

A DESCRIPTIVE STUDY OF MANAGEMENT OF PAEDIATRIC CHOLESTEATOMA

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Abstract

Introduction: Chronic otitis media (COM) is an inflammatory process in the middle ear cleft that results in permanent changes in the tympanic membrane including atelectasis, dimer formation, tympanosclerosis, retraction pocket development, or cholesteatoma. There is variable involvement of ossicular chain. Chronic otitis media results from long-term eustachian tube dysfunction with a poorly aerated middle-ear space, multiple bouts of acute otitis media, chronic otitis media with effusion and persistent middle ear infections.

Materials and Methods: All patients under 18 years age diagnosed with cholesteatoma in outpatient department and inpatient at B.Y.L NAIR CHARITABLE HOSPITAL (from January 2018 to October 2018) who satisfied the inclusion and exclusion criteria were included in the study. Informed consent was taken from each patient or their guardian and study was explained to each one of them. Detailed clinical examination involving examination through otoscopic findings was performed. Patients were subjected to tuning fork tests like Rinne's and Weber's test along with pure tone audiometry as per standard care and protocol. Patients also underwent radiological evaluation like HRCT temporal bone.

Results: 53.33 % patients belonged in the age group of 13-18 years followed by children between 5-12 years were 40%. Female patients comprised 20 (66.67%) of the study. The ratio of male to female was 1:2. In 40 % patient's right side was involved, left side and both the ears were involved in 30%. Thus unilateral involvement was more common i.e. in 70% patients. The most common type of hearing loss seen was moderate conductive hearing loss, in 30% patients, followed by mild and moderately severe conductive hearing loss, in 26.67% patients.

Conclusion: In our study most patients presented with a long duration of disease which was due to lack of awareness in our country regarding the disease. During the initial presentations the patients were often evaluated by general physicians and not otorhinolaryngologists in primary and secondary centres. These patients usually received only symptomatic treatment initially and were referred to higher centre when the disease did not respond to the same. Hence by the time patients present to us, the disease was already extensive.

Key Words: Chronic otitis media, atelectasis, dimer formation, tympanosclerosis, retraction pocket development, or cholesteatoma.

INTRODUCTION

Chronic otitis media (COM) is an inflammatory process in the middle ear cleft that results in permanent changes in the tympanic membrane including atelectasis, dimer formation,

tympanosclerosis, retraction pocket development, or cholesteatoma. There is variable involvement of ossicular chain. Chronic otitis media results from long-term eustachian tube dysfunction with a poorly aerated middle-ear space, multiple bouts of acute otitis media, chronic otitis media with effusion and persistent middle ear infections.¹

Cholesteatoma is a cystic lesion formed from keratinizing stratified squamous epithelium, the matrix of which is composed of epithelium that rests on a stroma of varying thickness known as the perimatrix. The term cholesteatoma was coined first by Johannes Meuller in 1839. It was first noticed by Rudolf Virchow who called it a keratoma, other names attributed to this lesion were cholesteatoidcholesteatoma, Margaritoma etc.²

Cholesteatoma is a misnomer as the lesion does not contain cholesterol nor is it a tumour to merit the suffix “oma”. Abrahamson et al (1977) described cholesteatoma as a three dimensional sac lined by keratinising squamous epithelium with a keratin core, capable of conforming to the middle ear cleft and bone erosion and having a tendency to recur after removal.³

Classification of Chronic Otitis Media: Active Mucosal chronic otitis media, Inactive mucosal chronic otitis media, Active squamousal chronic otitis media, Inactive squamousal chronic otitis media, Healed otitis media.

The clinical presentation on chronic otitis media varies with the underlying severity of infection, the host response, and the time course over which it manifests. It is not uncommon for COM to be entirely asymptomatic, particularly in children who often do not complain of hearing loss. In general, the primary symptom of COM is conductive hearing loss, but also otalgia, otorrhea, aural fullness, pulsatile tinnitus and otorrhagia.⁴

Acquired cholesteatoma can be classified in two categories. The first is primary acquired cholesteatoma, which arises from a skin-lined retraction pocket within which retained keratin debris accumulates. The second type, the secondary acquired cholesteatoma, develops from an ingrowth of skin through a tympanic membrane perforation that is retained within the middle ear, mastoid, or both.⁵

In this study, the etiological factors, mode of presentation of cholesteatoma in pediatric population was evaluated, with special focus on the factors influencing the final outcome and the surgical management of this condition.

