:* This is the operation for removal of lymph nodes from level II to level V only.
   d. *Anterior neck dissection:* This is the operation for removal of lymph nodes that surround the visceral structures on the anterior aspect of the neck (level VI lymph nodes).

THYROGLOSSAL CYST

The thyroid gland is formed from the median diverticulum originated between the tuberculum impair and hypobranchial eminence (see chapter 53). This diverticulum descends in the neck through the hyoid bone leaving a duct behind called the thyroglossal duct. A cyst may form inside the remnant of this duct, anywhere between the suprasternal notch and the foramen caecum of tongue. It is the most common congenital abnormality in the neck (around 70% of all congenital anomalies of the neck).

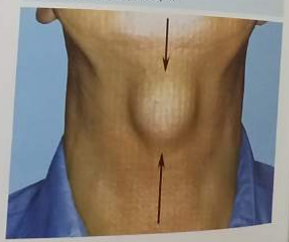
Clinical Features

In majority of the cases, thyroglossal duct cyst is present in children and young adults but in some cases it may present later in life. Most of the thyroglossal cysts (around 65%) are present below the hyoid bone, some (20%) at the level of hyoid bone and other (15%) above the hyoid bone. It usually occurs as a symptomless/painless lump in the midline of the neck (Fig. 55.4). On examination, it is mostly appears as soft, fluctuant, mobile cyst in the midline of the neck. It typically moves on swallowing and as well as on protrusion of the tongue. Sometimes cyst may get infected and produces symptoms of pain, redness or discharging sinus with signs of inflammation. Besides infection, another rare (< 1%) and important complication in later life is the presence of carcinoma in the cyst including papillary, follicular, mixed, anaplastic or Hurthle cell carcinoma.

Investigations

In children, diagnosis is typically straightforward clinically and is confirmed with an ultrasonography of the neck. Presence of normal thyroid gland in its normal anatomical position must be insured during ultrasonography. In adults or in complicated cases or where there is suspicion of malignancy, CT scan or MRI may be helpful for assessing content and extent of the cyst. Thyroid scan is indicated for ectopic thyroid in the cyst, where normal thyroid gland is absent on ultrasound of the neck.

Fig. 55.4: Thyroglossal cyst.



Treatment

It is treated by a surgical excision of the cyst along with removal of the part of body of the hyoid bone (Sistrunk's operation). A horizontal incision is done over the swelling and subplatysmal flaps are raised above and below. The cyst is dissected free from the strap muscles and the duct is followed upward. Cuts are made on either side of midline at the body of the hyoid bone and portion of the body of hyoid bone along with wedge of tongue muscles are removed and wound closed in layers.

BRANCHIAL CYST

The *branchial cyst* represents the remnant of the first branchial cleft. It is also known as lateral cervical cyst. It is usually present in lateral part of the neck deep to

Fig. 55.6: Opening of Branchial Sinus or Fistula.

sternocleidomastoid muscle at the junction of upper one-third and lower two-third (Fig. 55.5). The origin of branchial cyst is debatable and there are four theories of origin:

1. Branchial apparatus theory.
2. Cervical sinus theory.
3. Thymopharyngeal duct theory.
4. Inclusion theory.

Branchial cyst is mostly lined by stratified squamous epithelium and contains straw colored fluid with cholesterol crystals. In 80% of cases, the wall of the cyst contains lymphoid tissues. Males are slightly more affected than females (ratio of 3:2). The peak age incidence for presentation of branchial cyst is third decade. Majority are present in the classical upper lateral neck but some are also present in lower neck, parotid and posterior triangle of the neck.

Sometimes, there is incomplete fusion of the arches and a *branchial sinus* is formed. This sinus opens usually along the anterior border of sternomastoid muscle at the junction of its middle and lower third (Fig. 55.6). Rarely, a complete fistula running between the skin and the pharyngeal mucosa can result. Internal opening of this fistula is usually present into the oropharynx in the area of tonsillar fossa.

The branchial sinus and fistula can be demonstrated radiographically by the injection of radiopaque dye (Fig. 55.7). The treatment is complete surgical excision of the cyst, sinus or fistula.

Fig. 55.5: Branchial cyst. BC = branchial cyst SCM = sternocleidomastoid muscle.

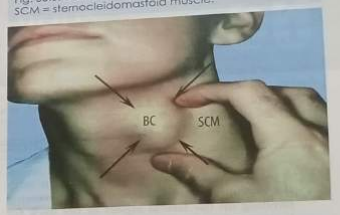


Fig. 55.7: Branchial fistula tract after injecting radiopaque dye.

Chapter Summary and Key Points

A mass in the neck is a common clinical entity that may be present in patients of any age group. Although, most masses are benign, malignant conditions must not be overlooked. Evaluation of a patient with neck mass must begin with a careful and complete history and thorough clinical examination. Two important considerations in such patients are: age and location of the mass. Most common causes of cervical lymphadenopathy in ENT practice are tuberculous, metastatic and lymphoma. In tuberculosis, lymph nodes are multiple and matted together while in lymphoma they are discrete, rubbery in consistency and non-tender. Hardness and fixity are the characteristic features of metastatic lymph nodes. Surgical treatment for a metastatic lymph node is neck dissection.

Best Choice Questions

Q1. A 23-year-old female patient came in with the complaint of progressively increasing swelling on the lateral aspect of the neck for last two months with low grade fever and night sweating. What is the most likely diagnosis?

a. branchial cyst.
b. cystic hygroma.
c. nodal metastasis.
d. tuberculous lymphadenopathy.

Q2. A 40-year-old female patient came with the complaints of a swelling in front of her neck for last 1 year. On examination, there was a single swelling which moved on swallowing but not on tongue protrusion. What is the most likely possibility?

a. branchial cyst.
b. dermoid cyst.
c. thyroglossal cyst.
d. thyroid nodule.

Q3. A 60-year-old male patient came with complaint of a progressively increasing swelling on the lateral aspect of his neck for last one month. On examination it was hard and fixed to the underlying structures. What is the most likely possibility?

a. lymphoma.
b. metastatic lymph node.
c. parapharyngeal abscess.
d. tuberculous lymphadenopathy.

Q4. A 30-year-old male patient came with neck swelling. On examination, there were multiple and discrete swellings in the posterior triangle of the neck. What is the most appropriate first investigation in this case?

a. CT scan.
b. fine needle aspiration cytology.
c. Mantoux test.
d. MRI scan.

Q5. A 48-year-old male patient was diagnosed as a case of carcinoma of the larynx. He had a single, mobile, ipsilateral metastatic lymph node at level III. What should be the appropriate treatment for nodal metastasis in this case?

a. anterior neck dissection.
b. radical neck dissection.
c. radiotherapy.
d. supraomohyoid neck dissection.

Answers

1. d.
2. d.
3. b.
4. b.
5. b.

CHAPTER 56

Neck Space Infections

- Retropharyngeal abscess
  - Acute retropharyngeal abscess
  - Chronic retropharyngeal abscess
- Parapharyngeal abscess
- Ludwig's angina

RETROPHARYNGEAL ABSCESS

Retropharyngeal space is a potential space that lies behind the pharynx between the buccopharyngeal fascia covering the pharyngeal muscles and the prevertebral fascia covering prevertebral muscles (Fig. 56.1). It extends from the base of the skull to the posterior mediastinum as far as the level of bifurcation of the trachea. The space is divided by a fibrous septa in the midline into two lateral halves called *space of Gillette*. Each of this space contains a retropharyngeal lymph node, which usually disappear by the age of four years. Retropharyngeal space communicates laterally with parapharyngeal space.

Retropharyngeal abscess is the collection of pus in this retropharyngeal space. There are two distinct clinical types:

1. Acute retropharyngeal abscess.
2. Chronic retropharyngeal abscess.

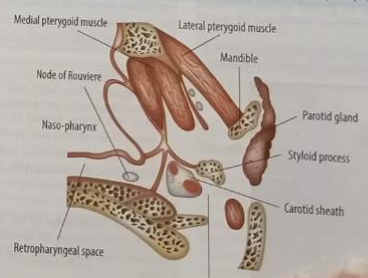
Acute Retropharyngeal Abscess

Acute retropharyngeal abscess is mostly caused by suppuration in the retropharyngeal lymph nodes. This variety is commonly seen in children below the age of 4 years (as the lymph nodes disappear after this age). Boys are more commonly affected than girls. The infection reaches through lymphatic channels from the nasopharynx or oropharynx. In adults acute retropharyngeal abscess may occur as a result of penetrating injury in the posterior pharyngeal wall or cervical esophagus by sharp foreign body like bone or fish bone. Rarely infection may reach here from petrous apex abscess. The common causative organism is *streptococcus pneumoniae*.

