"IDENTIFICATION OF INDICATORS FOR EXPLORING MASTOID ANTRUM IN TYPE 1 TYMPANOPLASTY FOR TUBOTYMPANIC DISEASE"

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Finally, I bow my head in a silent acknowledgement of all that **The Lord Almighty** has blessed me with.

Date: **Dr. Samriddhi.**

LIST OF ABBREVATIONS

COM	–	Chronic otitis media
TM	–	Tympanic Membrane
EAC	–	External Auditory Canal
PTA	–	Pure Tone Audiometry
AB Gap	–	Air Bone Gap
AC	–	Air Conduction
BC	–	Bone Conduction
dB	–	Decibel
UL	–	Unilateral
BL	–	Bilateral
S	–	Small
M	–	Medium
L	–	Large
ST	–	Subtotal
HP	-	Hypertrophied mucosa over promontory
HO	-	Hypertrophied mucosa over ossicles
CM	-	Congested middle ear mucosa
N	-	Normal
S	-	Sclerosed
P	-	Pneumatized
D	-	Diploic

ABSTRACT

Aim:

To identify the indicators for exploration of the mastoid antrum in patients undergoing type 1 tympanoplasty in tubotympanic disease.

Materials and methods:

89 patients of COM with ears becoming dry after two courses of antibiotics presented to Department of Otorhinolaryngology and head and neck surgery, Shri B M Patil Medical college, Hospital and Research centre, Vijayapura from November 2016 to August 2018. X ray mastoids, Pure tone audiometry and appropriate investigations were done followed by cortical mastoidectomy with type 1 tympanoplasty. A total of 89 cases were operated and the intraoperative findings of middle ear and patency of aditus in all cases were assessed and noted.

Results:

In 89 cases of our study, aditus was found blocked in 21 cases (23.6%) in which the middle ear findings were hypertrophied mucosa over promontory and hypertrophied mucosa over ossicles in 7 cases (33.3%), hypertrophied mucosa over promontory in 6 cases (28.6%), hypertrophied mucosa over ossicles in 4 cases (19%) congested mucosa over promontory and hypertrophied mucosa over promontory in 3 cases (14.3%), congested middle ear mucosa and hypertrophied mucosa over ossicles in 1 case (4.8%).

The relation between the patency of aditus and the middle ear findings is significant in our study with its chi square test value being **p= 0.0001*.**

Conclusion:

Sometimes tympanoplasty with cortical mastoidectomy is required in patients of chronic otitis media – Tubotymapanic disease even with dry ear after two course of

antibiotics. The aditus blockage reduces the success rate of tympanoplasty when cortical mastoidectomy is not done.

The aditus block was observed in cases where the middle ear findings showed hypertrophies middle ear mucosa over promontory, hypertrophied mucosa over ossicles and congested mucosa over promontry. This shows that cortical mastoidectomy and clearance of the aditus block must be considered in the cases of the above middle ear findings

.**Key words:**

Cortical mastoidectomy, Tympanoplasty.

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INTRODUCTION

Chronic suppurative otitis media is defined as chronic otorrhoea through a non intact tympanic membrane of greater than six weeks duration unresponsive to oral and oto-topical medications[1]

Chronic otitis media is an inflammatory process of mucoperiosteal lining of the middle ear space and mastoid [1]. This can be further divided into cholesteatomatous (atticoantral) and non cholesteatomatous (tubotympanic) disease or mucosal disease.

Mastoidectomy was first found in writing in 1671 by Johannes Riolanus[2]. Mastoidectomy was performed to save lives of people suffering from complications of infectious otitis. The procedure of mastoidectomy was first described in year 1873.

Some surgeons stated the indications for cortical mastoidectomy as to treat the purulent secretions through the attic, cholesteatoma of tympanic cavity, blocked aditus ad antrum, and congested, polypoidal, moist and discharging ear[3].

In the pre antibiotic era, cortical mastoidectomy was indicated in many cases of complications. After the introduction of antibiotics the indications of cortical mastoidectomy decreased because of less incidences of complications. Tympanoplasty is the surgery which is done widely in most cases of tubotympanic disease to inspect the middle ear findings, ossicles and considering further type of reconstruction. In some cases of dry ear where tympanoplasty was alone performed, few cases showed failure for the acceptance of graft due to the blockage of aditus. The study was conducted for those kind of cases where the ear becomes dry after adequate antibiotic treatment and to reduce the failure rate by identifying few indicators on opening the antrum.

This study helps to guide us in deciding when to perform cortical mastoidectomy in dry ears of Tubotympanic chronic suppurative otitis media.

OBJECTIVES

This study is done to identify the indicators to explore the mastoid antrum in cases of type 1 tympanoplasty in tubotympanic disease.

REVIEW OF LITERATURE

HISTORICAL REVIEW

Since the 1600 the otologists have been trying to restore hearing loss. The efforts to achieve a dry ear by eradicating the infection from middle ear and mastoid have been interlinked. The development of knowledge about the role of tympanic membrane and ear ossicles in conduction of sound has been critical in refining the techniques of drum repair.

In 1853, Toynbee used rubber disc with a silver wire items to assist in placement.[28]

In 1887, Blake used paper patch placement over the perforation which is still used as a test to screen for benefit from a proposed drum repair. [29,30]

These procedures helped in improving hearing, but did not close the perforation. This prompted in development a different method of repair, wherein epithelisation of perforated tympanic membrane was promoted.

In 1952, Wullstein and Zollner used the split thickness skin grafts. [31] This induced a lot of interest in many others who started using various other materials apart from skin with variable success rates. Like wise, the surgery of tympanoplasty became popular among otologists.

The first documented recommendation of mastoidectomy was found in the writings of Johannes Riolanus at 16711. Before the mid-19th century, mastoidectomy was performed only sporadically and in most cases as desperate attempt to save the lives of people suffering from complications of infectious otitis. Draining the red, warm abscess behind the ear by incision was described by lucas van leyden in 15245.

The first documented ear surgical incision to drain an infected ear was described by the French physician Ambroise Pare in 16th century[5].

Hermann schwartze and Adolf eysell were the first to describe the procedure of mastoidectomy in year 1873.

Schwartze stated few indications for the cortical mastoidectomy6:

1. "For treating the purulent secretion through the attic, without consideration for the hearing capacity and removing the malleus and incus.
2. To treat chronic purulent otorrhea of the tympanic cavity with positive signs of erosion of the incus and malleus as well as to treat cholesteatoma of the tympanic cavity.
3. To improve hearing and treat subjective noise when the malleus is fixed"

Holmquist J, Bergstorm B. made a study that failure to create a pneumatised air cell system in a patient of tubotympanic disease may increase the chance of surgical failure[7].

Mc Grew et al. made a randomized study in 62 patients by dividing them into group A and group B and concluded that though mastoidectomy was not necessary for membrane uptake, still the procedure impacted the clinical course in patients by reducing the number of further procedures and decreasing disease progression8.

Mohammed Bhagat, in the study of fifty adult patients with tubotympanic CSOM, without evidence of cholesteatoma, after adequate medical control of otorrhoea, tympanoplasty with cortical mastoidectomy was done. The patency of the aditus ad antrum was blocked in 20% of cases. Marginal and subtotal central perforations and

the presence of myringosclerosis increase the probability of an obstructed aditus and antrum[9].

According to Baylan et al. mastoidectomy is usually not necessary in all tubotympanic diseases[4].

Ruhl and Pensak suggested that mastoidectomy should be considered in presence of congested, polypoidal, moist, or discharging ear but may not be associated with aditus ad antrum[3].

SURGICAL ANATOMY

The ear is an organ for hearing and balance.

Ear is made up of three parts:

1. External ear
2. Middle ear
3. Inner ear

EXTERNAL EAR:

It consists of pinna and the external auditory canal. The function is mainly the transmission of sound from the external source to the middle ear.

Development [10]:

The development of pinna commences at 4 weeks as tissue condensations of the mandibular and hyoid arches appear at the distal portion of the first branchial groove. Within 2 weeks, six ridges known as hillocks of His arise from the tissue condensations three from the mandibular arch and three from hyoid arch. The tragus and the anterior external auditory canal are of mandibular arch origin whereas all the structures except these are of hyoid arch origin. It is achieved by the 5th month, independent of developmental progress in the middle and inner ears. The hillocks fuse into an anterior fold of mandibular arch and a posterior fold of hyoid arch. Adult configuration is achieved by 5^{th} month. The Darwinian tubercle, corresponding to the tip of pinna in lower mammals, is seen roughly at 6 months.

AURICLE

The shape of the auricle is formed by the thin, convoluted, continuous sheet of yellow elastic 'cartilage that curves forward to enclose the floor and anterior wall of the external cartilaginous meatus except the roof. Superiorly the cartilage of the meatus is lacking, leaving a deep cleft, the incisura terminalis, utilized by the surgeon

in making the extra cartilaginous endaural incision for surgical exposure of the temporal bone [10].

The curved rim is helix and in posterior superior aspect, Darwin's tubercle is present. Antihelix is Anterior and parallel to the helix. Triangular fossa is present superiorly where the antihelix divides into two crura and above lies the scaphoid fossa. Concha lies in front of antihelix and is partially enclosed by it. The cymba concha which is in direct superior relation with the suprameatal triangle. Tragus lies opposite to the concha, across the external auditory canal and below the crus of helix. The depressions of the lateral surface of the pinna cause elevations in the medial surface and are named correspondingly. The cartilage depends on the perichondrium for supply of nutrients. The auricle is connected by two extrinsic ligaments to the temporal bone. The anterior ligament runs from tragus to the root of the zygomatic arch. Posterior ligament runs from the medial surface of the concha to the lateral surface of the mastoid prominence [11].

Nerve supply

Lateral surface of the auricle is supplied by the auriculotemporal nerve (upper 2/3rd) and greater auricular (lower 1/3rd) the medial surface, by the lesser occipital (upper 2/3rd) and great auricular nerve (lower 1/3rd); concha by the auricular branch of the vagus.

Blood supply

The posterior auricular artery and the superficial temporal artery which are the branches of external carotid artery supply the pinna and external auditory canal.

Lymphatics

The lymphatics drain into the preauricular, post auricular and superficial cervical lymph nodes.

EXTERNAL AUDITORY CANAL [12]

It connects the concha and tympanic membrane. In the adult the average length is 24 mm. It is composed of two portions, an outer cartilaginous portion around 8 mm in length and inner bony portion 16 mm long constricted slightly in the middle by an isthmus. The tympanic membrane lies obliquely at the inner end of the meatus therefore the anterior and inferior walls arc longer than the posterior and superior walls. Inferior meatal recess is the depression at the junction of the tympanic membrane and inferior wall. This recess can be difficult to visualise and clear.

The cartilaginous portion is oval in section with a backward convexity continuous with the cartilage of the auricle. The direction is medial, upwards and backwards, while that of the bony meatus is medial, slightly upwards and forwards. There are two constrictions in the canal, one at the junction of cartilaginous and bony part and other in the osseous part 5 mm from the tympanic membrane where a prominence of the anterior canal wall reduces the diameter. The meatus may be partially straightened in the adult by pulling the auricle upwards, outwards and backwards. In neonate there is virtually no bony external meatus as the temporal bone is not yet developed and the tympanic membrane is more horizontally placed.

In cartilaginous part, the fissure of santorini provides a potential path of infection between the parotid gland and the superficial mastoid region. Foramen Huschke is the deficiency in the bony part in adults present antero-inferiorly. The EAC is lined by skin continuous with the auricle and extends over the tympanic membrane. In cartilaginous part, it contains hair follicles, sebaceous and ceruminous glands, which are absent in bony part. In the bony portion the skin is firmly attached to the periosteum and is very thin whereas in the cartilaginous portion the

subcutaneous tissue attaches the skin firmly to the perichondrium, which accounts for the pain and tenderness of the furuncle in the cartilaginous portion.

Blood supply [11]

Roof and anterior portion of canal- auricular branches of superficial temporal artery.

Anterior meatal wall skin- The deep auricular branch of the first part of the maxillary artery.

Posterior portion of canal- The auricular branches of the posterior auricular artery.

Venous drainage [11]

Veins drain into the external jugular vein, the maxillary vein and the pterygoid plexus.

Lymphatics [12]

1. Tragus and anterior external portion of the auricle drain - superficial parotid lymph nodes.
2. The posterior external and medial aspect of the auricle - retroauricular lymph nodes
3. The lobule and inferiorly of the external auditory canal - superficial cervical group of nodes.

TYMPANIC MEMBRANE [11, 12]

Tympanic Membrane is an elliptical and lies obliquely across the medial end of external auditory canal. It forms an angle of 55° with the floor of the external auditory canal. The lateral wall of the mesotympanum and small part of the epityrnpanum is formed by tympanic membrane and it separates the tympanic cavity from the external auditory canal. The convexity is towards the tympanic cavity. The

longest diameter from posterosuperior to anteroinferior is 9-10 mm, while the shortest diameter lies perpendicular and is 8-9 mm. tympanic annulus is a circumferential thickening of the fibrocartilaginous ring and it lodges in its groove the tympanic sulcus. Form the superior limits the annulus becomes fibrous bands which run centrally as anterior and posterior malleolar folds to the lateral process of malleus, the handle of which lies in the tympanic membrane.

1. Pars flaccida - lies above the malleolar folds lies, is a triangular region and lacks tympanic annulus at its margin and is lax.
2. Pars tensa - rest of tympanic membrane which is taut and concave when seen from the external ear.

Blood supply

Vessels supplying the tympanic membrane lie in connective tissue layer of the lamina propria. This layer has peripheral rim of arteries connected by radial anastomosis.

The arteries which supply are the:

Lateral surface by deep auricular branch of maxillary artery.

Medial surface:

1. Posteriorly: stylomastoid branch of the posterior auricular artery.
2. Anteriorly: tympanic branch of maxillary artery.
3. Twigs from middle meningeal artery.

Nerve supply

Lateral surface, anterior half by auriculotemporal branch of the fifth cranial nerve and posterior half by auricular branch of vagus nerve. Medial surface is supplied by tympanic branch of the glossopharyngeal nerve

Venous drainage

Veins drain into external jugular vein, transverse sinus, dural sinus and venous plexus around the eustachian tube.

Histology

Tympanic membrane contains three layers:

1. Outer epidermal layer
2. Middle fibrous layer — lamina propria
3. Inner mucosal layer

a) Outer epidermal layer

It is continuous with the skin of the external auditory canal, it contains four layers.

Stratum corneum: Outermost layer contains 1-6 compressed layer of cellular structure.