AIMS AND OBJECTIVES

1. To study the intraoperative findings and radiological (HRCT Temporal bone) findings.
2. To study the surgical technique in the management of this condition.

MATERIALS AND METHODS

Study design: single site, retrospective and prospective study tertiary healthcare centre.

The type of study: prospective + retrospective observational study

Study Period: 6 years

Retrospective Arm: 5 years (from January 2012 to March 2018)

Prospective Arm: 6 months (from March 2018 to October 2018)

Sample Size: 30

SETTING

This is a prospective and a retrospective observational study-

A) Prospective arm-

1. All patients under 18 years age diagnosed with cholesteatoma in outpatient department and inpatient at B.Y.L NAIR CHARITABLE HOSPITAL (from January 2018 to October 2018) who satisfied the inclusion and exclusion criteria were included in the study.
2. Informed consent was taken from each patient or their guardian and study was explained to each one of them.
3. Detailed clinical examination involving examination through otoscopic findings was performed.
4. Patients were subjected to tuning fork tests like Rinne's and Weber's test along with pure tone audiometry as per standard care and protocol. Patients also underwent radiological evaluation like HRCT temporal bone.

B) Retrospective Arm -

1. All the patients diagnosed with cholesteatoma and who have undergone surgical management for the same (satisfy the inclusion and exclusion criteria) at B.Y.L.Nair hospital from January 2012 to December 2017 were included in the study. The information of such patients were extracted from the operation register and the details of their presentation, investigation (PTA, HRCT) and surgical details were obtained from the medical records department and from the record of discharge summary maintained in the department of ENT. Waiver of consent were taken for the same.

2. Data were collected from operated patients who visit outpatient department for follow up after a valid, informed written consent is taken.

ASSESSMENT PARAMETERS: No evidence of residual or recurrent cholesteatoma 3 months post operative period.

DATA ANALYSIS: The data obtained from all the patients were entered into a worksheet. Since most of the data are descriptive in nature such as assessing the etiological factors, post operative hearing etc. The data were represented in form of tables, pie charts, frequency distribution curves etc. Data were analysed by appropriate statistical tests in consultation with a statistician.

RESULTS

Table 1: Age

AGE	Frequency	Percentage
Upto 5 Yrs	2	6.67%
Above 5 up to 12 Yrs	12	40.00%
13-18 Yrs	16	53.33%
Total	30	100.00%

53.33 % patients belonged in the age group of 13-18 years followed by children between 5-12 years were 40%.

Table 2: Gender distribution

Sex	Frequency	Percentage
Male	10	33.33%
Female	20	66.67%
Total	30	100%

Female patients comprised 20 (66.67%) of the study. The ratio of male to female was 1:2.