Clinical Features

At least half of the patients are under the age of one year. The predominant symptoms are dysphagia, difficulty in breathing and high-grade fever. Whooping cough is

Fig. 56.1: Transverse section through the neck showing retropharyngeal and parapharyngeal space.



common and the cry may resemble *'spasmodic'*. Stridor and nasal obstruction may also be present. Stiffness of the neck or torticollis is present and the head may be extended. On examination, the entire pharynx is congested with a lateral swelling of posterior pharyngeal wall. Edema of the larynx may develop quickly. Sudden death can occur due to spontaneous rupture of the abscess and aspiration of the pus.

Clinical Features of Acute Retropharyngeal Abscess

- Dysphagia.
- Difficulty in breathing.
- Fever: high grade.
- Croupy cough.
- Stridor and nasal obstruction.
- Swelling of posterior pharyngeal wall.

Investigations

1. *Imaging studies:* Plain X-ray of the neck, lateral view will show widening of the prevertebral space (Fig. 56.2). Because of spasm of the prevertebral muscles, there will be loss of cervical curvature (Fig. 56.2). CT scan of the neck will show site and extent of the abscess.
2. *Culture and Sensitivity (C/S)* of the pus which is obtained by incision and drainage of the abscess for appropriate antibiotic therapy.

Differential Diagnosis

The condition is to be differentiated from quinsy, chronic retropharyngeal abscess and parapharyngeal abscess.

Treatment

Incision and drainage is done immediately under general or local anesthesia. In general anesthesia, abscess may rupture during endotracheal intubation so special precautions should be taken. A Child is positioned in a supine position with the head low, mouth gag is inserted and a vertical incision is given in the posterior pharyngeal wall. Suction should be ready to prevent aspiration of pus. Broad spectrum systemic antibiotic through parenteral route is given which can be changed later on, according to the C/S report. Tracheostomy may be needed if there is a large abscess causing respiratory obstruction.

Fig. 56.2: X-ray neck (lateral view) showing widening of prevertebral space with loss of cervical curvature.

Chronic Retropharyngeal Abscess

Chronic retropharyngeal abscess is caused by tuberculous infection. The infection may reach the retropharyngeal space from erosion of the cervical vertebra due to tuberculosis of the vertebra. Tuberculous infection may also reach the retropharyngeal lymph nodes through lymphatic channels from cervical tuberculous lymphadenitis. The former type occurs centrally behind the pharynx while the later type occurs laterally as in acute retropharyngeal abscess.

Clinical Features

Chronic retropharyngeal abscess is seen in older children, adolescents and adults. Local signs and symptoms are slow and insidious on onset and may be masked by primary infection. The patient complains of pain in the throat and dysphagia along with the general signs and symptoms of tuberculosis. On examination, a fluctuant swelling will be seen in the posterior pharyngeal wall either centrally or laterally. Other enlarged and palpable cervical lymph nodes may be present.

Clinical Features of Chronic Retropharyngeal Abscess

- Dysphagia–slight.
- Discomfort or pain in the throat.
- Sore throat and cough.
- Other features of TB like weight loss and fever.
- Fluctuant swelling on posterior pharyngeal wall.
- Enlarged cervical lymph nodes.

Investigations

1. *Radiography:* Plain X-ray will show vertebral disease or calcification in retropharyngeal lymph nodes (Fig. 56.3). CT is very helpful in these cases to assess the extent of the abscess and condition of the vertebrae.
2. *Investigations for tuberculosis:* including blood CP, ESR, X-ray chest, sputum for AFB, Mantoux test etc.

Treatment

Incision and drainage of the abscess is made through the neck, never through the mouth. Full dose of combined antituberculous drug therapy for recommended duration is given.

Fig. 56.3: X-ray neck (lateral view) showing TB retropharyngeal Abscess with Vertebral disease.

PARAPHARYNGEAL ABSCESS

The *parapharyngeal space* lies lateral to the pharynx and communicates posteriorly with the retropharyngeal space (Fig. 55.1). It is pyramidal in shape and extends from the base of skull to the level of hyoid bone. Medially, it is bounded by the buccopharyngeal fascia covering the constrictor muscles of the pharynx, posteriorly by the prevertebral fascia, covering prevertebral muscles and transverse processes of cervical spine and laterally, by the pterygoid muscles, mandible and parotid gland.

Infection reaches the parapharyngeal space from the infections of tonsils, tonsillar fossa, penetrating foreign bodies, lower wisdom tooth and its surrounding gums and bones. The infection may also reach through external trauma to the neck by penetrating injuries and from ear infection via the petrous apex. The abscess may occur at any age but it is more frequent in adolescents and adults. The causative organisms are mostly *staphylococcus.*

Clinical Features

The patient usually presents with severe pain in the throat and marked trismus. There is high-grade fever and the patient looks very ill. Swelling in the neck may be present which is painful and tender to touch. On examination of the throat tonsils and posterior pharyngeal wall may be pushed medially. The spread of infection or abscess to the posterior compartment of parapharyngeal space may lead to involvement and palsies of the last four cranial nerves.

Differential Diagnosis

Parapharyngeal abscess has to be differentiated with space occupying lesions or neoplasia of the parapharyngeal space. The common neoplasia of this space are salivary gland tumors (e.g. pleomorphic adenoma, mucoepidermoid carcinoma, adenoid cystic carcinoma), neurogenic tumors (schwannoma, neuroma), lymphoid tissue tumors (lymphoma) and others (chemodectoma).

Clinical Features of Parapharyngeal Abscess

- Pain in the throat and odynophagia.
- Trismus: marked.
- Fever: high grade.
- External swelling of the neck.
- Tonsils and posterior pharyngeal wall pushed medially.
- Torticollis.
- Last four cranial nerves palsies.

Complications

It include:

1. Acute edema of the larynx.
2. Thrombophlebitis of internal jugular vein.
3. Septicaemia.
4. Direct spread of infection to retropharyngeal space and mediastinum.
5. Carotid burst.

Treatment

Broad spectrum systemic antibiotics through parenteral route is given immediately. Incision and drainage of the abscess is required if fluctuation is present. This may be done through the pharynx or through the neck depending on the point of maximum swelling. Incision and drainage is preferably done under general anesthesia. Tracheostomy may be rarely needed when endotracheal intubation is difficult as a result of severe trismus.

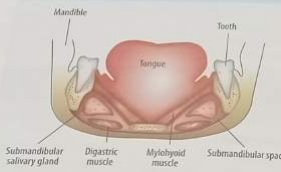
LUDWIG'S ANGINA

Ludwig's angina is the infection of the submandibular space. This space is bounded above by the mucous membrane of the floor of mouth and tongue and below by the deep fascia which extends from the hyoid to the mandible (Fig. 56.4). It is divided into two compartments by the mylohyoid muscle:

1. *Sublingual:* It lies above the mylohyoid muscle.
2. *Submaxillary and submental:* It lies below the mylohyoid muscle.

The two compartments are continuous with each other around the posteriorborder of mylohyoid muscle. The submandibular salivary gland also wraps around the mylohyoid muscle and extends into both of these compartments. In about 80% of the cases, infection reaches to this space by extension of dental root infection. The other causes are submandibular sialadenitis, penetrating injuries of the floor of mouth and mandibular fractures. Most of the infections of this space are caused by mixed aerobic and anaerobic organisms. Common organisms responsible are *streptococci, staphylococci, E. coli* and *bacteroids.*

Fig. 56.4: Vertical section through the submandibular space.