Stratum granulosum: Contains 1-3 layers of cells with smooth borders and interconnecting desmosomes, keratohyaline granules, lamellar granules and occasionally tonofilaments are present.

Stratum spinosum: Contains 2-3 layers of cells. It has prominent interdigitations with neighbouring cells.

Stratum basale: Contains single layer of cells separated by lamina propria, cells are polyhedral in shape or elongated parallel to the basement membrane.

b) Lamina propria

Collagen fibrils are present both in pars tensa and pars flaccida. It contains subepithelial connective tissue layer, outer radiate collagenous layer, inner circular

collagenous layer and submucosal connective tissue layer. In pars tensa the lateral fibres are radially arranged and deeper fibres are arranged in circular or parabolic or transverse fashion. it is random in pars flaccida.

c) Mucosal layer

It is the inner most layer. The cells are low simple squamous or cuboidal or columnar ciliated type of epithelium in pars tensa, whereas in pars flaccida taller ciliated cells are not found.

MIDDLE EAR CLEFT

It consists of the tympanic cavity (tympanum), eustachian tube and the mastoid air cell system. It is lined by a continuous layer of epithelium of respiratory type. Near the eustachian tube and anteroinferior part of the tympanic cavity it is columnar epithelium.

Development [13]

The tympanomastoid compartment appears at 3rd week as an outpouching of the first pharyngeal pouch known as the tubotympanic recess. The endoderm tissue of the dorsal end of this pouch eventually becomes the Eustachian tube and tympanic cavity. By 7 weeks, concomitant growth of second branchial arch constricts the midportion of the tubotympanic recess, the primary tympanic cavity lies lateral and primordial eustachian tube lies medial to this constriction. The terminal end of the first pharyngeal pouch buds into four sacci (anticus, posticus, superior and medius) which expand progressively to pneumatize the middle ear and the epitympanum. Expansion of the sacci envelops the ossicular chain and lines the tympanomastoid compartment, whereas the interface between two sacci gives rise to mesentry like mucosal folds, transmitting blood vessels.

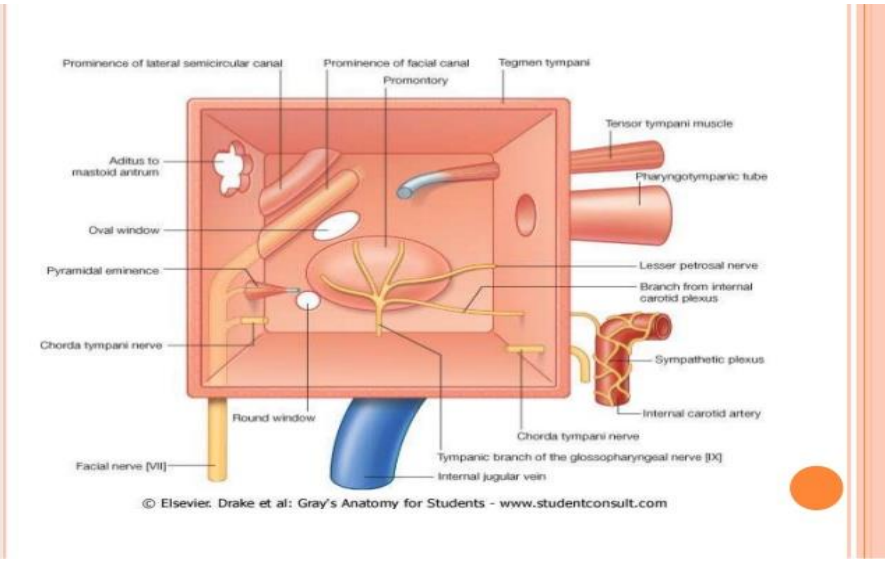
By 21st week, pneumatization reaches the antrum. The tympanic cavity is essentially completed by 30 weeks. Mastoid pneumatization is evident as early as 33 weeks and proceeds by well-established tracts. By birth, the antrum approximates that of the adult. However, mesenchymal resolution continues till one year postnatally. Similarly mastoid continues to grow for upto 19 years after birth.

The ossicular development in the humans starts at approximately 4 weeks. The first arch (Meckel's cartilage) through cartilaginous differentiation gives rise to primordial malleus and incus. Stapes is derived from 2'd arch (Reichert's cartilage) except for the medial surface of footplate and the annular ligament, which are of otic capsular origin. The ossicular chain has enchondral bone development. Development of stapes involves progressive encirclement of the stapedial artery. The ossicles attain adult size by 15 weeks and ossification soon begins, first in incus, then in the malleus and finally in the stapes. The tensor tympani and stapedius muscle develop from the mesenchyme of first and second branchial arches.

MIDDLE EAR CAVITY [11,12]

The external auditory canal forms the lateral wall and medial wall is by inner ear. It measures about 15 mm superoinferiorly and 13 mm anteroposteriorly. It is very narrow in its transverse diameter measuring 6 mm in epitympanum (attic above the level of malleolar folds), 4 mm hypotympanum (medial to the inferior part of tympanic sulcus) and 2 mm mesotympanum (medial to the tympanic membrane) which is the narrowest part.

FIGURE 1: MIDDLE EAR CAVITY



It has 6 walls, floor, roof, medial, lateral, anterior and posterior walls.

Roof

It separates the middle ear cavity, mastoid antrum and canal for tensor tympani from middle cranial cavity. It is formed by Tegmen tympani which is formed partly by petrous part of the temporal bone and partly by the squamous portion of the temporal bone.

Floor

It is formed by a thin plate of bone which separates it from the dome of jugular bulb. This floor may be deficient and thus jugular bulb may project into the tympanic cavity. Anteromedial to the vein is the tympanic branch of the glossopharyngeal nerve that pierces the floor on its way to arborize over the promontory in the formation of the tympanic plexus.

Anterior wall

The anterior wall which is vertical angulates acutely with the floor and forms a hypotympanic recess where inflammatory secretions accumulate. This wall has 4 openings. The eustachian tube opening is seen in the lower part of the anterior wall. A

thin plate of bone separates the eustachian tube and the middle ear from the internal carotid artery, which is perforated by caroticotympanic nerves derived from the sympathetic plexus on the internal carotid artery sheath. The canal for tensor tympani muscle is above the opening for eustachian tube. Canal of Huguier is a small opening in upper part which transmits chorda tympani nerve. Gasserian fissure is the 4th opening, Which transmits tympanic artery and anterior ligament of malleus.

Posterior wall

It has opening in the upper part to the mastoid antrum known as aditus, the wall is wider above and narrow below. This is a large irregular hole that leads back from the posterior epitympanum. Below the aditus is a small depression, the fossa incudis, which houses the short process of the incus and the ligament connecting the two. The pyramidal process below the fossa incudes which is a small hollow conical projection with its apex pointing anteriorly. It contains stapedius muscle, the tendon of which passes forward to be inserted into the neck of stapes.

Facial recess lies between the pyramid and the tympanic annulus. This is bounded medially by the facial nerve and laterally by the tympanic annulus, the chorda tympani runs between the facial nerve and tympanic annulus. This nerve always runs medial to tympanic membrane, which means that the angle between the facial nerve and the chorda allows access to the middle ear from the mastoid without disruption to the tympanic membrane.

Sinus tympani is the posterior extension of mesotympanum deep to the pyramid and the facial nerve. This extension of air cells into the posterior wall can be extensive when measured from the tip of the pyramid, the sinus can extend as far as 9 mm into the mastoid bone. The medial wall of the sinus tympani becomes continuous with the posterior portion of the medial wall of the tympanic cavity.

Medial wall

The medial wall separates the tympanic cavity from the inner ear. Its surface possesses several prominent features and two openings. The promontory is a rounded elevation occupying much of central portion of the medial wall, which has grooves on its surface and the nerves form the tympanic plexus. The promontory covers part of the basal coil of cochlea and in front merges with the anterior wall of the tympanic cavity. Behind and above the promontory is the fenestra vestibuli (oval window), a kidney shaped opening that connects the tympanic cavity with the vestibule, which in life is closed by the base of the stapes and its surrounding annular ligament. The long axis of fenestra vestibuli is horizontal.

The size is 3.25 mm long and 1.75 mm wide. Above the fenestra vestibuli is the facial nerve and below is the promontory. The fenestra cochlea (round window) which is closed by the secondary tympanic membrane (round window membrane) lies below and a little behind the fenestra vestibuli from which it is separated by a posterior extension of the promontory called the subiculum. Occasionally a spicule of bone extends from promontory above the subiculum and runs to the pyramid on the posterior wall of the cavity. This spicule is called the ponticulus.

The round window niche is triangular in shape, with anterior, posterosuperior and posteroinferior walls. The latter two meet posteriorly and lead to the sinus tympani. The average lengths of the walls are: anterior - 1.5 mm, superior - 1.3 mm and posterior - 1.6 mm. The shape of the round window membrane varies from round through oval and kidney shaped, with the average longest and shortest diameters of 2.30 mm and 1.87 mm respectively. The round window membrane consists of three layers: outer mucosal, middle fibrous and inner epithetlial layer. The mucosal layer contains the capillaries and nerves. The membrane of the fenestra cochlea forms part

of its floor. The scala tympani terminate posterior and medial to the membrane. The ampulla of the posterior semicircular canal is the closest vestibular structure to the membrane and its nerve (singular nerve) runs almost parallel to and 1 mm away from its medial attachment.

The facial nerve canal runs above the promontory and fenestra vestibuli in an anteroposterior direction. It is marked anteriorly by processus cochleariformis, which is a curved projection of bone, concave anteriorly and houses the tendon of tensor tympani muscle as it turns laterally to the handle of malleus. Behind the fenestra vestibuli, the facial canal starts to turn inferiorly as it begins its descent in the posterior wall of the tympanic cavity. The dome of lateral semicircular canal extends lateral to facial canal and is the major feature of the posterior portion of the epitympanum.

Lateral wall

It is mainly composed of the tympanic membrane. Scutum or (outer) attic wall is the wall between the epitympanic recess and the roof of the external auditory meatus. The fibro cartilaginous circumference of the pars tensa of the tympanic membrane is fixed into the tympanic sulcus. The upper limits of the sulcus are marked behind by the posterior canaliculus and in front by the anterior canaliculus of the chorda tympani nerve. The anterior canaliculus is placed at the medial end of petrotympanic fissure, which lodges the anterior ligament of the malleus and admits the anterior tympanic branch of the maxillary artery. The contents of middle ear cavity are: auditory ossicles, muscles, chorda tympani nerve and facial nerve.

FIGURE 2: TYMPANIC MEMBRANE

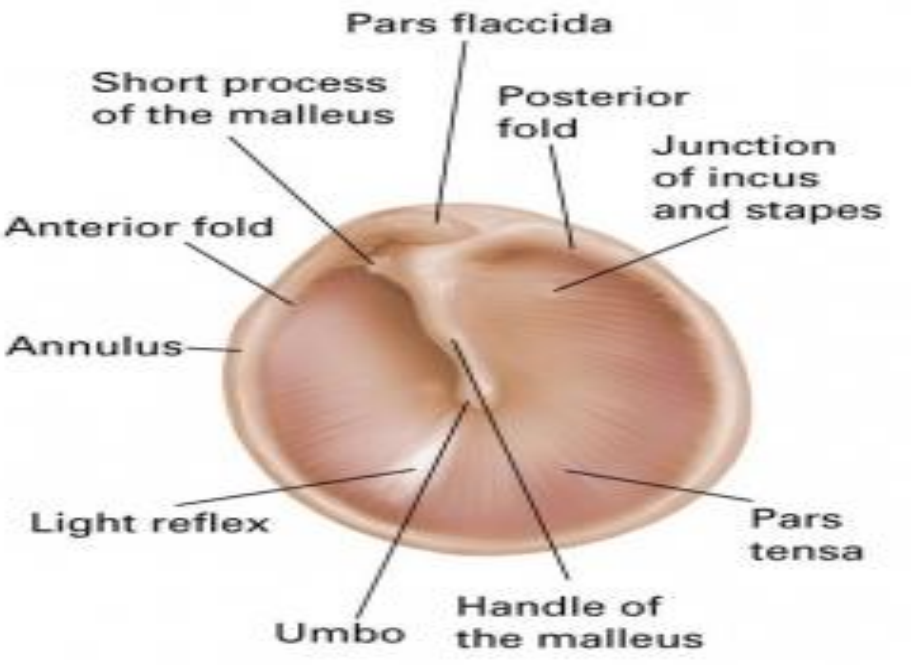
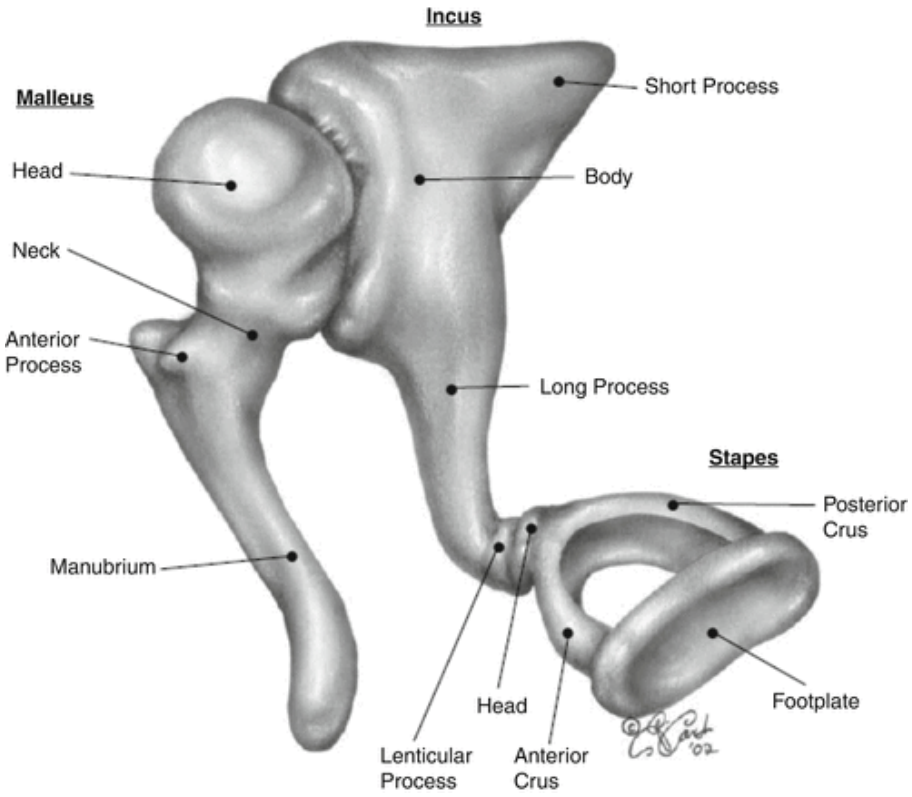


FIGURE 3: OSSICLES



OSSICLES:

Malleus

Malleus is hammer shaped and largest of all ossicles. It is about 7.5 to 9 mm in length has a head, neck, and three processes arising from below the neck. The head is in the attic or in the epitympanum and has on its posteromedial surface an elongated saddle shaped, cartilage covered facet for articulation with incus. The handle or manubrium is crescentric, concave laterally. The lower horn of the crescent terminates flatly at the umbo. The upper horn projects into the lumen of the external meatus as the lateral process. The neck is set at about 135° to the medial aspect of the handle, where the upper quarter joins the lower three quarter. The anterior surface of the neck is thickened and drawn forwards into a small spicule known as the anterior process, which is connected to the petrotympanic fissure by ligamentous fibres, occasionally augmented by muscle fibres.