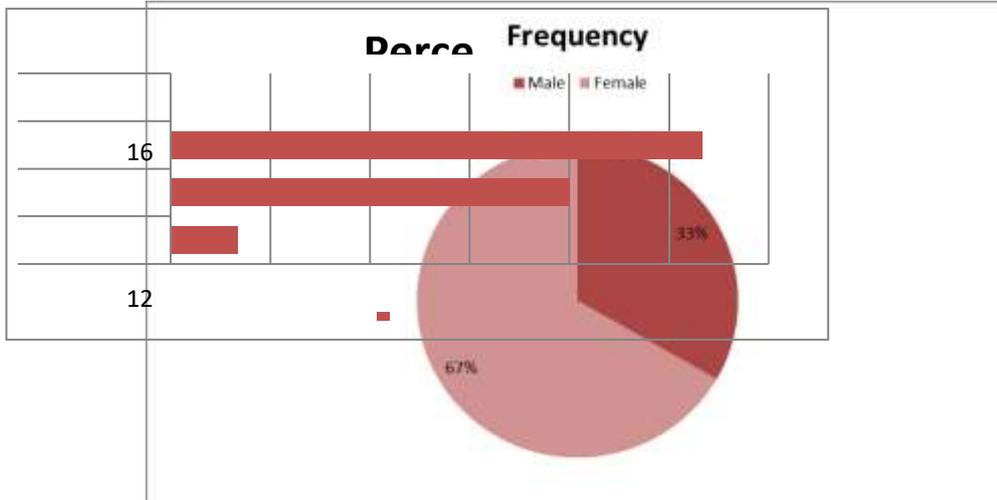


Table no.3: Side

SIDE	Frequency	Percent
B/L	9	30.00%
Left	9	30.00%
Right	12	40.00%
Total	30	100.00%

In 40 % patients right side was involved, left side and both the ears were involved in 30%. Thus unilateral involvement was more common i.e. in 70% patients.

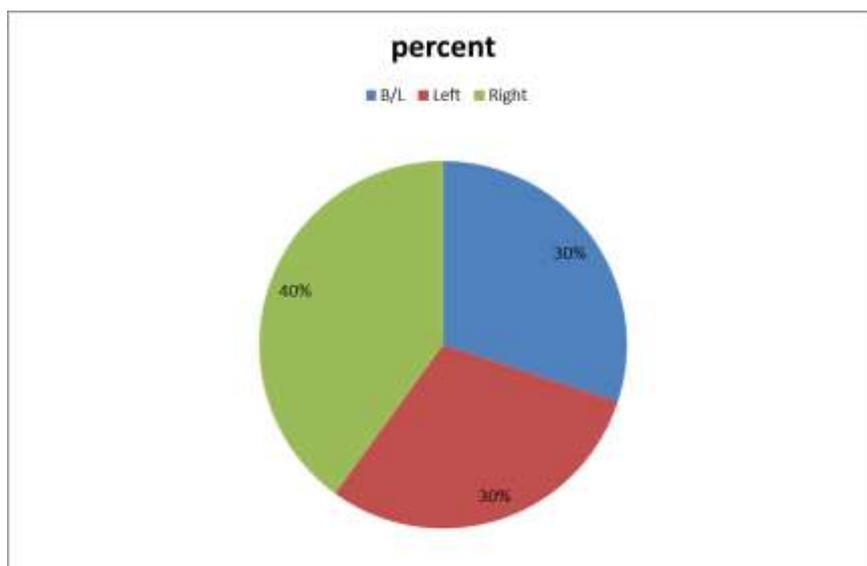
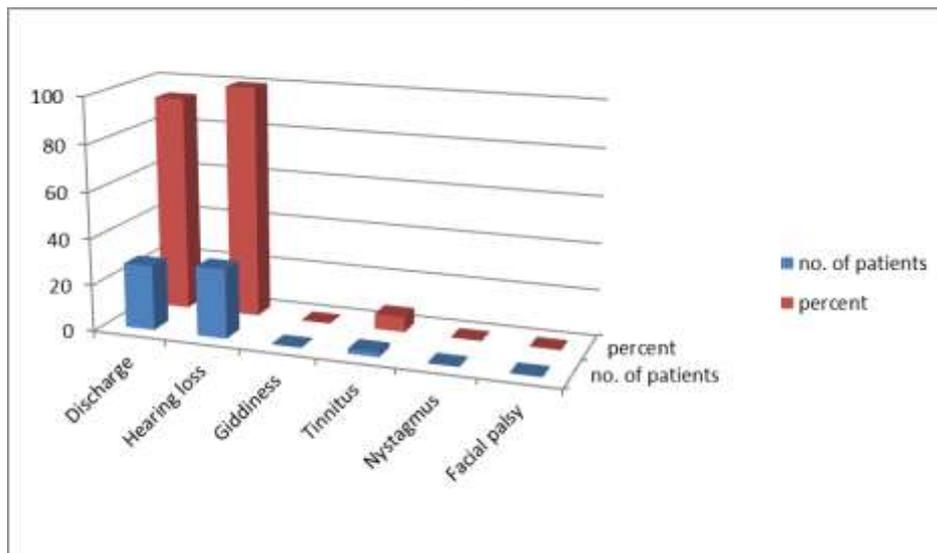