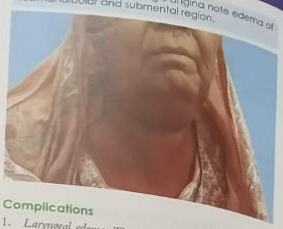
Clinical Features

When infection spreads to the sublingual space, structures in the floor of mouth are edematous and swollen. Tongue is pushed posterosuperiorly and in severe cases may cause respiratory obstruction. When infection spreads to the submaxillary space, there is edema and swelling in the submandibular and submental region (Fig. 56.5). In most of the cases there is diffuse cellulitis of the tissue planes and frank abscess formation is rare. The patient looks very ill with a high grade fever, pain, trismus, odynophagia and drooling of saliva. On examination, there is firm brawny swelling of the floor of mouth, submandibular and submental regions.

Clinical Features of Ludwig's Angina

- Odynophagia.
- Trismus.
- Swelling: submandibular, submental and floor of the mouth.
- Fever: high grade with toxaemia.
- Respiratory obstruction in severe cases.

Fig. 56.5: Patient of Ludwig's angina note edema of submandibular and submental region.



Complications

1. *Laryngeal edema:* This is most common complication of Ludwig's angina and results in dyspnea and stridor. Tracheostomy may be needed in severe cases.
2. *Spread of infection* to the other regions including parapharyngeal space, retropharyngeal space, mediastinum and lower respiratory tract.

Treatment

This condition is treated by appropriate systemic antibiotic. Other symptomatic treatment including anti-inflammatory, antipyretic and analgesic are also given. Frank pus formation occurs very rarely and in such cases incision and drainage is required. Tracheostomy may be needed in cases of respiratory obstruction especially in children.

Chapter Summary and Key Points

Many potential spaces are present in the fascial tissues of the neck. Among them three are important, namely retropharyngeal, parapharyngeal and submandibular space. Pus may collect in any of these spaces. Two clinical varieties of retropharyngeal abscess are described i.e. acute and chronic. Acute type is mostly caused by pus formation in the retropharyngeal lymph nodes in children. Sometimes penetrating foreign bodies through the posterior pharyngeal wall may cause acute retropharyngeal abscess. Chronic retropharyngeal abscess is tuberculous in nature. Ludwig's angina occurs mostly as a result of extension of dental root infection.

Difficult words

- *Squawk:* Characteristic voice of a duck.

Best Choice Questions

Q1. Which of the following directly communicates with the retropharyngeal space?
a. paraglottic space.
b. parapharyngeal space.
c. pre-epiglottic space.
d. pterygopalatine fossa.

Q2. Retropharyngeal lymph nodes usually disappear as the child grow. What is the most usual age for disappearance?
a. 1 year.
b. 2 years.
c. 4 years.
d. 8 years.

Q3. A 3-year-old boy presented high grade fever, dysphagia and dyspnea for 1 day. On examination of the throat, there was a smooth bulge in the posterior pharyngeal wall. What is the most common causative organism for this condition?
a. mycobacterium tuberculae.
b. proteus mirabilis.
c. pseudomonas aeruginosa.
d. streptococcus pneumoniae.

Q4. A 35-year-old male patient came in OPD with the complaints of progressively increasing dysphagia, pain in the neck, low grade fever and night sweating for last many months. On examination of the throat, there was a smooth bulge in the posterior pharyngeal wall . What is the most likely pathogen responsible for this condition?
a. mycobacterium tuberculae.
b. pseudomonas aeruginosa.
c. staphylococcus aureus.
d. streptococcus viridans.

Q5. A 2-year-old boy was brought to emergency (ER) with the complaints of high grade fever, dysphagia and breathing difficulty. On examination, he has a bulging in the posterior pharyngeal wall. What will be the most appropriate first investigation in this case?
a. blood complete picture.
b. throat swab for culture and sensitivity.
c. X-ray chest (PA view).
d. X-ray neck (lateral view).

Q6. What is the medial boundary of parapharyngeal space in an adult?
a. buccopharyngeal fascia.
b. mandible.
c. prevertebral fascia.
d. pterygoid muscles.

Q7. What is the rough shape of the parapharyngeal space in an adult male?
a. cuboidal.
b. cylindrical.
c. pyramidal.
d. spherical.

Q8. A 30-year-old male patient presented with abscess in the posterior compartment of parapharyngeal space with some nerves paralysis. Which of the following nerves are most vulnerable for paralysis?
a. glossopharyngeal and hypoglossal nerve.
b. glossopharyngeal, vagus and accessory nerve.
c. glossopharyngeal, vagus, accessory and hypoglossal nerve.
d. vestibulocochlear and glossopharyngeal nerve.

Q9. A 38-year-old male patient came with a neck swelling and on investigation, he was diagnosed with a tumor in the left parapharyngeal space. What is the most likely possibility for this?
a. lymphoid tissue tumors.
b. neurogenic tumors.
c. salivary gland tumors.
d. vascular tumors.

Q10. A 2-year-old girl was brought to ER with fever, dysphagia and respiratory distress. X-ray neck (lateral view) showed marked widening of the prevertebral space and loss of cervical curvature. What is the most appropriate treatment in this case?
a. admit and perform immediate incision and drainage.
b. admit and put her on artificial respiration immediately.
c. immediately perform endotracheal intubation.
d. start intravenous antibiotics and wait for 48 hours.

Q11. A 40-year-old male patient came with complaint of fever, pain and rapidly increasing swelling of submental and submandibular region for last two days. What is the most likely and dreadful complication that can occur in this case?

a. laryngeal edema.
b. lower respiratory tract infection.
c. mediastinitis.
d. parapharyngeal abscess.

Answers with Explanations

1. b.
2. c.
3. d.
4. a.
5. d.
6. a fascia covering constrictor muscles of the pharynx.
7. c apex at hyoid bone.
8. c palsies of last four cranial nerves.
9. c like pleomorphic adenoma, adenoid cystic carcinoma, mucoepidermoid carcinoma comprises about 50% of all parapharyngeal space tumors.
10. a.
11. a leads to dyspnea and stridor and tracheostomy may be needed.

CHAPTER

57

Lasers in ENT Practice

- Principle and Technique
- Types of Laser
- Lasers for ENT Surgeries
- Clinical use of Lasers in ENT
- Safety Measures for Laser Surgery

Principle and Technique

LASER is an acronym for *'Light Amplification by the Stimulated Emission of Radiation'*. In 1960, the first laser was built by using synthetic ruby crystal. In 1917, Einstein proposed that electromagnetic radiation can be produced when an electron jumps from a higher energy level to a lower energy level, thus releasing a photon of energy. The wavelength of this photon will be same for all atoms of a specific element or molecule. For this to occur, the atom must first be stimulated by some external energy, causing the electron to go from lower energy level to a higher energy level. In this stimulated state of atom, the electron can go back to its original low energy level resulting in spontaneous release of photon. If this released photon strikes another stimulated or high energy similar atom, another photon will be released, travelling in the same direction as the previous photon. Thus, lasers are electromagnetic radiations with specific wavelength, depending on the type of material from which it is emitted like carbondioxide, argon, ruby etc.

All currently available medical laser devices work in similar fashion. An optical resonating chamber has a fully reflective mirror at one end and a partially reflective mirror at the other end. Laser medium is present in this chamber which is stimulated with electrical energy, resulting in emission of photons. These photons escape from the partially reflective mirror as laser light.

Effects of laser on the tissues are due to local absorption of energy and subsequent production of heat in the tissues. Penetration of the laser into tissues depend on its wavelength and total energy delivered. Total energy is dependent on power intensity of the beam and duration of exposure.

Types of Laser

There are many types of lasers but only few are for medical use (see table). Depending on their hazardousness, lasers are classified into class I to class IV. Class I is a laser or laser system that cannot under normal operating conditions produce a hazard while class IV can produce a hazard not only from direct or specular reflection, but also from diffuse reflection. Most of the medical lasers belong to class IV and their use require extreme caution.

Some Common Types of Lasers

- Argon laser.
- CO_2 laser.
- KTP laser.
- Excimer laser.
- Diode 640 laser.
- Diode 805–980 laser.
- Nd-YAG laser.
- Erb-YAG laser.
- Combo laser (Nd-YAG + CO_2).
- Ho-YAG laser.