Incus

It consists of a body and two processes. The body lies in the epitympanum, the processes are set on to the body at right angles to each other. The long process is slender, and descends posteromedially and parallel to the slightly longer handle of malleus. The lower end of the long process is bent inwards and surmounted by a small tubercle covered with cartilage, the lentiform nodule, which articulates with the head of the stapes. The short process is thicker and shorter and passes horizontally backwards to obtain lodgement and ligamentous attachment to fossa incudis. A shallow saddle shaped depression in the anterior face of the head of the incus accommodates the convex facet on the posterior aspect of the head of the malleus. This joint allows a rotatory gliding movement. The excessive motion of the malleus on its outward swing is countered by the disengagement mechanism, while excessive

inward swing is believed to be opposed by the mutual action of tensor tympani and stapedius muscle.

Stapes

It consists of four parts head, neck, two crura and a base or footplate. The head faces laterally and articulates with the lenticular process of incus. The insertion of stapedus tendon is onto the posterior part of neck and upper portion of posterior crus. The two cura connect the neck and the footplate. The anterior crura is thinner and less curved than the posterior crus. Annular ligament attaches to the bony margins of the labyrinthinc capsule. The average dimensions of footplate are 3mm long and 1.4 mm wide.

AUDITORY MUSCLES:

The two auditory muscles tensor tympani and stapedius muscle exert a dampening effect on the amplitude of the vibratory waves, thus protecting the cochlea from excessive stimulation by loud noise.

Tensor tympani

It is a long slender muscle arising from cartilaginous portion of auditory tube, the adjoining portion of greater wing of the sphenoid, as well as from bony canal, above the auditory tube. It passes backwards in a tendon, round the processes cochleariformis and is inserted into the medial aspect of the upper end of the handle of malleus. It has got definite frequency selectivity for its contractions at 0.5 to 1 kHz resulting in decreased conductivity. Its nerve supply is by the mandibular nerve by way of a branch from the medial pterygoid nerve, which passes through the otic ganglion without synopsis.

Stapedius muscle

It is housed in a bony cavity. It arises from the walls of the conical cavity within the pyramid and from the downward curved continuation of this canal in front of the descending portion of the facial nerve. A slender tendon emerges from the apex of the pyramid and inserts into the stapes. Nerve supply is by the small branch of the facial nerve.

Arterial Supply of the tympanic cavity

Tympanic cavity is supplied by six arteries.

1. Anterior tympanic branch of maxillary artery – tympanic membrane
2. Stylomastoid branch of posterior auricular artery - posterior part of the cavity and mastoid air cells.
3. Superficial petrosal branch of middle meningeal artery which enters through the hiatus for the greater petrosal nerve.
4. Superior tympanic branch of middle meningeal artery which enters through the canal for tensor tympani.
5. Inferior tympanic branch from ascending pharyngeal artery accompanying the tympanic branch of the glossopharyngeal nerve.
6. Carotico tympanic branch of internal carotid artery passes directly into the cavity through the anterior wall.

Venous Supply of tympanic Cavity

Veins drain into pterygoid p!exus and superior petrosal sinus

Lymphatics of Tympanic Cavity

The lymphatic drainage of the epithelial lining of the tympanum and mastoid antrum passes to the parotid and upper deep cervical lymph nodes.

Nerve supply of Tympanic Cavity

Tympanic Plexus is formed by:

Tympanic branch of glossopharyngeal nerve,

The superior and inferior caroticotympanic branches of the sympathetic plexus of internal carotid artery.

EUSTACHIAN TUBE [11, 12]

It is also known as auditory or pharyngotympanic tube. The tube is about 36 mm long in the average adult, connects the tympanic cavity with the nasopharynx, and runs downwards, forwards and medially from the middle ear. There are two parts, a lateral bony posterior part arising from the anterior wall of the tympanic cavity and a medial fibrocartilaginous part entering the nasopharynx. The tube is lined by respiratory mucosa. The bony portion is 12 mm long. Isthmus is the narrowest portion which is of 2mm diameter. In infants the tube is more horizontal and relatively wider and shorter than in adults. It is supplied by ascending pharyngeal and middle meningeal arteries.

The aditus to the mastoid antrum

It is a large irregular opening connecting the posterior epitympanum and the air filled space of the mastoid antrum. Prominence of the lateral semicircular canal lies on the medial wall. The bony canal of the facial nerve lies below and slightly

medial. Seventh nerve to the semicircular canal- 1.77mm ; seventh nerve to short process of incus- 2.36mm; short process of incus to the semicircular canal- 1.25mm.

THE MASTOID ANTRUM

Mastoid antrum is an air filled sinus within the petrous part of temporal bone. It communicates with the middle ear through the aditus and has mastoid air cells arising from its walls. The antrum is well developed at birth and by adult life has volume of 1ml which is 14mm anteroposteriorly and 9mm superoinferiorly and 7mm side to side. Suprameatal triangle (macewen's) corresponds to the lateral wall.

Relations of mastoid antrum:

Roof- floor of middle cranial fossa

Floor- diagastric muscle laterally and sigmoid sinus medially

Medial wall- posterior semicircular canal

Lateral wall- suprameatal triangle

Anterior- aditus in its upper part, lower part the facial nerve passes in its descent

Posterior- bony covering of sigmoid sinus.

MASTOID AIR CELL SYSTEM [11, 12]

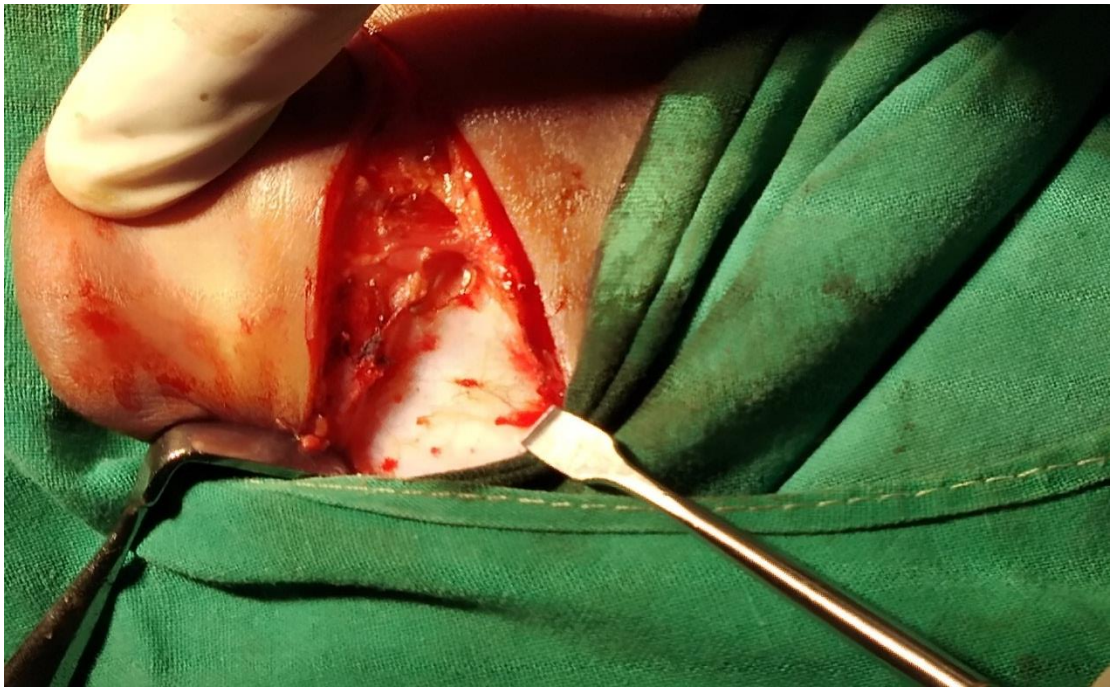
The air filled cavities arises from the walls of the mastoid antrum and sometimes from the walls of epitympanum and mesotympanum. The mastoid process is completely filled with air cells and lies separated from the sigmoid sinus and posterior and middle cranial fossa by a thin bone which may occasionally be deficient. When Cells extend medial to the descending portion of the facial nerve, are called as retrofacial cells. Tip cells extend down to the diagastric muscle. Perisinus cells are around the sigmoid sinus. Pneumatization may happen at the angle between the sigmoid sinus and the middle cranial fossa dura and even may extend beyond to the zygoma. The apex of petrous bone is pneumatised occasionally. These air cells like

the mastoid itself are lined with a flattened non-ciliated squamous epithelium. Pneumatization can be very extensive. Alternatively mastoid antrum may be the only air filled space in the mastoid process when sclerosed or acellular. This condition is noted in about 20% of the adult temporal bones. In between these two forms are the so called diploic or mixed types where air cells are present but are filled with marrow containing space that have persisted from the late foetal life.

TEMPORAL FASCIA [14]

There are six layers superficial to the skull. The pericranium is adherent to the calvarium which is covered by a loose layer of connective tissue. Superficial to this in the temporal region lies the temporalis muscle covered by the deep temporal fascia which in turn is covered by the superficial temporal fascia. The outer two layers are the subcutaneous fat and the hair-bearing scalp. The superficial temporal layer has many Synonyms, for example the temporoparietal layer, epicranial aponeurosis and the galeal extension. The deep temporal fascia has clear anatomical boundaries and is thus easier to define. It lies directly over the temporalis muscle and is thus confined by the anatomical limits of the muscle.

FIGURE 4: TEMPORALIS FASCIA



Superficial temporal fascia

The superficial temporal fascia is found directly below the fatty layer and hair follicles of the scalp. It is a thin, highly vascular layer of moderately dense connective tissue which is attached loosely to the overlying subdermal layer above the zygomatic arch, but increasingly firmly as one approaches the vertex. In contrast, its deep surface is separated from the underlying deep temporal fascia by a loose avascular plane.

Its other attachments are the galea above, the frontalis muscle in front, the occipitalis muscle behind and the post-auricular muscles and the subcutaneous musculo aponeurotic system of the face below. This layer has its own rich blood supply. Its arterial supply comes from the superficial temporal artery lying within its thickness. It is drained by a vein of the same name lying on top of the facial layer.

Arterial branches pass to the subdermal plexus but are not given off to the deep temporal fascia. Approximately two-thirds of the way towards the vertex from the zygomatic arch, the arterial vessels leave the superficial temporal fascia and enter

the subdermal layer. The temporal branch of the facial nerve lies just deep to the superficial temporal layer about one finger's breadth behind the zygomatic arch. The auriculo-temporal nerve lies just posterior to the superficial temporal vessels and its branches lie within the superficial temporal fascia. The galea and superficial temporal facial layers are continuous and no distinction can be made between the two.

The deep temporal fascia

The deep temporal fascia closely covers the temporalis muscle and its aponeurosis follows the muscle's anatomical boundaries. The blood supply of this fascia is from the middle temporal artery which arises from the superficial temporal artery. The middle temporal artery always runs superficial to the zygoma, entering the deep temporal fascia above the arch. None of its branches pass into the superficial temporal fascia but some do supply the temporalis muscle. The middle temporal vein accompanies the artery closely in its course through the deep temporal fascia.

There is no significant difference in the histology of two layers, in terms of collagen in connective tissue stains. The physical characteristics showed no difference in elasticity either between the two layers or between individual patients. The elasticity was, however, directly related to the content of dehydration of the fascia. The size of this fascia alters with its hydration 15 and there is no difference in thickness between the two layers.

The total area of fascia available on one side of the head is 260 cm2. The importance of this is emphasized because temporal fascia (superficial or deep) should always be available for tympanoplasty even in repeat operations. 14 Access to the fascia is easily obtained by extending a post-auricular incision vertically into the hairline, by utilizing a separate hairline incision or by using the opposite side of the head.

PHYSIOLOGY OF CONDUCTION OF SOUND [16]

Hearing is the vital basis for acquisition in speech and language and these skills in turn are most important tools of constructive thought. The sound conduction mechanism comprising the ossicles forms a link, extending from the pinna to the organ of corti.

Its functions include:

1. Collection and transmission of sound energy involving impedance matching at every stage and particularly matching between the external air and cochlear fluids.
2. Protection of the inner ear from the excess loud sounds, a function carried out by the tympanic muscle sacrificing the sensitivity of low intensity sound levels.

MIDDLE EAR SOUND CONDUCTION [17]

The sound waves in air cannot be transmitted efficiently to the fluid medium which fills the cochlea without the help of some device to overcome the impedance mismatch. The role of middle ear is to match these impedances by acting as an acoustic sound pressure transformer. It also has to provide for acoustic separation of the round window from oval window if movement of stapedial foot plate is to be transmitted to the perilymph in the cochlea.

The round window membrane provides the elasticity needed for the transmission of the sound wave into the fluid medium. If an incident sound wave falls on the oval and round windows simultaneously, the perilymph column will be unmoved, because the pressure exerted by the footplate at the oval window would be exactly resisted by pressure, acting in the opposite direction on the round window membrane.

This difficulty is overcome by protection of the air cushion within the tympanum and by the preferential channelling of the sound waves from the tympanic membrane through the ossicular chain to the oval window. By these means the round window is acoustically isolated from the oval window.

Ossicular movement [16, 17]

The vibrations of the tympanic membrane are conveyed to the malleus through its handle. The malleus and incus move as one functional unit except at very high intensity, rotating in and out through a tiny arc, about an axis which passes from the anterior process of the malleus backwards to the end of the short process of the incus. The oscillating movement of the stapes in the oval window, received from the long process of the incus is in and out like that of a piston, when amplitude is low.