Table no.4: Findings

Findings	No. Of Pateints	Percentage
Discharge	28	93.33
Hearing loss	30	100
Giddiness	0	0
Tinnitus	2	6.67
Nystagmus	0	0
Facial palsy	0	0

The most common presenting feature was hearing loss, seen in 100% patients; followed by ear discharge in 93.335 patients.

Table 5: Discharge



Discharge character	No. of patients	Percentage
Purulent	19	63.33
Mucopurulent	11	36.33
Blood stained	10	33.33
Non blood stained	20	66.66
Scanty	22	73.33

Foul smelling	28	93.33
Continuous	27	90

The most common characteristic of ear discharge was purulence (63.33%), scantiness (73.33%) and foul-smelling (93.33%).

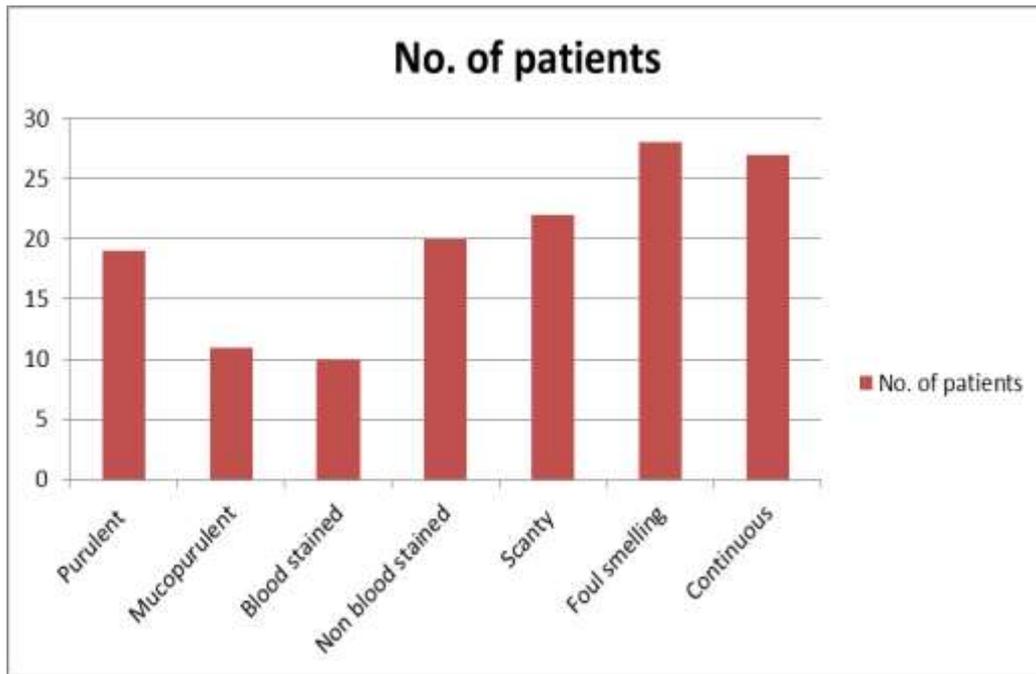


Table no.6: Duration of otorrhoea

Duration of otorrhoea	No. of Patients	Percentage
0-6months	3	10
6months-1 year	0	0
2yr-5years	11	36.33
6-10years	12	40
>10 years	4	13.33

Duration of otorrhoea was 6-10 years in 40% patients. Thus many patients presented with a long history of otorrhoea.