Lasers for ENT Surgeries

Commonly used lasers in ENT surgeries are:

1. *CO_2 laser:* This is the most widely used laser in ENT surgeries. It produces light in the far infrared range, wavelength being 10,600 nm. It is invisible to the human eye, so it is provided with a low power helium-neon laser carried coaxially to act as a sighting beam. Its energy is strongly absorbed by any water containing tissue regardless of pigmentation. Its effect is also extremely localized.
2. *Diode 805–980 laser:* This type of laser is now becoming increasingly used. It can be used with the optical fibers system. In non-contact mode it causes coagulation of the tissues and in contact mode, it can be used as a hot knife.
3. *Argon laser:* This type of laser produces visible blue green light of wavelength 488–514 nm. Its energy is particularly absorbed by the pigmented tissues like hemoglobin and is mainly used for coagulation of small blood vessels.

4. *Nd-YAG laser:* It produces invisible light of wavelength 1,064 nm.
5. *KTP 532 laser:* This is a modification of Nd-YAG laser. It produces a visible beam of wavelength 532 nm, which is selectively absorbed by the pigmented tissues.

Clinical use of Lasers in ENT

Now more and more diseases are being treated with different type of lasers in ENT practice. It should be remembered that laser is just a *cutting tool*, not a *magic wand*. Following are common conditions which can be treated with different lasers:

Otology

1. Myringotomy.
2. Stapedotomy.
3. Cholesteatoma surgery.

Rhinology

1. Turbinate reduction.
2. Resection of septal spur.
3. Epistaxis: Osler's disease.
4. Eustachian tuboplasty.
5. Removal of polyp, cyst and papilloma.
6. Resection of vascular lesions.
7. Adenoidectomy.
8. Choanal atresia.

Laryngology

1. Laryngeal web, cyst.
2. Laryngeal stenosis.
3. Hemangioma.
4. Vocal nodules.
5. Vocal polyp, granuloma.
6. Reinke's edema.
7. Recurrent laryngeal papillomatosis.
8. Keratosis, leukoplakia.
9. Bilateral recurrent nerve palsy.
10. Phonosurgery.
11. Laryngeal cancer.

Intra-oral Conditions

1. Papilloma, granuloma, cyst, ranula.
2. Hemangioma.
3. Leukoplakia, erythroplakia.
4. Oral submucous fibrosis.
5. Hypertrophy of lymphoid tissue.
6. Tonsillectomy.
7. Uvulo-palato-pharyngoplasty.
8. Early cancer.
9. Base of tongue hyperplasia.
10. Zenker's diverticulum.

Safety Measures for Laser Surgery

As mentioned earlier, most of the lasers used in medical practice belongs to class IV. Following are the safety measures which must be strictly followed in laser surgery:

1. Anesthesia:
   a. no use of nitrous oxide.
   b. use only volatile anesthetic agents.
   c. use of metal tube or coated tube only.
   d. oxygen concentration must not exceed 35%.
   e. continuous I/V anesthesia is ideal.
2. Environment:
   a. proper warning signs.
   b. prevent entry of non-essential personnels.
   c. properly locked doors to prevent unnecessary entry of personnels in OT.
   d. proper evacuation of the smoke.
3. Protection of personnels:
   a. only trained personnels entry in OT.
   b. must wear eye protective glasses.
   c. education for safety measures.
4. Protection of patients:
   a. all exposed parts must be covered with saline soaked towels and packs.
   b. eyes must be covered with saline soaked pads.

Chapter Summary and Key Points

LASER is an acronym for 'Light Amplification by the Stimulated Emission of Radiation'. Effects of laser on the tissues are due to local absorption of energy and subsequent production of heat in the tissues. Most of the medical lasers belong to class IV and their use require extreme caution. Commonly used lasers in ENT surgeries are CO_2, diode, argon, Nd-YAG and KTP lasers. Now more and more conditions are being treated with different types of lasers in ENT practice. It should be remembered that laser is just a cutting tool, not a magic wand.

Best Choice Questions

Q1. In which of the following condition 'laser' is produced?
a. when an electron goes from higher energy level to lower energy level orbit.
b. when an electron is emitted from an atom by an external energy source.
c. when an electron strikes an atom under the influence of a magnetic field.
d. when neutron strikes to proton of an atom in a very strong magnetic field.

Q2. Lasers are classified into four groups according to their hazardousness. In which of the following group, do most of the lasers for medical use belong?
a. class I.
b. class II.
c. class III.
d. class IV.

Q3. A 20-year-old male patient had a planned CO_2 laser surgery for his laryngeal complaint. What is used to cover the patient's eyes during the surgery for protection?
a. dry towels.
b. glasses.
c. metallic discs.
d. saline soaked pads.

Q4. Which of the following type of laser is most commonly used in ENT practice?
a. argon.
b. CO_2.
c. KTP.
d. Nd-YAG.

Q5. Which of the following anesthetic agent is contraindicated for use during laser surgery?
a. chloroform.
b. enflourane.
c. halothane.
d. nitrous oxide.

Q6. What is the characteristic appearance of CO_2 laser light?
a. it is blue green in color.
b. it is invisible.
c. it is orange in color.
d. it is white in color.

Q7. A 30-year-old man presented subglottic stenosis after prolonged endotracheal intubation. Which of the following laser is best for treating this patient?
a. argon.
b. CO_2.
c. KTP.
d. Nd-YAG.

Answers with Explanations

1. a causes release of energy in the form of photon.
2. d requires extreme caution.
3. d water absorbs energy.
4. b.
5. d it is inflammable.
6. b pointing beam is thus required.
7. b.

CHAPTER

58 Radiology in ENT Practice

- Plain X-ray mastoid
- Plain X-ray Paranasal Sinuses (PNS)
- Plain X-ray nasal bone
- Plain X-ray soft tissue nasopharynx (lateral view)
- Plain X-ray neck
- Plain X-ray floor of the mouth
- Sialography
- X-Ray barium swallow
- Orthopantomogram (OPG)
- CT scan of the nose and paranasal sinuses
- Angiography
- Thyroid scan (thyroid scintigraphy)

Only the important and commonly used imaging tools in ENT practice are discussed here.

Plain X-Ray Mastoid

There are many views of plain X-ray which are used in clinical practice to see changes in the temporal bone but the most commonly used and important are *'oblique lateral or Law's view'*. The others are Stenver's view (oblique postero-anterior view), submentovertical view, Towne's view (half axial view), perorbital view, jugular foramen view etc.

Since the temporal bones are symmetrically placed on both sides, a true lateral view results in superimposition of the two sides. Therefore to prevent this superimposition, the skull or incident rays is tilted at an angle in oblique lateral view. This view allows assessment of degree of pneumatization of the mastoid, the state of translucency of the air cells and position of the sigmoid sinus and its relation to the tegmen tympani (Fig. 58.1).

Fig. 58.1: Plain X-ray of the mastoid, lateral view showing well pneumatized mastoid.

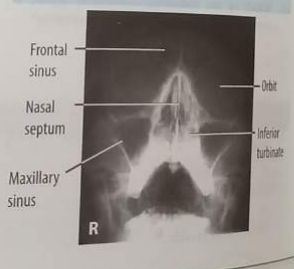
In case of mastoiditis, the air cells appear hazy due to accumulation of pus in the air cells. In long standing cases of tubotympanic type of chronic suppurative otitis media, the air cells are lost and replaced by sclerotic bone (Fig. 9.5). In case of extensive cholesteatoma, erosion of the attico-antral region and the bridge can be visible.

Plain X-Ray Paranasal Sinuses (PNS)

Although CT scan is now the best mean for assessing nose and paranasal sinus pathologies, plain X-rays are still in use due to the cost and time used in CT scan. The different views for plain X-rays include *occipitomental* or *Water's view, occipitofrontal* or *Caldwell's view, submentovertical view* and *lateral view*. The most commonly used view in clinical practice is the occipitomental or Water's view (Fig. 58.2). In this view, the mouth is kept wide open to view the sphenoid sinus.

The structures clearly visible in Water's view are maxillary sinus, frontal sinus, nasal cavity, nasal septum,

Fig. 58.2: Plain X-ray PNS (Water's view).



shadow of inferior turbinate and sphenoid sinus through the open mouth. The ethmoidal air cells are largely obscured in this view but few cells may be seen. Sinuses will appear hazy in case of sinusitis, polypi and neoplasia. Fluid level may be seen in the maxillary sinus if there is collection of pus or secretions (Fig. 24.2). Radiopaque foreign body or rhinolith may be seen in the nasal cavity in this view (Fig. 22.8). Lateral view is sometimes used to see radiopaque foreign body in the nasal cavity (Fig. 22.7).