At higher amplitude the footplate executes a rocking motion about a vertical axis through its posterior edge. When the stapedius muscle contracts, in response to sound pressure levels 80 dB or more above the threshold, the mode of stapes movement may change to one of longitudinal rotation about its long axis. This form of vibration attenuates sound levels reaching the cochlea, especially in the low frequencies.

Sound pressure transformation

The problem of impedance matching, wherein relatively light and inelastic air can impart its energy to relatively dense and highly elastic fluid is solved by two mechanisms — ossicular lever action and hydraulic action. The pressure of sound waves on the stapes footplate is almost twenty times greater than on the tympanic membrane as a result of the combined effect of these mechanisms.

Ossicular leverage

It is provided by the movement of the malleus — incus complex acting as a lever about its axis of rotation. The handle of malleus is 1.3 times longer than the long process of the incus, when each is measured from its tip to the fulcrum at the axis. This factor of 1.3 is the size of the mechanical gain provided by the lever action.

Hydraulic action

It depends on the relative surface areas of the tympanic membrane and the stapes footplate. Anatomically the surface area of the tympanic membrane is about 21 times that of the footplate. It is known that the central 2/3rd of area of tympanic membrane moves as a unit and it is this central part which provides the area to relate to that of the footplate. The functional ratio of tympanic membrane surface area to footplate area is then 2/3rd of 21:1 = 14:1, which is the mechanical advantage derived from the hydraulic action. The combined benefits of lever action and the hydraulic action provide an increase of pressure at the oval window of 14 x 1.3 or just over 18 times.

Auditory tube function

Effective sound transmission through the middle ear and into the cochlea requires that the air in the middle ear is maintained at a pressure level identical to that of the ambient air in the external acoustic meatus. Deviations from this ambient level of pressure, the impedance of middle ear increases. The pressure of air in the middle ear must at all times be kept at the ambient external level as a prerequisite for efficient middle ear function and inner ear sound conduction. Auditory tube maintains this pressure. Auditory tube obstruction raises the threshold of hearing by 30-40dB. In normal individuals, the limits of variation for compliance and resistance arc much narrower for female subject, but the average values arc similar to both sexes.[23]

Sensorineural function

Air conducted sound waves are admitted to the cochlear perilymph through the oval window, and the information they convey emerges at the other end of the cochlea as nerve impulses in the afferent fibres of the cochlear nerve. The cochlea is a tube filled with perilymph, coiled on itself $2^3/_4$ times. Along the length this tube is divided into two channels by a cochlear partition. The upper channel is the scala vestibuli, into which the oval window opens.

The lower channel is the scala tympani, which is sealed at its end by the round window membrane. These two perilymphatic channels communicate with each other only at the cochlear apex, through the helicotrema. The scala media containing the endolymph is separated from scala vestibuli by Reissner's membrane and from scala tympani by basilar membrane supporting the organ of corti and associated structure. The basilar membrane is 35 mm long gradually increases in width from 0.08 mm at the base near the oval window to 0.5 mm at the apex. There is progressive increase in mass and decrease in stiffness along the length of the membrane.

Sensorineural function ultimately involves the movement of cochlear partition by sound waves, conversion of mechanical energy into electrical energy (transduction) resulting in electrical events in the fibers of cochlear nerve.

MOVEMENT OF THE COCHLEAR PARTITION [16]

1. **Helmholtz's Place Theory** [18]: He suggested that basilar membrane consist of a series of tuned resonators. In this theory any segment of the basilar membrane is activated by a sound wave of the resonant frequency of that segment, with high frequency waves exciting segments in the basal turn and low frequencies exciting the more apical regions.
2. **Rutherford's Telephone Theory:** According to this the frequency of activating sound wave is signalled by the rate of discharge in the cochlear nerve fibres. The latent period of nervous action limits this theory to the perception only of frequencies below 1000 Hz, if the relationship between sound wave frequency and nerve impulse has a simple ratio of 1:1.
3. **Wever's Volley Theory:** Combines both Place and Telephone theory principles, postulating that:

a) High frequencies are perceived as per place theory (in the basal turn).

b) Low frequency (below 1000 Hz) stimulates nerve action potentials at a rate equal to the stimulus frequency.

c) Intermediate frequencies are represented in the auditory nerve by asynchronous discharges in groups of neurons, whose combined activity represents the frequency of the stimulus.

4. Von Bekesy's Travelling Wave Theory [19]:

Each wave increases in amplitude until it reaches a maximum at a place, which is specific for its frequency and then rapidly dies away. Successive trains of waves produced by a sustained tonal stimulus have an envelope with a maximal displacement at a site determined by the stimulus frequency. High frequency waves activate only the basal turn, which appears to move as one. Lower frequency waves

travel farther along the whole length of the partition to the apex before reaching their maximum. Sharpening of this frequency sensitivity takes place partly in the cochlea and farther by neural mechanisms in the brain. The traveling wave uniquely represents the frequency of excitation and many of its physical character may subsequently be used by brain for finer pitch assessment.

CHRONIC OTITIS MEDIA

Chronic otitis media (COM) is an inflammatory process in the middle ear space that results in long term or more often, permanent changes in the tympanic membrane including atelectasis, dimer formation, perforation, tympanosclerosis, retraction pocket development, or cholesteatoma [20].

Classification of COM

COM can be classified as an active, inactive and inactive with frequent reactivation. The classification scheme was developed by Nadol JB [20].

Chronic inactive otitis media with perforation (dry perforation)

There is an permanent perforation of the pars tensa but the middle ear mucosa is not inflamed. A perforation may be completely surrounded by a remnant of pars tensa or a part of perforation may extend to the fibrous annulus. The lamina propria around the perforation is thickened due to proliferation of fibrous tissue. The mucocutaneous junction is usually located at the margin of perforation, but not necessarily. Squamous epithelium can migrate medially into the middle ear. At the time of tympanoplasty, it is necessary to excise such a grown squamous epithelium, which can be recognized by its velvety appearance under the operating microscope.

Chronic inactive otitis media with retraction pocket (retraction at the atelectasis and epidermoidisation)

Negative static middle ear pressure can result in retraction of the membrane. A retraction pocket consists of the invagination into the middle ear from a part of the ear drum. Epidermoidisation is a more advanced type of retraction and refers to replacement of middle ear mucosa by keratinising squamous epithelium without retention of the keratin debris.

Chronic inactive otitis media with frequent reactivation

In this, there will be episodes of reactivation or flare ups occur. It is due to a subclinical inflammation in the middle ear and the mastoid air cell system. The patient is able to return to a clinically inactive state after each flare up.

Chronic active otitis media without cholesteatoma

There is a chronic inflammation within the mucosa of the middle ear and mastoid, with varying degree of oedema, submucosal fibrosis, hypervascularity and infiltration with lymphocytes, plasma cells and histiocytes. Area of mucosa may ulcerate with proliferation of blood vessels, fibroblasts and inflammatory cells leading to granulation tissue. There is production of mucopurulent discharge which drains via a perforated tympanic membrane.
The mucosal changes may progress to form an aural polyp that can protrude through defects in a tympanic membrane. Inflammatory changes occurs in the entire middle ear cleft including antrum and various air cell tracts of the temporal bone. Active mucosal COM is often associated with resorption of parts or whole of the ossicular chain.

The ossicles may show hyperemia with proliferation of capillaries and prominent histiocytes. The long process of incus, stapes crura, body of incus and maibrium are involved in that order of frequency. The infection, inflammation pressure and keratin can lead to elaboration of a variety of molecular factors which lead to recruitment development and activation of osteoclasts. These activated osteoclasts then result in bone resorption.

Chronic active otitis media with cholesteatoma

The hallmark of cholesteatoma is retention of keratinous debris. Histologically squamous epithelium lining or the matrix of cholesteatoma is similar to that of a skin. The matrix of cholesteatoma is usually surrounded by a layer of inflamed, vascular, subepithelial connective tissue. A cholesteatoma can be filled with keratin and be quite dry, or be associated with active bacterial infection leading to profuse malodorous otorrhoea. Cholesteatoma are potentially dangerous because of their potential to incite resorption of bone, leading to intratemporal or intracranial complication.

TYMPANOPLASTY

It is a surgery in which inspection and repair of the middle ear sound conducting apparatus with reconstruction of tympanic membrane is done.

Wullstein created a classification scheme identifying six basic types of tympanoplasty

Type 1: Inspection of the middle ear and correction of the perforation wherein the ossicular chain is intact.

Type 2: Ossicular chain examination shows erosion of the malleus and therefore placement of graft over the intact incus and stapes.

Type 3: Ossicle erosion of malleus and incus so that the graft is placed over the head of stapes.

Type 4: Ossicle erosion of malleus, incus and head, neck and crura of stapes. Only a mobile footplate remains. Sound protection of round window is given by placing graft against the footplate, thus masking an air containing cavity in continuity with the round window and Eustachian tube.

Type 5: Footplate of stapes is fixed. A fenestra is made on the horizontal semicircular canal. The graft seals off the middle ear to give sound protection to the round window.

Type 6: The round window is left exposed to the direct impact of sound waves. Mobile footplate is protected by small tympanic air space in continuity with the Eustachian tube.

CORTICAL MASTOIDECTOMY

The first documented recommendation of mastoidectomy was found in the writings of Johannes Riolanus at 1671[1]. Before the mid 19th century, mastoidectomy was performed only sporadically and in most cases as a desperate attempts to save the lives of people suffering from complications of infectious otitis. Draining the red, warm abscess behind the ear by incision was described by lucas van leyden in 1524[5]. The first documented ear surgical incision to drain an infected ear was described by the French physician Ambroise Pare in 16th century[5].

Hermann schwartze and Adolf eysell were the first to describe the procedure of mastoidectomy in year 1873.

Indications

1. Control of chronic otitis media with or without cholesteatoma.
2. Acute coalescent mastoiditis.
3. Standard approach for cochlear implantation, excision of tumours, surgery of vertigo.

The three priorities of surgery for COM are to eradication of disease, prevention of disease recurrence, preservation or restoration of hearing.

Contraindication

1. Unreconstructable posterior canal wall defect
2. Patients in whom proper follow up is questionable
3. Unresectable matrix involving the labyrinth, facial nerve, carotid, dura and sinus tympani.

The important landmarks on the lateral surface of temporal bone are spine of henle(a bony projection posterosuperior to the bony meatus), linea temporalis(a ridge of bone which makes the inferior limit of the temporalis muscle attachment and extends from superior border of zygomatic arch posteriorly onto the mastoid cortex), and Mac Ewans triangle (linea temporalis superiorly, posterior bony meatus anteriorly, a line tangential to bony meatus and perpendicular to linea temporalis posteriorly).

PURE TONE AUDIOMETRY

The hearing sensitivity of an individual only for pure tone sounds can be assessed. PTA does not determine the exact pathology of a disorder but it classifies the deafness into three categories that is conductive, sensorineural or mixed. It helps to limit the number of possibilities in the diagnostic workup. PTA is a part of ascertaining the hearing threshold level of a subject for pure tone sounds of various frequencies. The resultant plotted graph is called pure tone audiometry.

The audio oscillator generates pure tone sounds of various frequencies. Frequencies at which they are measured are at 125, 250, 500, 1000, 1500, 2000, 2500, 4000, 6000, 8000 and 10000Hz. Attenuator dial attenuates the tones and is marked in decibels (dB) and graduated in 5 dB steps from -10 to 110 dB. audiometry is connected to Standard and specified earphones or to a bone conduction vibrator through which the sound is presented to the subjects ear.

Technique of air conduction test:

The conventional method is most commonly used. First the better ear is tested, and is begun with a 1000Hz sound and then the other frequencies are tested in order till 10,000 and repeated again followed by 500-250 Hz. In each frequency the threshold is tested as follows: The examiner first familiarizes the patient with the tone by introducing the sound at an arbitrarily presumed suprathreshold level. If the patient

hears the tone then the tone is reduced in the step of 10dB till the patient stops hearing or fails to give response. Once this stage is reached the tone is raised by 5 dB. If the patient hears the tone, the sound is again decreased by 10 dB. If he still does not hear it, the tone is raised again by 5dB. In this way by several threshold crossings, the exact hearing threshold id obtained when one gets three out of five responses correct. The second ear is tested in a similar manner but one may start with last frequency used to test the first year as there is no need to now start with the 1000Hz. This method is called 5-up10-down method.

Technique of bone conduction test:

The bone conduction vibrator attached to a spring metal band is placed over the mastoid bone. The region over mastoid should be as free of hair as possible. The bone conduction vibrator is moved over the mastoid bone area till point is reached where maximum sound is heard. The vibrator is then placed over this point and the test is done. The vibrator should not touch the pinna, nor the ear phone since it might impede the vibrations of the bone conductor. The technique is same of air conduction testing(5-up 10-down method). In chronic otitis media usually conduction deafness is found. Degree of deafness may be anything between very mild to severe.

No definite correlation is established between the size or location of the perforation and the degree of deafness. However, a complete loss of middle ear system results in AB gap of about 60dB. Sensorineural deafness though not very common is sometimes present, and causes mixed type of deafness. Sensorineural impairment usually affects the higher frequencies and is due to diffusion of toxins(liberated by infective organism) through round window membrane into the scala tympani of the inner ear at region of basal turn of cochlea. However, damage to the scala tympani may not be restricted to basal turn only and the whole of cochlea may

be severely damaged in some cases, causing a total or profound sensorineural deafness [21].

MATERIALS AND METHODS

SOURCE OF DATA

All patients of chronic suppurative otitis media Tubotympanic type with dry ears after receiving two courses of antibiotics and undergoing type 1 tympanoplasty in the department of otorhinolaryngology, Shri B.M Patil Medical College Hospital and Research Centre, Vijayapura between October 2016 to March 2018.

METHOD OF COLLECTION OF DATA

- Preoperative examination of the patient including the complete clinical history of years of ear discharge, number of antibiotic courses prior to admission, number of ear discharges per year etc. was noted.
- Detailed examination of the patient with emphasis on detailed otoscopic findings and examination under microscope is done to see the status of tympanic membrane and its perforation, middle ear mucosa, discharge from the ear are noted.
- Patient were subjected to investigations such as urine routine and blood routine examinations. Pure tone audiometric examination was done to assess the dB loss of hearing, bilateral mastoid x- rays are taken.
- Intra operative findings of the patient are noted such as the status of tympanic membrane and the perforation, middle ear mucosal congestion or hypertrophy or both, patency of aditus ad antrum, status of ossicular chain and for presence of hypertrophied mucosa around ossicles and promontry.
- The evaluation of the case is done after the opening of mastoid antrum, and the indicators are noted.