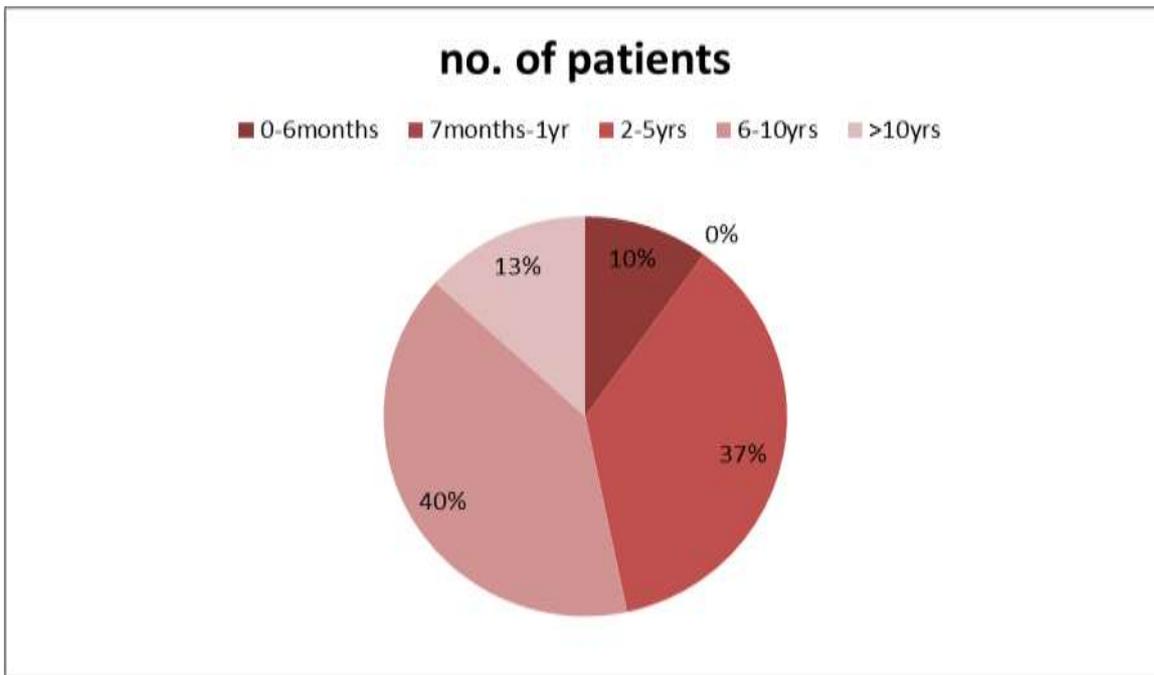


Table no. 7: HEARING LOSS

HEARING LOSS	Frequency	Percent
Mild CHL	8	26.67%
Mod CHL	9	30 %
Mod severe CHL	8	26.67%
Severe HL	3	10%
Profound HL	2	6.67%
Total	30	100.00%

The most common type of hearing loss seen was moderate conductive hearing loss, in 30% patients, followed by mild and moderately severe conductive hearing loss, in 26.67% patients.

Table no.8: Intra operative findings

Intra-operative findings	No.of patients	Perentage
Chol flakes	27	90
Chol flakes+granulations	3	10
Total	30	100

The most common intra-operative finding was cholesteatoma seen in 90% patients.

Table 9: Ossicular involvement intra-operatively

Finding	Malleus		Incus		Stapes	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Normal	16	53.33	0	0	18	60
Eroded	13	43.33	23	76.67	12	40
Absent	1	3.33	7	23.33	0	0
Total	30	100	30	100	30	100

The most common ossicle involved was Incus in 100% patients, followed by malleus in 47% patients.

Table no.10: X ray Mastoid findings

X-Ray	Frequency	Percentage
Sclerotic	23	76.67
Mixed	6	20
Pneumatic	1	3.33

The most common type of mastoid on x-ray was sclerotic in 76.67% patients followed by mixed type in 20% patients.

Table no.11: HRCT findings

HRCT Temporal Bone	No. of Patients	Percentage
Soft tissue	30	100
Ossicular discontinuity	30	100
Facial nerve dehiscence	4	13.33
Labyrinthine fistula	0	0

Dural plate erosion	3	10
Sinus plate erosion	2	6.67

Soft tissue and ossicular discontinuity was seen in 100% patients. Facial nervedehiscence was seen in 13.33% patients. Dural plate erosion and sinus plate erosion was seen in 10% and 6.67% patients respectively.