Plain X-Ray Nasal Bone

Plain X-ray of the nasal bone is done by placing a film in direct contact with the side of the nose and will show the integrity of the nasal bone (Fig. 58.3). This X-ray is usually requested in cases of facial trauma to see fracture of the nasal bone as well as its displacement (Fig. 22.3). This X-ray has very little clinical importance but medicolegally, it is very important to record the injury.

Plain X-Ray Soft Tissue Nasopharynx (Lateral View)

This X-ray is specifically done to assess the thickness of soft tissue in the nasopharynx, uvula and the extent of nasopharyngeal airway. Enlarged adenoids can be clearly visible in this view (Fig. 38.2).

Fig. 58.3: Plain X-ray nasal bone (lateral view) showing normal intact nasal bone.

Fig. 58.4: Plain X-ray neck (lateral view) showing normal structures of the neck.

Plain X-Ray Neck

Plain X-ray neck is usually done to show the air and soft tissue interface with surrounding bony structures. X-ray neck is done in both anteroposterior and lateral view. Lateral view is more commonly used where the nasopharynx, larynx and other parts of the pharynx are clearly visible (Fig. 58.4). In this view, the upper respiratory passage clearly outlines valleculae, cavity of the larynx, trachea, soft palate, base of tongue, epiglottis etc. Sometimes, enlarged palatine tonsils may be seen as oval densities in the oropharynx.

Careful note should be made of the thickness of soft tissues of the prevertebral space. This is important as a bulge or increase in thickness may indicate an edema, abscess, hematoma, cyst or tumor (Fig. 55.2).

Radiopaque foreign bodies in the upper aerodigestive tract will be visible in both lateral and anteroposterior view (Fig. 46.4 and 46.5). In case of acute epiglottitis, the swollen epiglottis will be visible on lateral view as thumb (thumb sign, see Fig. 48.2).

Plain X-Ray Floor of the Mouth

Plain X-ray of floor of the mouth (occulusal view) is done for detecting radiopaque stones in the submandibular or sublingual duct (Fig. 52.1).

Sialography

Injection of radiopaque contrast medium into Stenson's or Wharton's duct to demonstrate the ductal system is still in use to investigate the diseases of the parotid and submandibular salivary gland. Before the contrast medium is injected, plain films are obtained to demonstrate any radiopaque calculi or calcification within the gland. Sialography is more commonly done for the submandibular gland than for the parotid gland (Fig. 57.5

Fig. 58.5: Sialography of the left submandibular gland showing normal ductal system.

and 52.2). Radiolucent stones will be visible as filling defect. Any obstruction like stricture or stenosis in the ductal system will be visible on sialography.

X-Ray Barium Swallow

X-ray barium swallow is done for the assessment of pharyngeal and esophageal diseases. A contrast medium (barium) is taken orally and the films are taken during the swallowing phase. A mass will be visible as a filling defect while the mucosal irregularity is also visible. Any stricture, stenosis, pharyngeal web will be seen clearly (Fig. 36.1).

Orthopantomogram (OPG)

Orthopantomogram is also known as *'orthopantogram'* or *'dental panoramic radiograph'*. It is a special type of radiograph which shows panoramic view of the upper and lower jaw. It shows the structures from one ear to the other in a two dimensional panoramic view (Fig. 58.6). It clearly shows the whole mandible, all teeth, temporomandibular joint and part of maxillary bones. This view is commonly used by the dentist for assessing the pathology of the teeth. In ENT practice, this view is used for assessing the mandible specially for involvement or erosion of the mandible by carcinoma of the oral cavity (Fig. 40.4).

CT Scan of the Nose and Paranasal Sinuses

CT scan of the nose and paranasal sinuses is much more superior and helpful than plain X-ray and is now considered as a mandatory investigation in a patient undergoing endoscopic nasal and sinus surgery. On CT scan, images can be obtained in axial, coronal and frontal plane (Fig. 58.7, 58.8, 58.9, 21.2, 25.1 and 28.3). All the sinuses, nasal cavity, turbinates, osteomeatal complex, nasopharynx and surrounding structures can be assessed in detail on a CT scan.

Fig. 58.6: An orthopantomogram showing a normal mandible. One molar on the right lower side is missing.

Fig. 58.7: CT scan of the nose and PNS (coronal view) showing: 1 = maxillary sinus; 2 = ethmoidal air cells ; 3 = orbit; 4 = inferior turbinate.

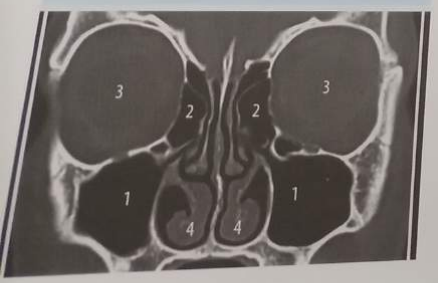


Fig. 58.8: CT scan of the nose and PNS (axial view) showing: 1 = normal maxillary sinus; 2 = nasal cavity; 3 = nasopharynx; 4 = opaque soft tissue mass in left maxillary sinus.

Fig. 58.9: CT scan of the nose and PNS (axial view) showing: 1 = normal ethmoidal air cells; 2 = eye ball; 3 = orbital cavity; 4 = mucosal thickening in ethmoidal air cells.

Angiography

In ENT practice, angiography is mainly used in cases of nasopharyngeal angiofibroma (see chapter 29). The angiofibroma is diagnosed on angiography which shows a vascular tumor (Fig. 29.4). In addition to diagnostic value, embolization of the feeding vessels can be performed during angiography, which reduces bleeding during surgery.

Thyroid Scan (Thyroid Scintigraphy)

In thyroid scintigraphy or scan, a radioactive material is injected intravenously which is taken up by the functioning thyroid tissues. Earlier radioactive iodine (I^{123} or I^{131}) was used but now technetium 99m pertechnate (Te^{-99m}) is used for thyroid scan. A hyperfunctioning thyroid tissue will take up more material than the surrounding tissue while a non-functioning tissue will take up less material. Thyroid scan is used for assessing size, functionality and presence of nodules in the thyroid gland (see chapter 53). On the basis of tracer uptake, thyroid nodule may appear as cold (less uptake), warm (slightly more uptake) or hot (more uptake).

Chapter Summary and Key Points

The most commonly used view for plain X-ray mastoid is oblique lateral or Law's view. The most commonly used view for plain X-ray of paranasal sinuses is Water's view or occipitomental view. The ethmoidal air cells are largely obscured in this view. Plain X-ray nasal bone (lateral view) has a medico-legal importance in cases of nasal bone fracture. In case of enlarged adenoids, plain X-ray soft tissue nasopharynx (lateral view) is diagnostic. Plain X-ray floor of the mouth (occulusal view) is used for detecting radiopaque stones in the submandibular or sublingual duct. Sialography is mostly used for detecting pathologies of submandibular gland and duct. X-ray barium swallow is often the first investigation in a patient complaining of dysphagia. Orthopantomogram (OPG) is a radiograph which shows panoramic view of the upper and lower jaw. CT scan of the nose and PNS is much superior than plain X-ray and is now considered mandatory for patients undergoing endoscopic sinus surgery. Angiography in ENT practice is mostly used in case of nasopharyngeal angiofibroma. Thyroid scan is used for assessing size, functionality and presence of nodule in the thyroid gland.

Best Choice Questions

Q1. A 28-year-old male patient came with the complaint of discharge from the right ear for last five years. Which of the following view for plain X-ray mastoid region would be most beneficial?

a. Law's view.
b. Stenver's view.
c. submentovertical view.
d. Towne's view.

Q2. A father brought his 3-year-old son with the complaint that he had inserted a small lithium battery cell in his nose 2 hours ago. Which of the following view for plain X-ray would you recommend in this case?

a. anteroposterior view.
b. lateral view.
c. submentovertical view.
d. Water's view.

Q3. A mother brought her 7-year-old son with the complaint of mouth breathing, snoring, repeated earache and nocturnal enuresis. Which of the following X-ray would you recommend?

a. X-ray floor of the mouth (occulusal view).
b. X-ray mastoid (Law's view).
c. X-ray nasopharynx (lateral view).
d. X-ray PNS (Water's view).