Inclusion Criteria

1. Age between 10-60 yrs.
2. Central perforations.
3. Ear becoming dry after two course of antibiotics.
4. The ossicular chain is intact (as per pure tone audiometry)
5. **Exclusion Criteria**

1. Revision tympanoplasty cases.
2. Ear with chronic granular myringitis.
3. Discharge persisting even after two course of antibiotics.
4. Ear with ossicular discontinuity.
5. Patient with upper respiratory tract infection.
6. Patients with immune compromised status like renal failure, diabetes.
7. Atticoantral disease
8. Habits of smoking, tobacco chewing.

Type of study

Prospective Study

Sample size

- The incidence of tubotympanic type in Chronic Suppurative Otitis Media is 86.2%.[9]
- At 95% confidence interval and 15% allowable error, the calculated sample size is 100.
- $$n = \frac{Z\alpha^2 \times p \times q}{e^2}$$

where

z – z value at α level = 95%

P - prevalence rate

e - precision.

Hence a minimum of 87 cases of type1 tympanoplasty with cortical mastoidectomy will be required for this study.

Statistical Analysis

Data will be analysed by: - Mean ± SD

- Percentages
- Diagrams
- Chi Square test with 'P' value

RESULTS AND OBSERVATIONS

The present study "**IDENTIFICATION OF INDICATORS FOR EXPLORATION OF MASTOID ANTRUM IN TYPE 1 TYMPANOPLASTY FOR TUBOTYMPANIC DISEASE"** was done in shri B. M. Patil medical college, hospital and research centre, Vijayapura during the period of December 2016 to august 2018. The results and the analysis of the study are as follows:

AGE DISTRIBUTION

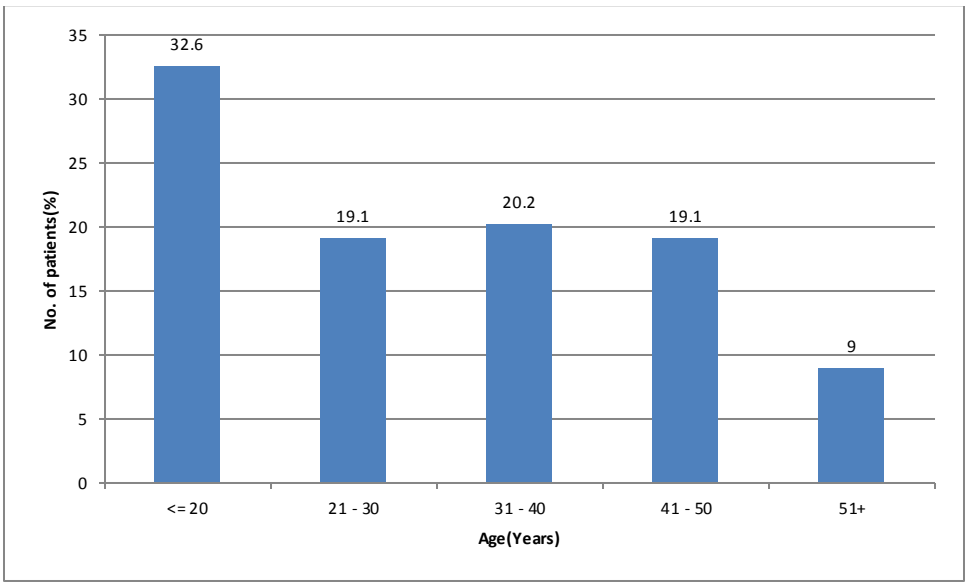
Out of total 89 cases operated, the age of the patients varied between 11 – 60 years, i.e., the youngest of the patient was 11 years and the eldest was 60 years.

TABLE 1: Percentage distribution of age among total patients

Age(Years)	No. of Patients	percentage
<= 20	29	32.6
21 - 30	17	19.1
31 - 40	18	20.2
41 - 50	17	19.1
51+	8	9.0
Total	89	100.0

There were 29 patients (32.6%) in the age group of below 20 years, highest number in our study and least being 8 patients (9%) of > 50 years.

Graph 1: Percentage distribuion of age among total patients.



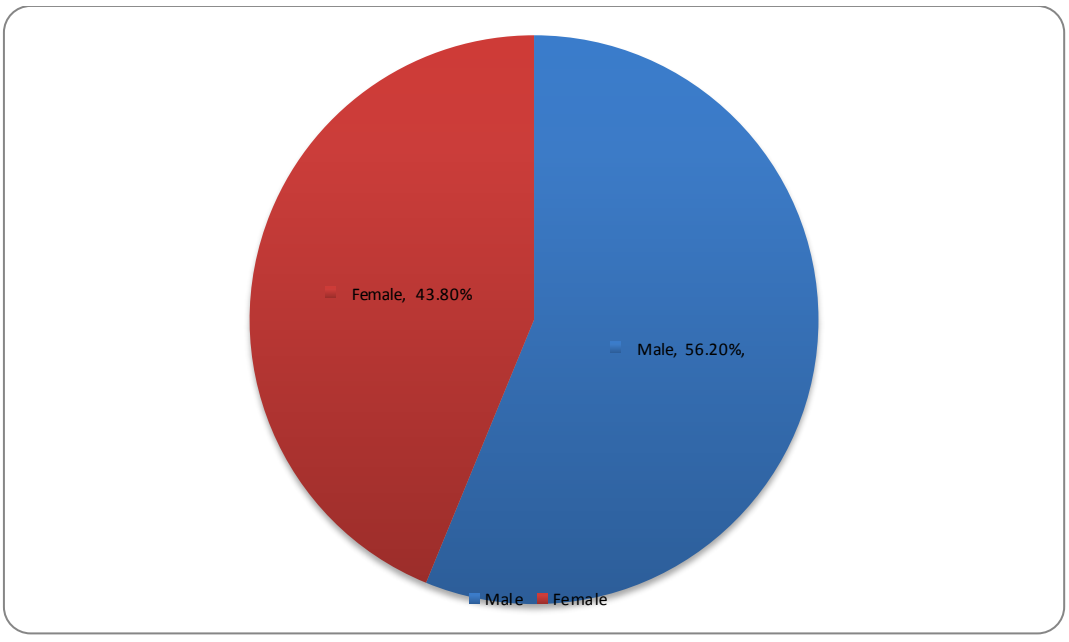
SEX DISTRIBUTION

In our study of 89 cases 50 patients (56.2%) were males and 39 patients (43.8%) were females.

Table 2: Percentage distribution of sex among total patients

Gender	No. of Patients	percentage
Male	50	56.2
Female	39	43.8
Total	89	100.0

Graph 2: Percentage distribution of sex among total patients



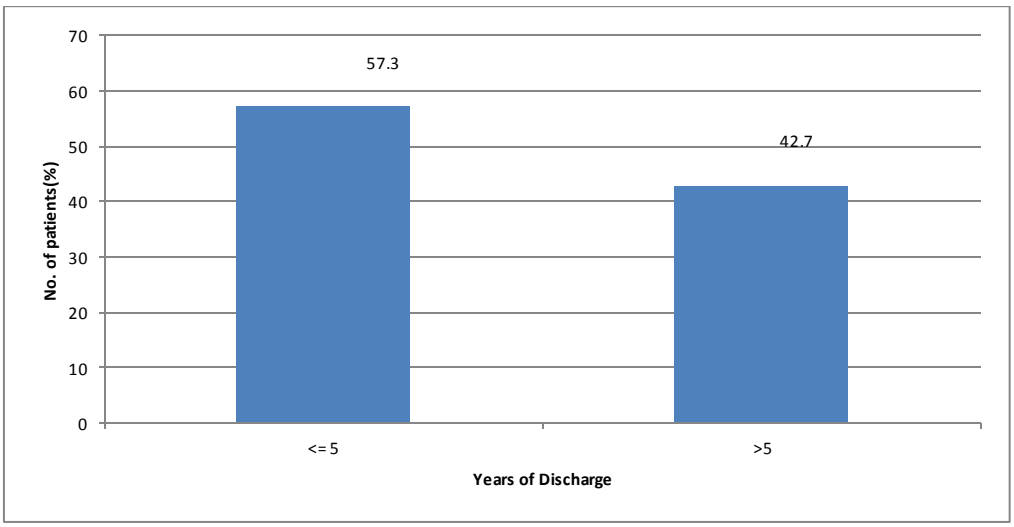
YEARS OF EAR DISCHARGE

In our study, 51 cases (57.3%) had ear discharge of <= 5 years, 38 cases(42.7%) had ear discharge for > 5 years.

Table 3: Percentage distribution of years of ear discharge.

Years of Discharge	No. of Patients	Percentage
<= 5	51	57.3
>5	38	42.7
Total	89	100.0

Graph 3: Percentage distribution of years of ear discharge.



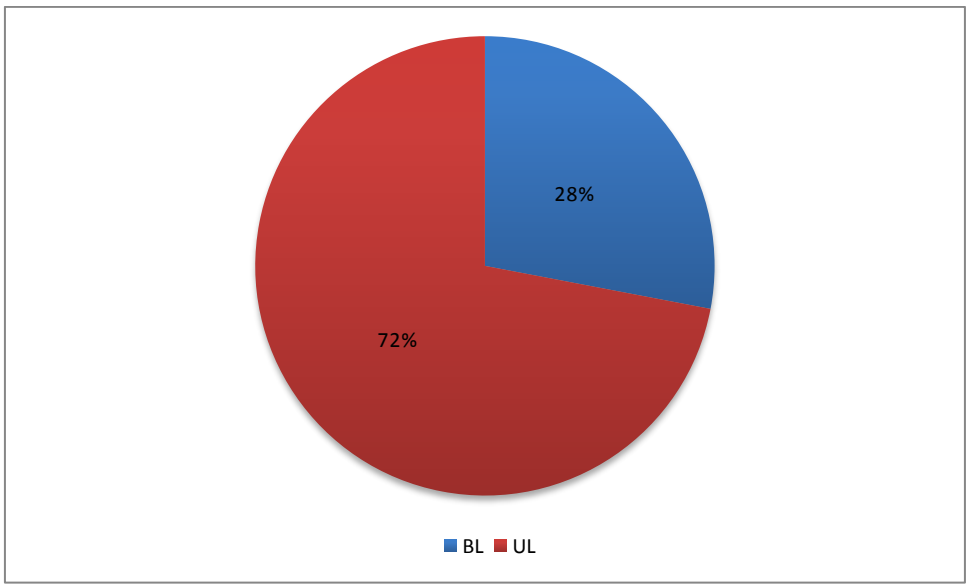
EAR INVOLVED

In our study 25 cases (28%) were bilateral and 64 cases (72%) were unilateral

TABLE 4: Percentage distribution of UL/BL among total patients.

UL/BL	No. of Patients	percentage
BL	25	28
UL	64	72
Total	89	100.0

Graph 4: Percentage distribution of UL/BL among total patients.



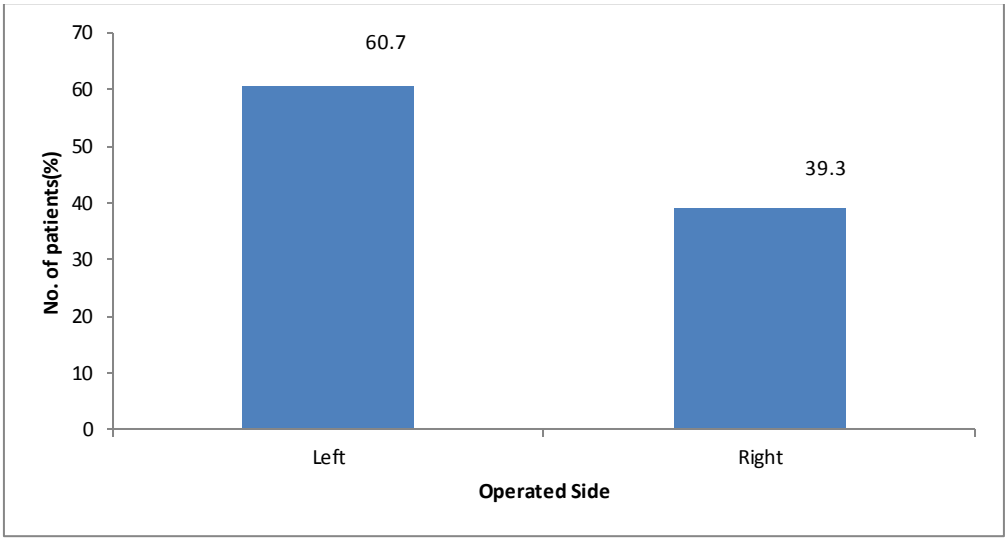
OPERATED SIDE

Out of 89 cases of our study, we had 54 cases (60.7%) who were operated on left side and 35 cases (39.3%) on right side.

Table 5: Percentage distribution of side of operation.

Operated side	No. of Patients	percentage
Left	54	60.7
Right	35	39.3
Total	89	100.0

Graph 5: percentage distribution of side of operation.



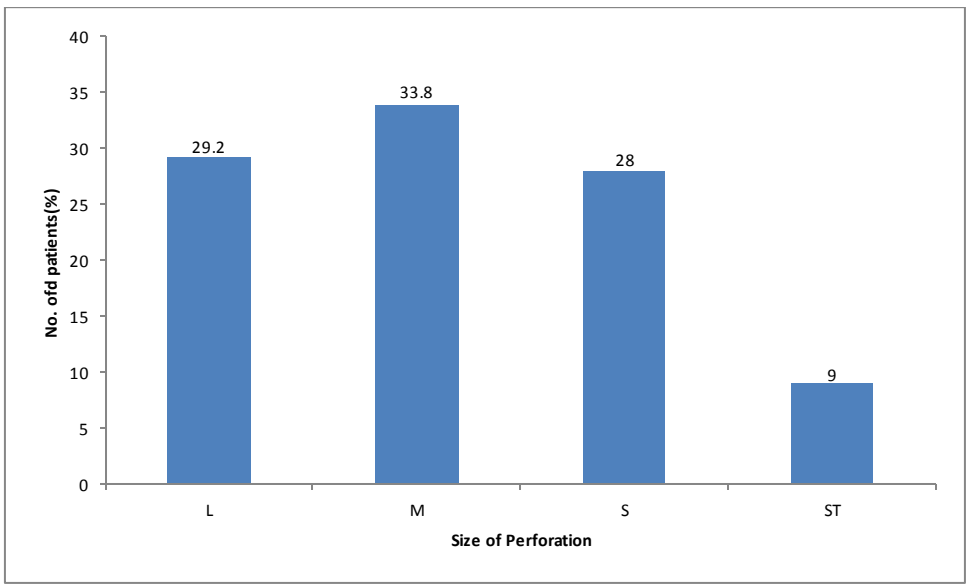
SIZE OF PERFORATION

Out of total 89 cases of central perforations, 26 cases (29.2%) were large, 30 cases (33.8%) were medium, 25 cases (28%) were small, 8 cases (9%) were subtotal perforations .