Q4. A father brought his 9-year-old son with the complaint of rapidly progressing respiratory distress, stridor, dysphagia and high grade fever for last one day. Which of the following radiological investigation would be most helpful for diagnosis?

a. X-ray chest (PA view).
b. X-ray nasopharynx (lateral view).
c. X-ray neck (lateral view).
d. X-ray PNS (Water's view).

Q5. A 58-year-old male patient came with an extensive growth on the right cheek. Biopsy was done, which showed squamous cell carcinoma. Which investigation would you perform for assessing mandibular involvement in this case?

a. X-ray orthopantomogram (OPG).
b. X-ray floor of the mouth (occulusal view).
c. X-ray mandible (anteroposterior view).
d. X-ray mandible (lateral view).

Q6. Plain X-ray neck (lateral view) was performed on a 14-year-old boy. Radiologist reported that thumb sign is positive. What is the most probable diagnosis?

a. acute epiglottitis.
b. acute laryngitis.
c. acute pharyngitis.
d. acute tonsillitis.

Answers with Explanations

1. a.
2. b.
3. c.
4. c Thumb sign will be visible.
5. a.
6. a.

CHAPTER 59

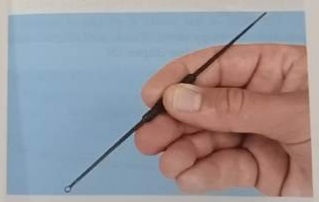
ENT Surgical Instruments

Ear Speculum

Ear speculum is used for examination of the external auditory canal and tympanic membrane in OPD. It is also used in surgical operations of the ear.

Probe (Jobson Horne Probe)

This probe has many uses in ENT. It is used for cleaning of the external auditory canal and performing a 'probe test'. The rounded ring end is used for removing foreign body from the ear and nose while the pointed end is used for probe test and screening of discharge.



Siegle's Pneumatic Speculum

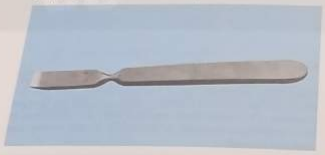
It is used for checking mobility of the tympanic membrane. The speculum has a lensed window and can be fitted into the external auditory canal to make an airtight chamber. The rubber bulb attached with the speculum is used to increase pressure in the canal, which moves the eardrum inwards.

Self-Retaining Mastoid Retractor (Mollison's Retractor)

This self-retaining mastoid retractor is used in surgical operations of the mastoid and ear. It is used for retracting the skin and fascia during surgery.

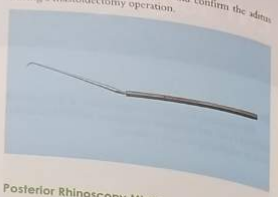
Periosteal Elevator (Farabeuf Elevator)

This instrument is used to elevate periosteum from the underlying bone. It is used in mastoidectomy, tympanoplasty, Caldwell Luc's operation etc.



Aditus Seeker (Dundas Grant Seeker)

Aditus seeker is used to find and confirm the admis during a mastoidectomy operation.

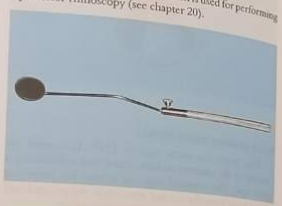


Mastoid Gouge (Jenkin Gouge)

This gouge is used to remove the bone in mastoidectomy and Caldwell Luc's operation.

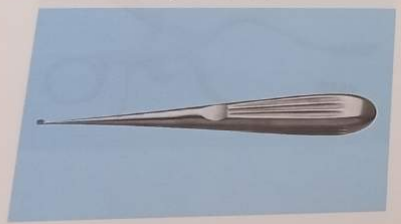
Posterior Rhinoscopy Mirror

This mirror with angulated stem is used for performing a posterior rhinoscopy (see chapter 20).



Mastoid Currette

Mastoid currette is used to remove and clear the diseased mastoid air cells, granulation tissues and cholesteatoma during mastoidectomy.



Laryngeal Mirror (Indirect Laryngoscopy Mirror)

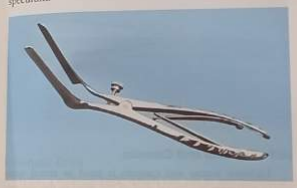
The stem of this mirror is straight in contrast to posterior rhinoscopy mirror. This is used for performing indirect laryngoscopy (see chapter 33).

Thudicum Nasal Speculum

Thudicum nasal speculum is used for examining the nasal cavity (anterior rhinoscopy) and all nasal surgeries. Different sizes of short and long bladed nasal speculum are available.

Self-Retaining Nasal Speculum (Killian Nasal Speculum)

Killian nasal speculum is used in different nasal operations like SMR, septoplasty, polypectomy, Caldwell Luc's operation etc. It is a self-retaining type of nasal speculum.



Suction Nozzle

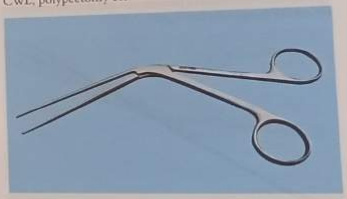
Suction nozzle is used for performing suction in the ear and nose in OPD and during surgeries.

Hammer or Mallet

Hammer or mallet is used in different surgical procedures, to remove bone by gouge or chisel like in mastoidectomy, SMR, septoplasty, CWL operation etc.

Nasal Packing Forceps (Tilley Forceps)

Tilley forceps is used for anterior nasal packing. It is also used in surgical operations like SMR, septoplasty, CWL, polypectomy etc.

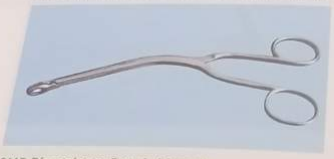


Nasal Polypectomy Forceps (Watson William Polypi Forceps)

This forceps is used in nasal polypectomy to remove polypi.

Luc's Forceps

Luc's nasal forceps is used in different surgical operations on the nose. It is used in SMR and septoplasty to remove cartilage and bone pieces. In nasal polypectomy and Caldwell Luc's operation, it is used to remove polypi. Biopsy from the nasal growth can be taken using these forceps.

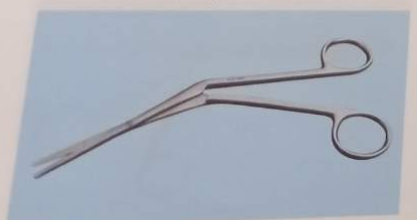


SMR Dissector or Freer's Dissector

This instrument is used in SMR and septoplasty operation to elevate mucoperichondrial flap from the underlying cartilage. It is also used in Coldwell Luc's operation for elevation of periosteum and in tympanoplasty for taking temporalis fascia graft.

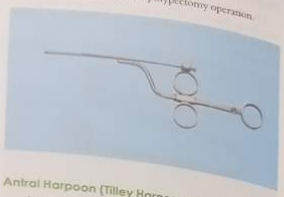
Turbinectomy Scissors (Heymann Turbinectomy Scissors)

This scissor is used to cut the inferior turbinate in turbinectomy operation. It can also be used in SMR and septoplasty operation to cut nasal septal cartilage. Nasal adhesions can also be cut by this scissors.



Nasal Snare (Gleggi Nasal Snare)

Nasal snare is used in nasal polypectomy operation.



Antral Harpoon (Tilley Harpoon Trocar)

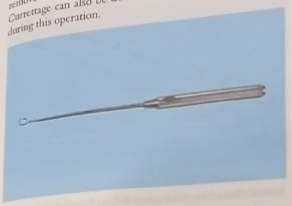
Antral harpoon is used to perform antrostomy i.e. to make a hole in the lateral wall of the nose in the inferior meatus. Antrostomy is done at the end of Caldwell Luc's operation for the drainage of maxillary antrum.

Lichwitz Trocar and Cannula

Lichwitz trocar and cannula is used in antral wash out to perforate the lateral wall of the nose in the inferior meatus to enter into the maxillary antrum. After entering into the antrum, the trocar is removed without disturbing the cannula. Antral washout is done by attaching a syringe with the cannula.

Antral Currette

Antral currette is used in Caldwell Luc's operation to remove the diseased mucosa from the maxillary antrum. Currettage can also be done from the ethmoidal air cells during this operation.