Table 6: Percentage distribution of size of perforation among total patients.

Size of perforation	No. of Patients	percentage
L	26	29.2
M	30	33.8
S	25	28
ST	8	9
Total	89	100.0

Graph 6: Percentage distribution of size of perforation among total patients.



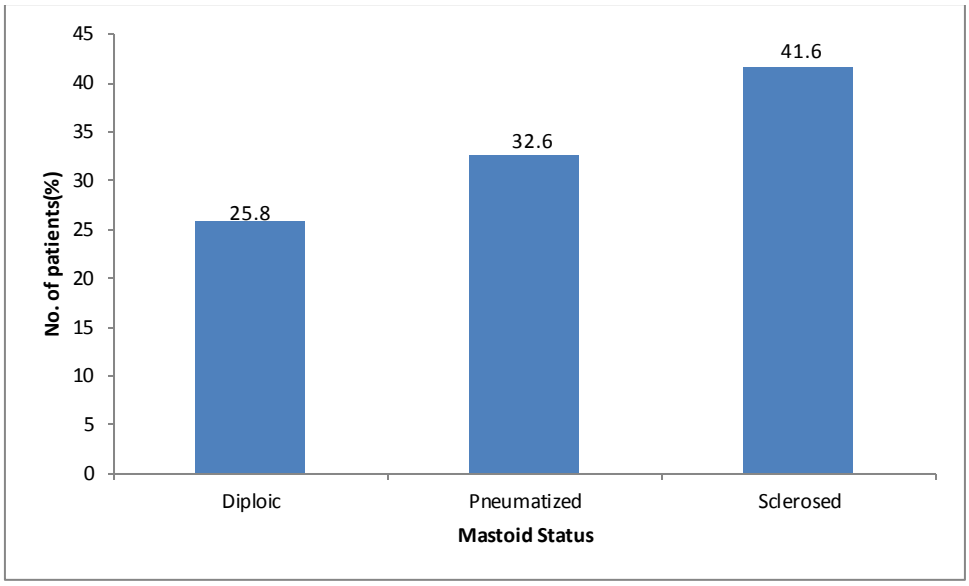
MASTOID STATUS

In our study of 89 cases, the mastoid status in 23 cases (25.8%) was diploic, 29 cases (32.6%) was pneumatized and 37 cases (41.6%) was sclerosed.

Table 7: Percentage distribution of mastoid status.

Mastoid Status	No. of Patients	Percentage
Dioploic	23	25.8
Pneumatized	29	32.6
Sclerosed	37	41.6
Total	89	100.0

Graph 7: Percentage distribution of mastoid status.



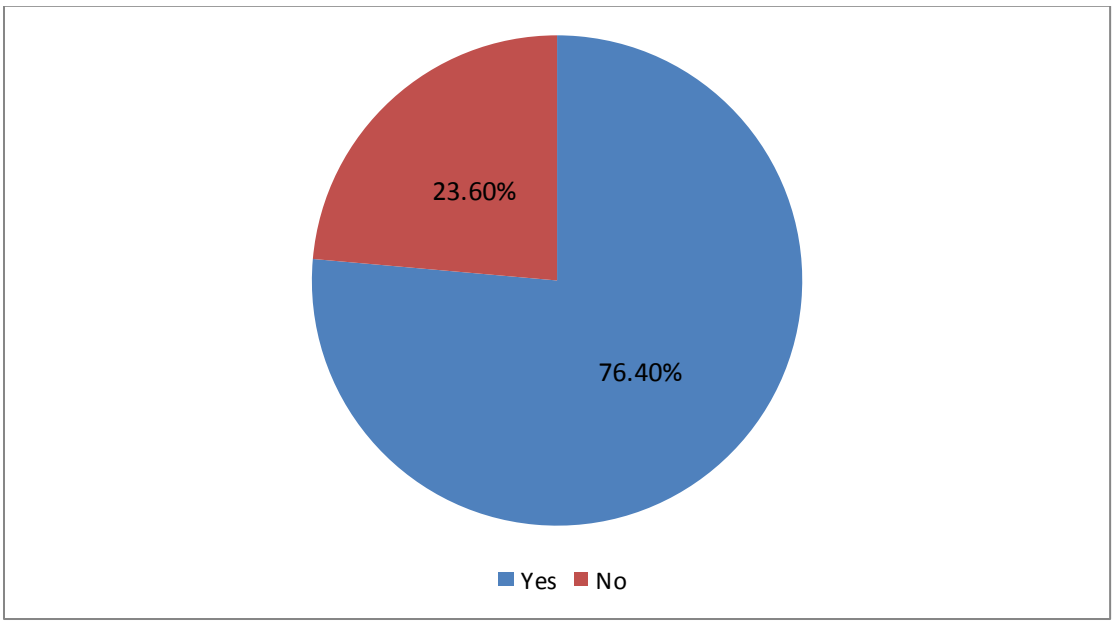
PATENCY OF ADITUS

In our study of89 cases, aditus was patent in 68 cases (76.4%) and was blocked in 21 cases (23.6%).

Table 8: Percentage distribution of patency of aditus.

Patency of Aditus	No. of Patients	Percentage
Yes	68	76.4
No	21	23.6
Total	89	100.0

Graph 8: Percentage distribution of patency of aditus.



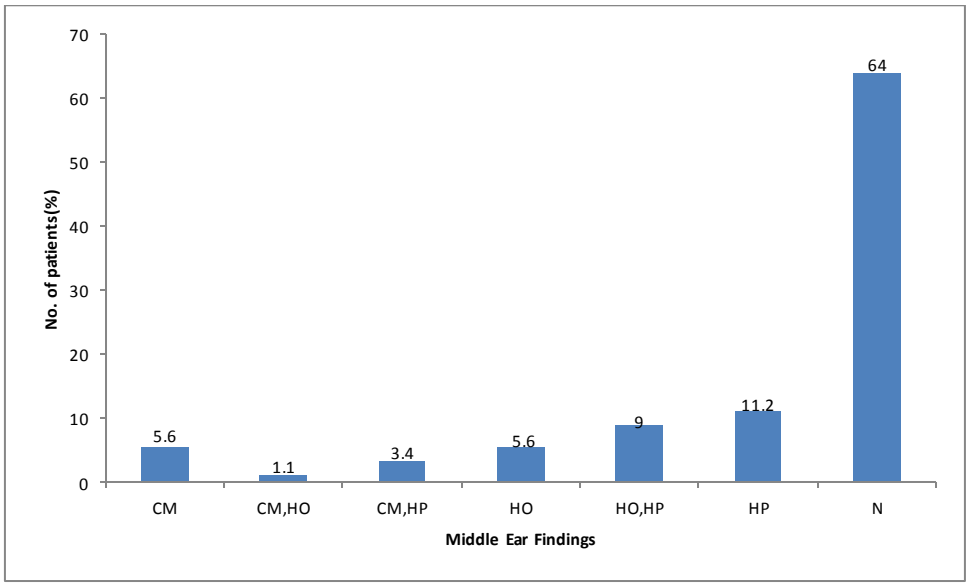
MIDDLE EAR FINDINGS

In our study of 89 cases, the middle ear findings were congested mucosa over promontory in 5 cases (5.6%), congested mucosa over promontory and hypertrophied mucosa over ossicles in 1 case (1.1%), congested mucosa over promontory and hypertrophied mucosa over promontory in 3 cases (3.4%), hypertrophied mucosa over ossicles in 5 cases (5.6%), hypertrophied mucosa over promontory and hypertrophied mucosa over ossicles in 8 cases (9%), hypertrophied mucosa over promontory in 10 cases (11.2%) and middle ear findings were normal in 57 cases (64%).

Table 9: Percentage distribution in middle ear findings.

Middle Ear Findings	No. of Patients	percentage
CM	5	5.6
CM,HO	1	1.1
CM,HP	3	3.4
HO	5	5.6
HO,HP	8	9
HP	10	11.2
N	57	64.0
Total	89	100.0

Graph 9: Percentage distribution in middle ear findings.



ASSOCIATION BETWEEN MIDDLE EAR FINDINGS AND PATENCY OF ADITUS

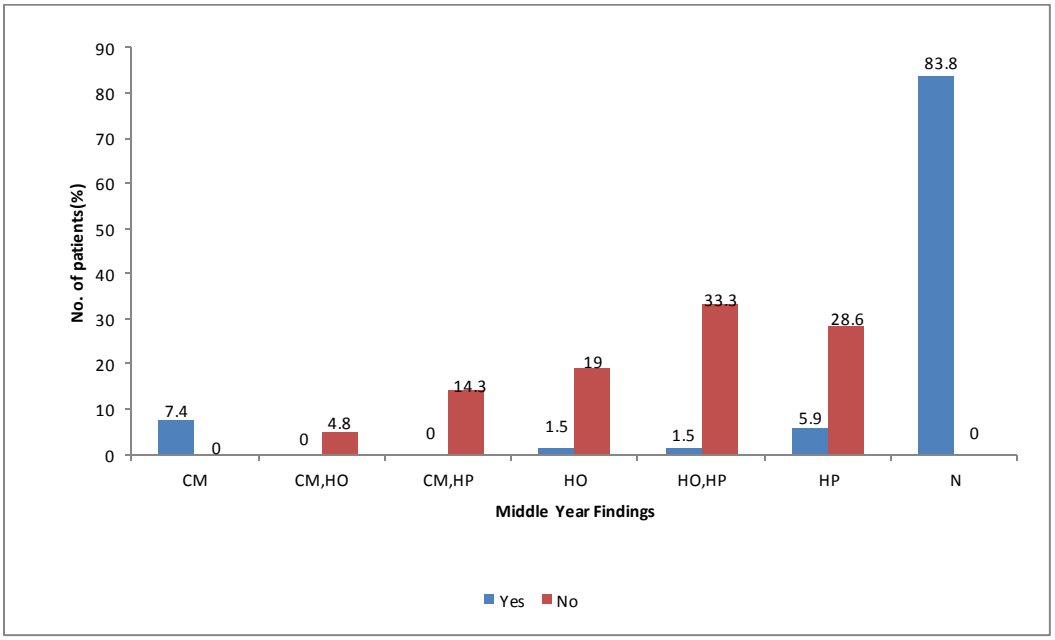
In 89 cases of our study, aditus was found blocked in 21 cases (23.6%) in which the middle ear findings were congested middle ear mucosa and hypertrophied mucosa over ossicles in 1 case (4.8%), congested mucosa over promontory and hypertrophied mucosa over promontory in 3 cases (14.3%), hypertrophied mucosa over ossicles in 4 cases (19%), hypertrophied mucosa over promontory and hypertrophied mucosa over ossicles in 7 cases (33.3%), hypertrophied mucosa over promontory in 6 cases (28.6%).

Our study showed significant chi square test with p value = 0.0001*.

Table 10: Association between Middle Ear Findings and Patency of Aditus.

Middle Ear Findings	Patency of Aditus			Chi square test
	Yes (%)	No(%)	Total	
CM	5(7.4%)	0	5(5.6%)	P=0.0001*
CM,HO	0	1(4.8%)	1(1.1%)	
CM,HP	0	3(14.3%)	3(3.4%)	
HO	1(1.5%)	4(19.0%)	5(5.6%)	
HO,HP	1(1.5%)	7(33.3%)	8(9%)	
HP	4(5.9%)	6(28.6%)	10(11.2%)	
N	57(83.8%)	0	57(64%)	
Total	68(100%)	21(100%)	89(100%)	

Graph 10: Association between Middle Ear Findings and Patency of Aditus



Association between Middle Ear Findings and Years of discharge

In our study of 89 cases, the association between the number of years of ear discharge and the middle ear findings were the following. In less than 5 years of ear discharge the findings were congested mucosa over promontory in 1 case (2.0%), congested mucosa over promontory and hypertrophied mucosa over ossicles in 1 case (2.0%), congested mucosa over promontory and hypertrophied mucosa over promontory in 2 cases (3.9%), hypertrophied mucosa over ossicles in 2 cases (3.9%), hypertrophied mucosa over promontory and hypertrophied mucosa over ossicles in 3 cases (6.8%), hypertrophied mucosa over promontory in 6 cases (11.8%) and middle ear findings were normal in 36 cases (70.6%).

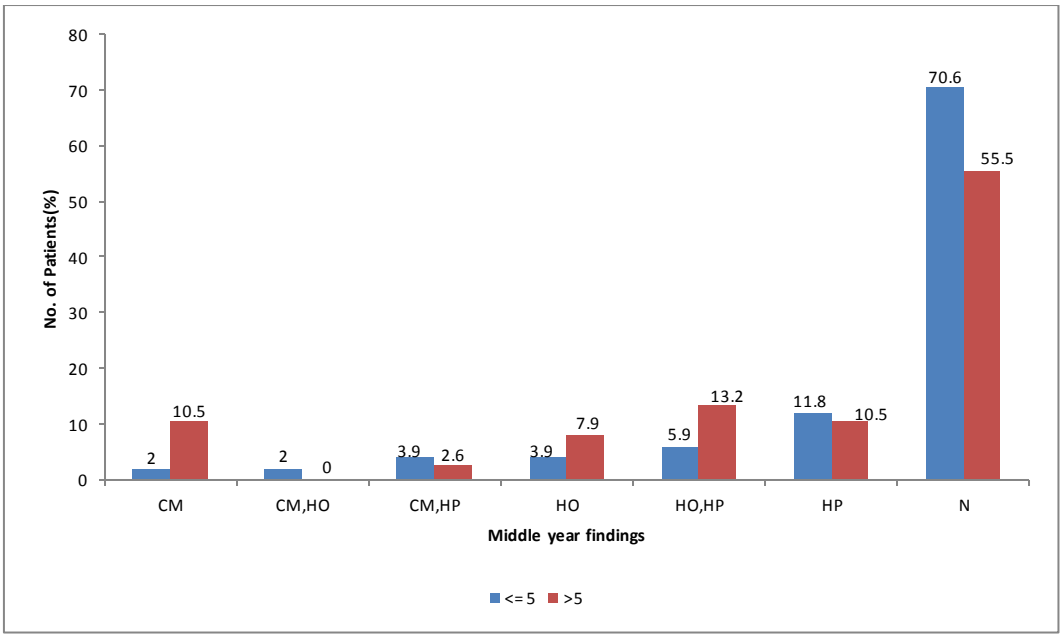
In ears discharging more than 5 years, the findings were congested mucosa over promontory in 4 cases (10.5%), congested mucosa over promontory and hypertrophied mucosa over promontory in 1 cases (2.6%), hypertrophied mucosa over ossicles in 3 cases (7.9%), hypertrophied mucosa over promontory and hypertrophied mucosa over ossicles in 5 cases (13.2%), hypertrophied mucosa over promontory in 4 cases (10.5%) and middle ear findings were normal in 21 cases (55.5%).

The p value according to Chi Square test = 0.539, which is insignificant.

Table 11: Association between Middle Ear Findings and Years of discharge

Middle Ear Findings	Years of discharge			Chi square test
	<= 5 N(%)	>5 N(%)	Total N(%)	
CM	1(2.0%)	4(10.5%)	5(5.6%)	P=0.539 NS
CM,HO	1(2.0%)	0	1(1.1%)	
CM,HP	2(3.9)	1(2.6%)	3(3.4%)	
HO	2(3.9)	3(7.9%)	5(5.6%)	
HO,HP	3(5.9)	5(13.2%)	3(3.4%)	
HP	6(11.8)	4(10.5)	10(11.2%)	
N	36(70.6%)	21(55.5)	57(64%)	
Total	51(100%)	38(100%)	89(100%)	

Graph 11: Association between Middle Ear Findings and Years of discharge



ASSOCIATION BETWEEN THE MIDDLE EAR FINDINGS AND SIZE OF PERFORATION

In our study of 89 cases, medium central perforation were 30 cases, large central perforations were 26 cases, small central perforations were 25 cases, and subtotal perforations were 8 cases with not significant chi square test value of p = 0.378 for the association in between the middle ear findings and the size of perforation.

In large central perforation, the middle ear findings of hypertrophied mucosa over promontory was present in more cases – 2 (7.7%).

In medium central perforation, hypertrophied mucosa over promontory and ossicles was found in more cases – 4 (13.3%).

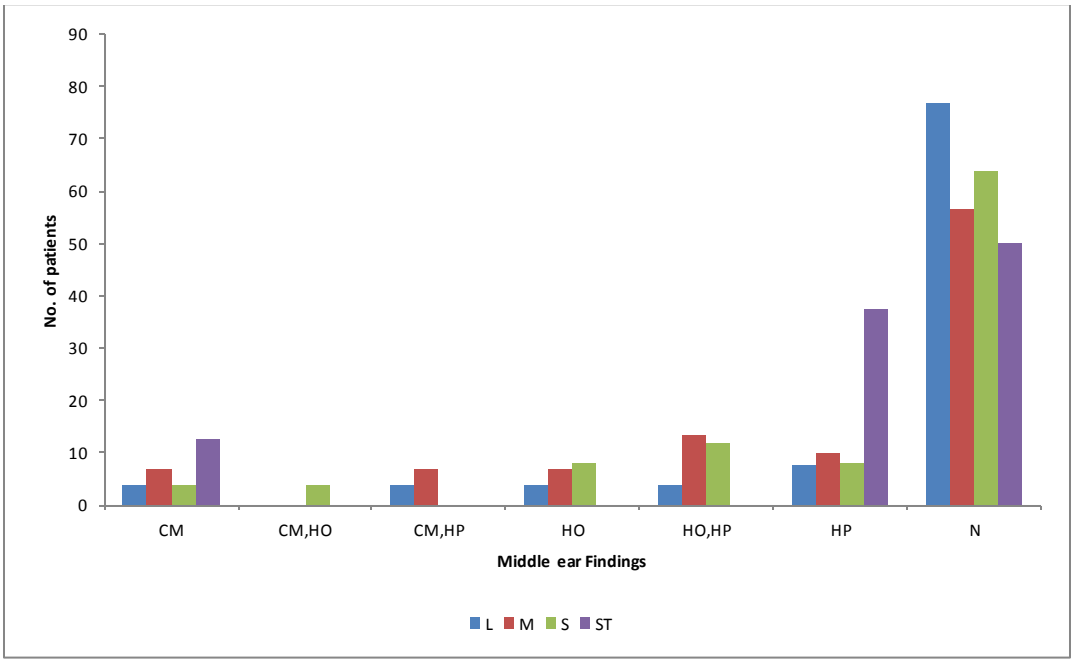
In small central perforation, hypertrophied mucosa over promontory and ossicles was found in more cases – 3 (12%).

In subtotal central perforation, hypertrophied mucosa over promontory was found in more cases – 3 (37.3%).

Table 12 : Association between Middle Ear Findings and Size of perforation.

Middle Ear Findings	Size of perforation					Chi square test
	N(%)	N(%)	N(%)	N(%)	N(%)	
	L	M	S	ST	Total	
CM	1(3.8)	2(6.7)	1(4)	1(12.5)	5(5.6%)	
CM,HO	0	0	1(4)	0	1(1.1%)	
CM,HP	1(3.8)	2(6.7)	0	0	3(3.4%)	P=0.378
HO	1(3.8)	2(6.7)	2(8)	0	5(5.6%)	NS
HO,HP	1(3.8)	4(13.3)	3(12)	0	8(9%)	
HP	2(7.7)	3(10)	2(8)	3(37.5)	10(11.2%)	
N	20(76.9)	17(56.7)	16(64)	4(50)	57(64%)	
Total	26(100)	30(100)	25(100)	8(100)	89(100%)	

Graph 12: Association between Middle Ear Findings and Size of perforation



DISCUSSION

Age distribution

Our study included patients within the age group of 11-60 years with a mean age of 30.87 and SD of 14.132. Majority of the patients were in the age group of 11 to 20 years followed by 31 to 40 years with 32.6% and 20.2% respectively.

This is in contrast to the study by Ortegren, where the maximum number of patients were in the age group of >40 years [22].

Sex distribution

Thomasan PC et al in their study of 26 cases , male to female ratio was 1.36[23]. Mathai J in his study of 200 cases, the male to female ratio was 1.85 [24]. In our present study of 89 cases we had 50 males and 39 females with male to female ratio of 1.28 which is almost similar to above literature.

Years of ear discharge

In our study, 51 cases (57.3%) had ear discharge of <= 5 years, 38 cases(42.7%) had ear discharge for > 5 years.

Ear involved

Jackler R K et al in their study of 48 patients BL tympanic membrane perforation was seen in 25% of patients [25]. Booth J B in his study of 284 cases, found the incidence of BL disease to be 30 %.[26]

In our study of 89 cases, 25 cases (28%) were having BL disease and 64 cases (72%) were having UL disease. This is in similarity with the above quoted literature.

Operated side

Out of 89 cases of our study, we had 54 cases (60.7%) who were operated on left side and 35 cases (39.3%) on right side.

Size of perforation

Kumar N et al in their study reported that out of 64 cases of COM, 6 cases (9.4%) had perforation size <25%, 28 cases (43.7%) had perforation size of 25-50%, 9 cases (14%) has perforation size of 51-75% and 21 cases (32.8%) had peroration size of >75%.[27]

In our study of 89 cases, 25 cases (28%) had small perforation, 30 cases (33.8%) had medium cental perforation, 26 cases (29.2%) had large central perforation and 8 cases (9%) had subtotal perforations in contrast to the above study.

Mastoid status

In our study of 89 cases, the mastoid status in 23 cases (25.8%) was diploic, 29 cases (32.6%) was pneumatized and 37 cases (41.6%) was sclerosed.

Patency of aditus

Mohammed Bhagat, in the study of 50 adult patients with tubotympanic CSOM, without evidence of cholesteatoma, after adequate medical control of otorrhoea, tympanoplasty with cortical mastoidectomy was done to see patency of the aditus ad antrum, 20% had a blocked aditus. The status of middle ear was not assessed in their study. Marginal and subtotal central perforations and the presence of myringosclerosis increase the probability of an obstructed aditus ad antrum[9].

In 89 cases, aditus was patent in 68 cases (76.4%) and was blocked in 21 cases (23.6%) similar to the above study.

Middle ear findings

Ruhl and Pensak suggested that mastoidectomy should be considered in presence of congested, polypoidal, moist, or discharging ear[3]. This may improve the success rate of surgery.

In our study of 89 cases, Middle ear findings were congested mucosa over promontory in 5 cases (5.6%), congested mucosa over promontory and hypertrophied mucosa over ossicles in 1 case (1.1%), congested mucosa over promontory and hypertrophied mucosa over promontory in 3 cases (3.4%), hypertrophied mucosa over ossicles in 5 cases (5.6%), hypertrophied mucosa over promontory and hypertrophied mucosa over ossicles in 8 cases (9%), hypertrophied mucosa over promontory in 10 cases (11.2%) and middle ear findings were normal in 57 cases (64%).

Association between middle ear findings and patency of aditus

Ruhl and Pensak suggested that mastoidectomy should be considered in presence of congested, polypoidal , moist or discharging ear but all cases may not be associated with blocked aditus ad antrum[3].

In 89 cases of our study, aditus was found blocked in 21 cases (23.6%) associated with middle ear findings like congested middle ear mucosa and hypertrophied mucosa over ossicles in 1 case (4.8%), congested mucosa over promontory and hypertrophied mucosa over promontory in 3 cases (14.3%), hypertrophied mucosa over ossicles in 4 cases (19%), hypertrophied mucosa over promontory and hypertrophied mucosa over ossicles in 7 cases (33.3%), hypertrophied mucosa over promontory in 6 cases (28.6%).

Our study showed significant chi square test with p value = 0.0001*.

Association between Middle Ear Findings and Years of discharge

In our study of 89 cases, the association between the number of years of ear discharge and the middle ear findings were as below, less than 5 years of ear discharge the findings were congested mucosa over promontory in 1 cases (2.0%), congested mucosa over promontory and hypertrophied mucosa over ossicles in 1 case (2.0%), congested mucosa over promontory and hypertrophied mucosa over

promontory in 2 cases (3.9%), hypertrophied mucosa over ossicles in 2 cases (3.9%), hypertrophied mucosa over promontory and hypertrophied mucosa over ossicles in 3 cases (6.8%), hypertrophied mucosa over promontory in 6 cases (11.8%) and middle ear findings were normal in 36 cases (70.6%).

In ears discharging more than 5 years, the findings were congested mucosa over promontory in 4 cases (10.5%), congested mucosa over promontory and hypertrophied mucosa over promontory in 1 cases (2.6%), hypertrophied mucosa over ossicles in 3 cases (7.9%), hypertrophied mucosa over promontory and hypertrophied mucosa over ossicles in 5 cases (13.2%), hypertrophied mucosa over promontory in 4 cases (10.5%) and middle ear findings were normal in 21 cases (55.5%).

The chi square test showed p value =0.539 which is insignificant, inferring that the association between the middle ear findings and years of ear discharge was not related.

Association between the middle ear findings and size of peroration

Mohammed Bhagat, in the study of 50 adult patients with tubotympanic CSOM, without evidence of cholesteatoma, after adequate medical control of otorrhoea, tympanoplasty with cortical mastoidectomy was done and the patency of the aditus ad antrum was seen, 20% had a blocked aditus. Marginal and subtotal central perforations and the presence of myringosclerosis increase the probability of an obstructed aditus and antrum[9].

In our study of 89 cases, medium central perforation were 30 cases, large central perforations were 26 cases, small central perforations were 25 cases, and subtotal perforations were 8 cases with not significant chi square test value of p = 0.790 for the association in between the middle ear findings and the size of perforation.

According to Raul and Pensak, some type of mastoidectomy may be needed to improve the success rate in failed tympanoplasty cases for noncholesteomatous COM. This is again of importance to note that exploration of mastoid is necessary.

Limitations:

1. Our study had relatively smaller sample size.
2. Follow up with success rate would have been determined in our cases.

Further studies are required by taking a larger sample size and comparision of middle ear findings in all tympanoplasty cases with and without exploration of antrum.

CONCLUSION

Sometimes tympanoplasty along with cortical mastoidectomy is required for patients of chronic otitis media – tubotympanic disease even with dry ear after two courses of antibiotics. The aditus blockage reduces the success rate of tympanoplasty when cortical mastoidectomy is not done.

The aditus block was observed in cases where the middle ear findings showed hypertrophied middle ear mucosa over promontory, hypertrophied mucosa over ossicles and congested mucosa. This shows that cortical mastoidectomy and clearance of the aditus block must be considered in the cases of above middle ear findings.

SUMMARY

The study **"IDENTIFICATION OF INDICATORS FOR EXPLORING MASTOID ANTRUM IN TYPE 1 TYMPANOPLASTY FOR TUBOTYMPANIC DISEASE"** was done in Shri B M Patil Medical college, hospital and research centre, Vijayapura during the period of December 2016 to August 2018.

A total of 89 patients were selected based on the inclusion criteria for the study to find out the indicators to open the antrum in all type 1 tympanoplasty.

Of the 89 cases the age group of patients varied from 11 to 60 years. There were 50 males and 39 female patients. BL COM was seen in 25 cases and UL COM in 64 cases.

Of the 89 cases, 25 cases had small perforation, 30 cases had medium central perforation, 26 cases had large central perforation and 8 cases had subtotal perforations.

Out of 89 cases of our study, we had 54 cases who were operated on left side and 35 cases on right side. The mastoid status in 23 cases was diploic, 29 cases was pneumatized and 37 cases was sclerosed. The aditus was patent in 68 cases and was blocked in 21 cases.

In 89 cases of our study, aditus was found blocked in 21 cases (23.6%) in which the middle ear findings were hypertrophied mucosa over promontory and hypertrophied mucosa over ossicles in 7 cases (33.3%), hypertrophied mucosa over promontory in 6 cases (28.6%), hypertrophied mucosa over ossicles in 4 cases (19%), congested mucosa over promontory and hypertrophied mucosa over promontory in 3 cases (14.3%), congested middle ear mucosa and hypertrophied mucosa over ossicles in 1 case (4.8%).

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ANNEXURE – I

ETHICAL CLEARANCE CERTIFICATE

B.L.D.E. UNIVERSITY'S
SHRI.B.M.PATIL MEDICAL COLLEGE, BIJAPUR-586 103
INSTITUTIONAL ETHICAL COMMITTEE

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 04-10-2016 at 03pm to scrutinize the Synopsis of Postgraduate Students of this college from Ethical Clearance point of view. After scrutiny the following original/corrected & revised version synopsis of the Thesis has been accorded Ethical Clearance.

Title "Identification of Predicators for opening Mastoid antrum in type I tympanoplasty for hibotympanic disease."