Nasal Gouge (Fish Tail or 'V' Shaped Gouge)

Nasal gouge is used in SMR and septoplasty operations to remove the bony spur.

Ballenger Knife

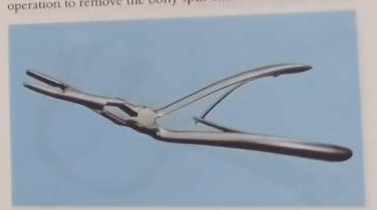
It has a rotating knife which can cut in any direction. This is used in SMR operation to cut nasal cartilage in any direction.

Jenkins Chisel

Jenkins chisel is used to remove and cut the bone in different operations e.g. rhinoplasty.

Double Action Septal Bone Punch (Jansen-Middleton Septum Forceps)

This instrument is used in SMR and septoplasty operation to remove the bony spur and thick bone.

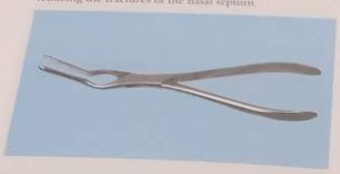


Walsham Forceps

Walsham forceps is used for reducing the fractures of the nasal bone.

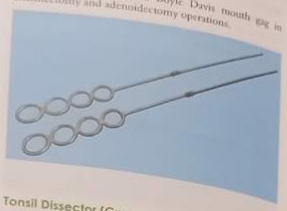
Ashe's Forceps

This is similar to Walsham's forceps except that its beak is bent laterally and longer. This forceps is used for reducing the fractures of the nasal septum.



Draffin's Suspension Rods

It is used to suspend Boyle Davis mouth gag in tonsillectomy and adenoidectomy operations.



Boyle Davis Mouth Gag

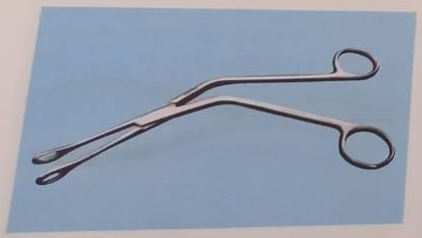
Boyle Davis mouth gag is used in tonsillectomy, adenoidectomy and other operations of the mouth. It is used to open the mouth during surgery. Different sizes of tongue plates are available.

Tonsil Dissector (Gwynne Evans Tonsil Dissector)

Tonsil dissector is used to dissect the tonsil during tonsillectomy operation.

Tonsil Holding Forceps (Danis Browne Forceps)

Tonsil holding forceps is used in tonsillectomy operation to hold the tonsil. It is very similar to Luc's forceps.

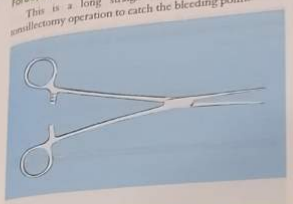


Mollison Anterior Pillar Retractor with Tonsil Dissector

This instrument is used in tonsillectomy and adenoidectomy operations to retract the pillars and soft palate. The other end is used for tonsil dissection.

Straight Tonsil Artery Forceps (Birkett Tonsil Artery Forceps)

This is a long straight artery forceps, used in tonsillectomy operation to catch the bleeding point.



Knot Pusher (Negus Knot Pusher or Knot Tier)

This instrument is used in tonsillectomy operation to carry the silk or suture material in its place deep into the tonsil bed.

Curved Tonsil Artery Forceps (Negus Tonsil Artery Forceps)

This is a curved artery forceps. It is used in tonsillectomy operation to catch the bleeding point before ligation. It can also be used to catch the tonsil pedicle before cutting and ligation, if a snare is not used.

Pharyngeal Suction Nozzle (Yankauer Suction Tube)

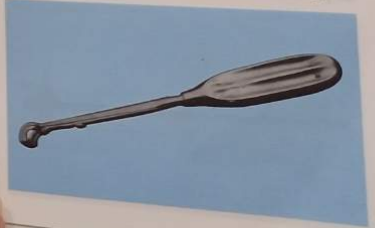
Pharyngeal suction nozzle is used to suck secretions or blood from the oral cavity and pharynx. It is used in tonsillectomy, adenoidectomy and other surgeries of the oral cavity and pharynx.

Tonsil Snare (Eves Tonsil Snare)

It is a cutting type of snare and used in tonsillectomy operation to cut the tonsil pedicle. First, it crushes the artery and then it cuts the pedicle, so there is no bleeding from the tonsillar artery.

Adenoidectomy Curette (St. Clair Thomson Adenoid Curette)

Adenoidectomy currette is used in adenoidectomy operation to remove the adenoid tissues. It is fitted with a guard, which prevents slippage of the adenoid tissues.



Crocodile Forceps

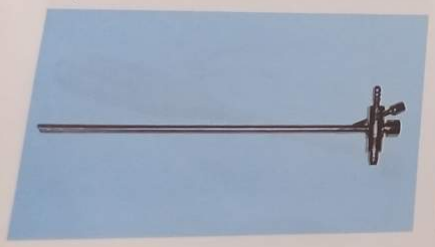
This forceps have many uses in ENT practice. They are available in different sizes. They are used for removal of foreign body from the nose, ear, pharynx and larynx.

Tracheal Dilator (Trousseau Dilating Forceps)

Tracheal dilator is used in tracheostomy operation to dilate the tracheal opening during insertion of the tracheostomy tube.

Bronchoscope

This is a rigid type of bronchoscope and used to perform bronchoscopy (see chapter 46). At the end, holes are present which helps in aeration of the opposite lung if bronchoscope is inserted into the main bronchus on one side. Separate channels for anesthesia gases and aspiration are present.



Esophagoscope

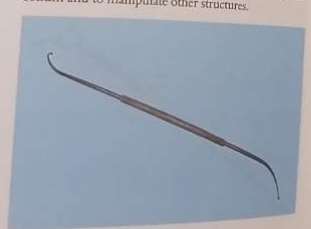
This is a rigid type of esophagoscope and it is used to perform esophagoscopy (see chapter 46). Its inserting end is blunt in contrast to bronchoscope and markings are also present to measure the distance. At the other end, a small handle is present which indicates the bevelled side of the inserting end.

Straight Forward Telescope 0°

This telescope is used in Functional Endoscopic Sinus Surgery (FESS) (see Fig. 25.6 as well).

Ball Probe (Double Ended Maxillary Sinus Ostium Seeker)

This ball probe is used in Functional Endoscopic Sinus Surgery (FESS). It is used to identify the maxillary sinus ostium and to manipulate other structures.

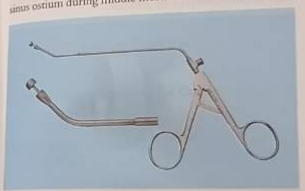


Antral Cannula

This is a curved suction nozzle, used in functional endoscopic sinus surgery. It is used for suction especially in maxillary sinus.

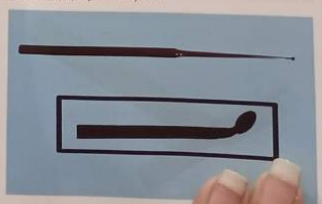
Middle Meatal Antrostomy Punch

This is used in FESS for widening of natural maxillary sinus ostium during middle meatus antrostomy.



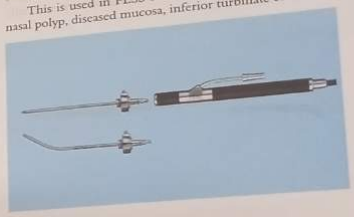
Rosen's Round/Circular Knife

Rosen's round/circular knife is used for making incision in the external auditory canal for raising the tympanomeatal flap (Rosen's incision). This incision is used for many surgeries of the middle ear like transcanal myringoplasty/tympanoplasty, stapedectomy/stapedotomy, exploratory tympanotomy etc.



Micro Shaver (Micro Debrider) Hand Piece with Straight and Curved Blades

This is used in FESS for shaving off the tissues like, nasal polyp, diseased mucosa, inferior turbinate etc.



Montgomery's 'T' Tube

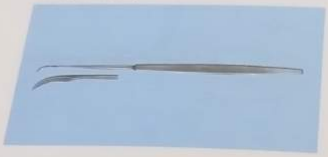
Montgomery's 'T' tube is used for the treatment of sub-glottic and upper tracheal stenosis. The tube can be placed after open surgical procedure or endoscopically in such cases. The tube was first introduced by William Montgomery in the year 1965.

Oto-endoscope

This is oto-endoscope zero degree (00) and used in endoscopic ear surgery. Its length is shorter than nasal endoscope. Usual length is 10 cm. and usual diameter is 1.7 mm.

Sickle Knife

This is used in Functional Endoscopic Sinus Surgery (FESS). It is used as a knife for giving incision especially during uncinectomy.

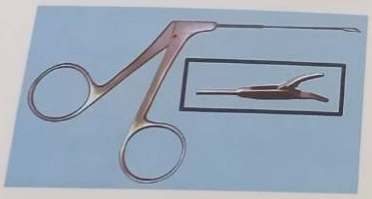


Antral Punch (Upside Backward Biting Punch)

This is a backward biting punch and used in FESS for widening of sinus ostium and removing thin bone.

McGee Wire Crimper Forceps

McGee wire crimper forceps/wire closure forceps is used in stapedotomy operation for crimping or securing the titanium/steel wire of the prosthesis around the long process of the incus.



Shepard's Grommet Without Wire

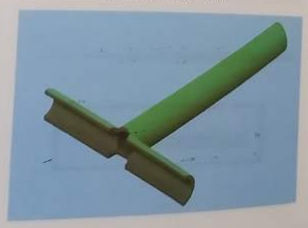
Shepard's grommet is used for drainage purpose in the treatment of otitis media with effusion after myringotomy. The grommet is available with or without wire. The wire helps in the removal of the grommet.

Teflon Stapes Piston

It is used as prosthesis in stapedotomy operation for otosclerosis. Its diameter varies from 0.4 to 0.8 mm. In Teflon stapes piston, crimping is not required (self-crimping).

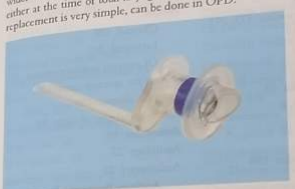
Goode's 'T' Tube

Goode's 'T' tube is used for drainage purpose in the treatment of otitis media with effusion after myringotomy. The main advantage of this tube is that spontaneous extrusion rate is much less than Shepard's grommet, so it is used in cases where long term placement is required like in recurrent otitis media with effusion.



Provox Voice Prosthesis

Provox voice prosthesis is used for speech rehabilitation purpose after total laryngectomy. The device is inserted after making a tracheoesophageal puncture. The advantages of using this tube are; it is an indwelling tube and does not need to be removed for cleaning purpose, patient's compliance is much better, lumen diameter is wider so less resistance in speech, can be inserted anytime either at the time of total laryngectomy or afterwards and replacement is very simple, can be done in OPD.



Myringotomy Knife (Myringotome)

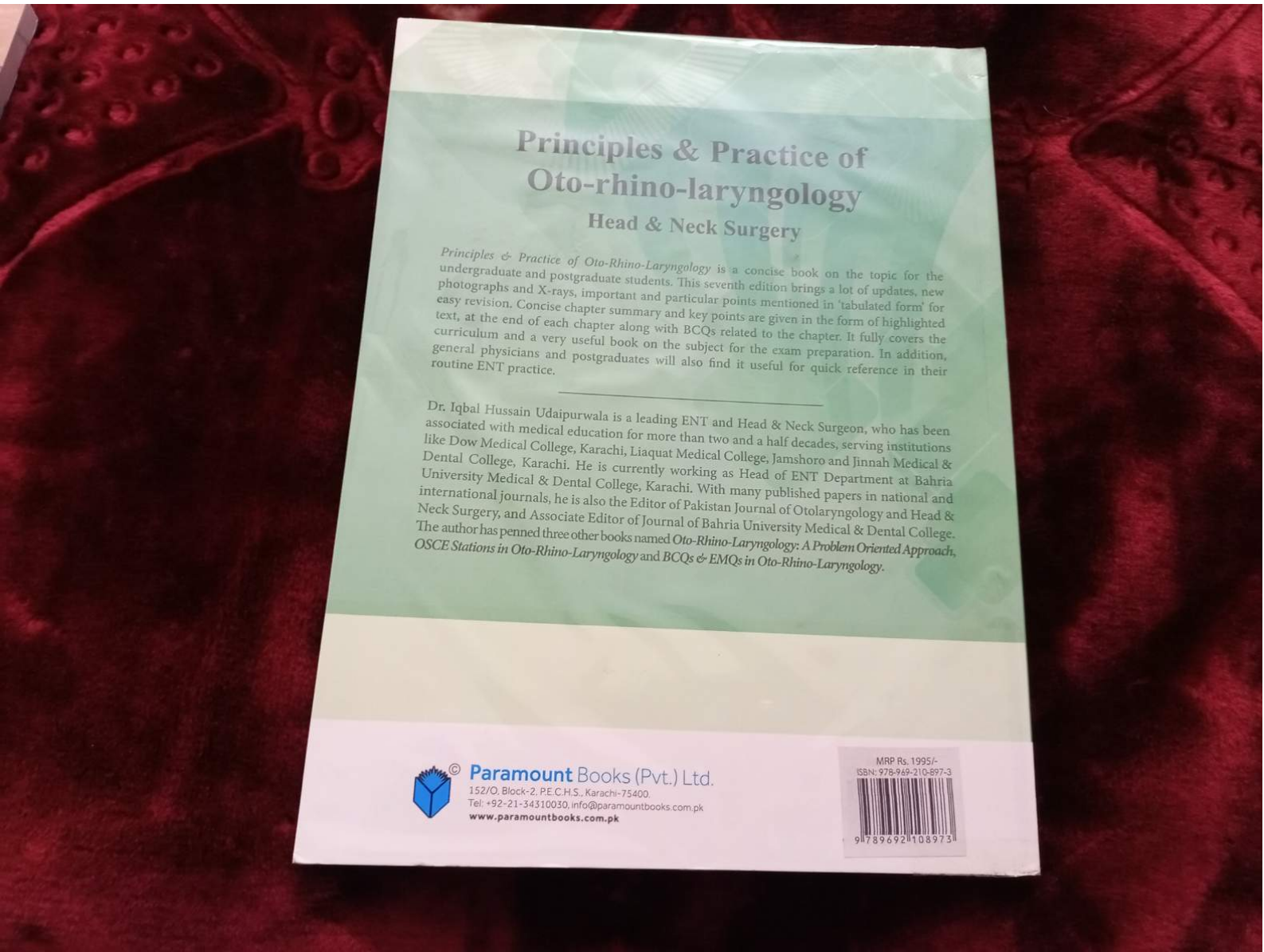
See Fig. 9.3.

Direct Laryngoscope (Anterior Commissure Type)

See Fig. 44.1, 44.2 and 44.3.

Tracheostomy Tubes

See Fig. 51.1, 51.2 and 51.3.



Principles & Practice of Oto-rhino-laryngology

Head & Neck Surgery

Principles & Practice of Oto-Rhino-Laryngology is a concise book on the topic for the undergraduate and postgraduate students. This seventh edition brings a lot of updates, new photographs and X-rays, important and particular points mentioned in 'tabulated form' for easy revision. Concise chapter summary and key points are given in the form of highlighted text, at the end of each chapter along with BCQs related to the chapter. It fully covers the curriculum and a very useful book on the subject for the exam preparation. In addition, general physicians and postgraduates will also find it useful for quick reference in their routine ENT practice.

Dr. Iqbal Hussain Udaipurwala is a leading ENT and Head & Neck Surgeon, who has been associated with medical education for more than two and a half decades, serving institutions like Dow Medical College, Karachi, Liaquat Medical College, Jamshoro and Jinnah Medical & Dental College, Karachi. He is currently working as Head of ENT Department at Bahria University Medical & Dental College, Karachi. With many published papers in national and international journals, he is also the Editor of Pakistan Journal of Otolaryngology and Head & Neck Surgery, and Associate Editor of Journal of Bahria University Medical & Dental College. The author has penned three other books named *Oto-Rhino-Laryngology: A Problem Oriented Approach*, *OSCE Stations in Oto-Rhino-Laryngology* and *BCQs & EMQs in Oto-Rhino-Laryngology*.

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