Name of P.G. student Dr. Samyiddhi
Dept of Otorhinolaryngology.

Name of Guide/Co-investigator Dr H.T. Lathadevi.
Prof, of ENT.

DR.TEJASWINI. VALLABHA
CHAIRMAN
INSTITUTIONAL ETHICAL COMMITTEE
BLDEU'S, SHRI.B.M.PATIL
MEDICAL COLLEGE, BIJAPUR.

Following documents were placed before E.C. for Scrutinization
1) Copy of Synopsis/Research project.
2) Copy of informed consent form
3) Any other relevant documents.

ANNEXURE – II

SCHEME OF CASE TAKING

1) NAME: CASE NO:

2) AGE: IP NO:

3) SEX: DOA:

4) RELIGION: DOS:

5) OCCUPATION: DOD:

6) RESIDENCE:

7) CHIEF COMPLAINTS:

8) HISTORY OF PRESENTING ILLNESS:

9) PAST HISTORY:

- Diabetes mellitus
- Hypertension
- History of any previous surgery.

Course of antibiotics

1.

2.

10) FAMILY HISTORY:

11) GENERAL PHYSICAL EXAMINATION:

Pallor:	Present/Absent
Icterus:	Present/Absent
Clubbing:	Present/Absent
Generalized Lymphadenopathy:	Present/Absent
Build:	Poor/Medium /Well
Nourishment:	Poor / Medium / Well

12) VITALS

PR:

BP:

RR:

Temp:

13) OTHER SYSTEMIC EXAMINATION:

- Respiratory System
- Cardiovascular System
- Central Nervous System
- Per Abdomen examination

14) LOCAL EXAMINATION

- EAR Right Left
  - Pinna
  - Pre auricular area
  - Post auricular area
  - Infra auricular area

- External auditory canal

- Tympanic membrane

  Pars Tensa

  Pars flaccida

  Middle ear mucosa

- Mastoid Tenderness
- Fistula sign
- Tragal Tenderness
- Facial nerve function
- Nystagmus
- Tuning Fork test

  Rinnes

  Webers

  ABC

- NOSE
- ORAL CAVITY
- OROPHARYNX

15) INVESTIGATION:

BLOOD ROUTINE: URINE ROUTINE:

X RAY: BILATERAL MASTOID

PURE TONE AUDIOMETRY:

- Pre Operative – Air Bone Gap

16) FINAL DIAGNOSIS:

17) SURGERY: **Intra operative findings**:-

Type of perforation -

Ossicle chain – intact / discontinuty

Middle ear mucosa- hypertrophied / normal

Patency of aditus- yes/ no

Patency of Eustachian tube- yes/ no

Mastoid air cells-

Additional findings

19) INFERENCE:

20) COMMENTS:

ANNEXURE –III

INFORMED CONSENT FORM

BLDE (DEEMED TO BE UNIVERSITY) SHRI B. M. PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTRE, BIJAPUR- 586103

TITLE OF THE PROJECT - IDENTIFICATION OF INDICATORS FOR OPENING MASTOID ANTRUM IN TYPE 1 TYMPANOPLASTY FOR TUBOTYMPANIC DISEASE

PG STUDENT - Dr. SAMRIDDHI
DEPARTMENT OF
OTORHINOLARYNGOLOGY

PG GUIDE - Dr. H.T.LATHADEVI
PROFESSOR
DEPARTMENT OF
OTORHINOLARYNGOLOGY
SHRI B. M. PATIL MEDICAL COLLEGE
HOSPITAL AND RESEARCH CENTRE,
BIJAPUR – 586103

All aspects of this consent form are explained to the patient in the language understood by him/her.

1) PURPOSE OF RESEARCH:

I have been informed about this study. I have also been given a free choice of participation in this study.

2) PROCEDURE:

I am aware that in addition to routine care received I will be asked series of questions by the investigator. I have been asked to undergo the necessary investigations and treatment, which will help the investigator in this study

3) RISK AND DISCOMFORTS:

I understand that I may experience some pain and discomfort during the examination or during my treatment. This is mainly the result of my condition and the procedure of this study is not expected to exaggerate these feelings that are associated with the usual course of treatment.

4) BENEFITS:

I understand that my participation in this study will help to patients survival and better outcome.

5) CONFIDENTIALITY:

I understand that the medical information produced by this study will become a part of Hospital records and will be subject to the confidentiality and privacy regulation. Information of a sensitive personal nature will not be a part of the medical records, but will be stored in the investigator's research file and identified only by a code number. The code-key connecting name to numbers will be kept in a separate location.

If the data are used for publication in the medical literature or for teaching purpose, no name will be used and other identifiers such as photographs and audio or videotapes will be used only with my special written permission. I understand that I may see the photographs and videotapes and hear the audiotapes before giving this permission.

6) REQUEST FOR MORE INFORMATION:

I understand that I may ask more questions about the study at anytime. **Dr. SAMRIDDHI** is available to answer my questions or concerns. I understand that I will be informed of any significant new findings discovered during the course of the study, which might influence my continued participation.

If during the study, or later, I wish to discuss my participation in or concerns regarding this study with a person not directly involved, I am aware that the social worker of the hospital is available to talk with me. A copy of this consent form will be given to me to keep for careful reading.

7) REFUSAL OR WITHDRAWAL OF PARTICIPATION:

I understand that my participation is voluntary and that I may refuse to participate or may withdraw consent and discontinue participation in the study at any time without prejudice to my present or future care at this hospital. I also understand that **Dr. SAMRIDDHI** may terminate my participation in the study after she has explained the reasons for doing so and has helped arrange for my continued care by my own physician or physical therapist, if this is appropriate.

8) INJURY STATEMENT:

I understand that in the unlikely event of injury to me resulting directly from my participation in this study, if such injury were reported promptly, the appropriate treatment would be available to me, but no further compensation would be provided. I understand that by my agreement to participate in this study I am not waiving any of my legal rights.

I have explained to _____the purpose of the research, the procedures required and the possible risks and benefits to the best of my ability in patient's own language.

_____ _____

Dr. SAMRIDDHI Date

(Investigator)

STUDY SUBJECT CONSENT STATEMENT

I confirm that **Dr. SAMRIDDHI** has explained to me the purpose of research, the study procedures that I will undergo, and the possible risks and discomforts as well as benefits that I may experience in my own language. I have read and I understand this consent form. Therefore, I agree to give consent to participate as a subject in this research project.

_____ _____

Participant / Guardian Date

_____ _____

Witness to signature Date

ANNEXURE – V

KEY TO MASTER CHART

SL.No.	-	Serial Number
IP No.	-	In patient Number
UL	-	Unilateral
BL	-	Bilateral
OS	-	Operated side
L	-	Left
R	-	Right
SOP	-	Size of Perforation
S	-	Small
L	-	Large
M	-	Medium
ST	-	Sub Total
PT	-	Pure tone audiometry
P	-	Pneumatised
S	-	Sclerosed
N	-	Normal
HP	-	Hypertrophied mucosa over promontory.
HO	-	Hypertrophied mucosa around ossicles.
CM	-	Congested mucosa over promontory.
NS	-	Not significant

MASTER CHART

Sl No	Name	IP No	Age	Sex	Years of discharge	UL/BL	Operated side	Size of perforation	PTA	Mastoid Status	Patency of Aditus	Middle Ear Findings
1	Sahil	77	15	F	2	UL	R	S	20	P	Y	N
2	Soumya S	2235	20	F	5	UL	L	M	25	S	Y	N
3	Sanjay	3633	32	M	1.5	BL	R	M	15	S	N	HP
4	Sadanand	6856	49	M	2	UL	L	L	30	P	Y	CM
5	Deepa V S	7961	36	F	1	BL	L	M	30	P	Y	N
6	Hemanth	10592	36	M	7	UL	L	ST	35	S	Y	N
7	Roopa	13865	26	F	5	BL	L	M	20	S	Y	N
8	Sangamesh	14369	58	M	3	UL	L	S	10	D	N	HP,HO
9	Santhbai	14287	50	F	1	UL	L	S	15	P	Y	N
10	Udaykumar	14519	44	M	1	UL	L	S	20	P	Y	N
11	Laxmi	14860	20	F	7	UL	R	M	20	D	N	HP,HO
12	Rudresh	15005	17	M	2	BL	R	M	20	P	Y	N
13	Renuka	15010	31	F	2	UL	L	M	15	P	Y	N
14	Neelamma	15580	32	F	3	UL	L	M	25	D	Y	N
15	Mahalingappa	16007	35	M	1	UL	L	S	10	D	Y	N
16	Beerappa	16218	16	M	2	BL	R	L	30	P	N	HO
17	Pradeep G K	16559	9	M	5	BL	L	S	15	S	Y	N
18	Bheembai	17729	60	F	25	UL	L	L	18	S	Y	N
19	Shreedevi	17730	12	F	3	BL	R	M	10	S	Y	N
20	Basavaraj	18056	24	M	4	UL	L	M	10	D	N	HO,HP
21	Umesh R S	18533	45	M	15	UL	L	L	25	S	Y	N
22	Madan	1884	12	M	2	UL	L	S	15	D	N	HP
23	Denvedra	19623	41	M	22	BL	R	L	15	S	Y	N
24	Devamma	19886	41	F	13	UL	L	ST	30	S	Y	N

25	Ishawarya	17701	20	F	15	UL	R	L	30	S	Y	N
26	Anil	20057	17	M	10	BL	L	L	25	S	Y	N
27	Ayyappa S P	19882	13	M	6	UL	L	M	20	D	Y	N
28	Rajani V W	21897	25	F	6	UL	L	M	10	D	Y	CM
29	Subhash	22030	60	M	15	UL	L	L	20	S	YY	N
30	Keerti	23167	13	F	2	BL	R	S	15	D	Y	N
31	Shrikanth	23467	23	M	12	BL	R	S	15	S	N	HO,HP
32	Kashibai	23442	17	F	3	UL	R	L	35	P	Y	N
33	Razak	23794	19	M	4	UL	L	ST	35	S	Y	N
34	Anandkumar	25162	34	M	18	UL	R	L	25	S	Y	N
35	Kalavati	25281	20	F	2	UL	L	M	20	P	Y	N
36	Sangamesh	25510	13	M	1	UL	R	M	15	D	N	HO
37	Nagaraj	25777	51	M	4	UL	L	L	25	S	Y	N
38	Boramma	26902	18	F	4	UL	R	S	20	D	Y	N
39	Bhagyashree	26246	9	F	7	BL	R	M	15	D	Y	HP
40	Sakubai R	28278	40	F	20	UL	R	M	10	S	Y	HO
41	Mahananda	28827	40	F	2	UL	R	M	25	P	N	HP
42	Umesh	908	24	M	2	UL	R	M	20	P	Y	N
43	Laxmi	3163	18	F	3	UL	L	L	20	P	Y	N
44	Harindra MS	4328	32	M	5	UL	L	M	15	D	Y	N
45	Ananad	44580	45	M	30	BL	L	L	25	S	Y	HP,HO
46	Gouranna	6312	30	M	23	UL	R	L	15	D	N	CM,HP
47	Gurusiddavva	6346	50	F	1	UL	L	S	20	P	Y	N
48	Kantesh	7399	46	M	1	BL	R	S	15	P	Y	N
49	Roopa	8759	14	F	2	BL	L	S	15	S	Y	N
50	Renuka M	18343	25	F	7	UL	R	M	20	P	N	HO,HP
51	Prakash	19399	38	M	9	BL	L	L	30	S	Y	N
52	Parvati	20954	21	F	8	BL	R	M	20	S	Y	CM

53	Pooja	21323	20	F	6	UL	L	M	25	D	Y	N
54	Prasad	21650	41	M	5	UL	L	L	25	P	Y	HP
55	Sushilabai	21684	30	F	3	UL	L	L	15	D	Y	N
56	Sachin	25011	18	M	6	UL	L	S	20	P	Y	N
57	Jayshree	25253	52	F	7	UL	L	S	10	S	Y	CM
58	Shekhar Loni	25257	59	M	2	UL	L	S	20	P	Y	N
59	Uma	27136	35	F	8	UL	L	L	35	S	Y	N
60	Sunil	28428	11	M	8	BL	L	S	35	S	N	HP
61	Rohit	28785	40	M	6	UL	L	M	15	P	Y	N
62	Radika	30238	49	F	4	BL	L	L	15	P	Y	N
63	Ganesh G K	41082	13	M	3.5	BL	L	L	20	S	Y	N
64	Sachin B	41867	22	M	6	UL	L	S	12	S	N	HO
65	Ambrish	24779	19	M	3	UL	R	M	10	P	Y	N
66	Sunil A P	34737	23	M	8	BL	L	M	25	D	Y	N
67	Dasharat	39065	46	M	5	UL	R	S	20	P	Y	N
68	Faruq	32669	34	M	7	UL	L	S	15	D	Y	N
69	Yajanam	33405	50	M	3	UL	L	S	15	S	Y	N
70	Rameja	33926	35	F	2	UL	R	M	10	P	N	CM,HP
71	Ganesh	34554	11	M	1.5	UL	R	ST	35	P	Y	HP
72	Sunil	34737	23	M	4	UL	L	ST	25	D	Y	N
73	Ravi Mohan	35374	27	M	3	BL	L	M	20	P	Y	N
74	Bhavesh	39480	35	M	4	UL	R	L	40	P	Y	N
75	Basavaraj	40847	56	M	22	UL	L	ST	32	S	Y	CM
76	Neelabai	41227	25	F	2	UL	R	S	15	D	Y	N
77	Mahesh	37686	38	M	21	BL	L	ST	25	S	N	HP
78	Vijaylaxmi	1562	26	F	4	UL	L	L	25	S	Y	N
79	Laxman	6562	42	M	5	UL	R	S	20	P	N	CM,HO
80	Ashok N	8256	38	M	7	BL	L	L	15	P	Y	N

81	Rakesh	8533	19	M	10	UL	R	S	10	S	N	HO
82	Sarojini	11567	55	F	2	UL	L	S	20	S	N	HP,HO
83	Rudresh V N	16449	16	M	9	UL	R	L	15	D	Y	N
84	Pooja	16089	48	F	16	UL	L	M	15	D	N	HP,HO
85	Gurudevi	33483	41	F	22	UL	R	ST	30	S	Y	HP
86	Manjula	34321	21	F	4	UL	R	L	35	S	N	HP
87	Suramma	34620	28	F	7	UL	R	L	15	D	Y	N
88	Kiran	34628	11	M	1.5	UL	R	M	10	S	N	CM,HP
89	Mangalabai	43652	50	F	12	BL	L	M	15	S	Y	N