Table no.12: Extent of disease on HRCT Temporal bone

Site of disease	HRCT Temporal bone findings		Intra-operative findings	
	Frequency	Percent	Frequency	Percent
Middle ear and mastoid	25	83.33	25	83.33
Middle ear only	5	16.67	5	16.67
Mastoid only	0	0	0	0

Maximum patients i.e.83.33% showed both middle ear and mastoid involvement,whereas only middle ear was involved in only 16.67% patients.

Table no.13: Ossicular status comparison on HRCT Temporal bone and Intra-operatively

	CT Findings		Operative findings	
	frequency	percent	frequency	Percent
Malleus				
-Intact	16	53.33	16	53.33
-Eroded	13	43.33	13	43.33
-Absent	1	3.33	1	3.33
Incus				
-Intact Eroded	0	0	0	0
Absent	23	76.67	23	76.67

	7	23.33	7	23.33
Stapes				
-Intact Eroded	21	70	18	60
-Absent	9	30	12	40
	0	0	0	0

Malleus was eroded in 13 patients (43.33%) both on HRCT Temporal bone as well as intra-operatively.

Similarly incus was found to be eroded in 23 patients (76.67%) on HRCT Temporal bone and intra-operatively. It was found to be absent in 7 patients on HRCT Temporal bone and intra-operatively (23.33%).

Stapes erosion was seen in 9 patients (30%) on HRCT Temporal bone and in 12 patients (40%) intra-operatively. Facial nerve dehiscence was seen in 4 patients (13.33%) on HRCT Temporal bone and intra-operatively in 5 patients (16.67%). Lateral semicircular canal fistula was seen in 1 patient intra-operatively whereas it wasn't seen on HRCT Temporal bone.

Scutum erosion was observed in all 30 patients (100%) both on HRCT Temporal bone and intra-operatively. Erosion of dural plate was seen in 3 patients on HRCT Temporal bone, whereas intra-operatively it was seen in 2 patients. Sinus plate was observed in 2 patients both on HRCT Temporal bone and intra-operatively.

Table 14: Type of tympanoplasty

Type	Frequency	Percent
Type 3	17	56.67
Type 4	13	43.33
Total	30	100

DISCUSSION

This study is based on a total number of 30 patients (up to 18 years of age) having cholesteatoma and who underwent further management in the form of canal wall down mastoidectomy from January 2012 to October 2018.

Age distribution: In our study out of the total 30 patients, 16 patients were in the age group of 12-18 years of age.

Sex: In our study 20 patients were female i.e.(66.67%).

Side: Right side was involved more followed by left ear and bilateral sides and unilateral was more prevalent i.e. in 21 patients (70%) as compared to bilateral involvement in 9 patients i.e.30%.

Clinical features: The diagnosis of cholesteatoma is usually made on otologic finding. In our study

the most common finding was hearing loss , seen in 100% patients followed by discharge seen in 93.33%.(28 patients)

In contrast to our study, Sadé et al. found that a discharge was the first symptom in 62.0% of cases; hypoacusis was present in 11.0% of cases. Similar to our study, in a retrospective study done by Simon C. Parisier et al (1988), the most common presenting symptoms were otorrhoea (73%), hearing loss (85%), otalgia (32%), tinnitus (8%) and vertigo (8%). Only (0.8%) presented with an intracranial complication.⁹

As the patients in our study have active squamosal chronic otitis media with cholesteatoma, the discharge in most patients i.e.22 (73.33%) is scanty thus found to be a little less common. Whereas hearing loss was complained by all the patients.

2 patients had mixed hearing loss who also complained of tinnitus. The most common characteristics of the discharge was purulence, continuity and foul-smelling. Also duration of otorrhoea was found to be much longer i.e. approximately 7-10 years of symptoms in 40% patients. Thus patients presented after a long history of otorrhoea. Thus suggesting us that the awareness in our country regarding the disease is very less and patients usually present to us when the disease is extensive.

When an infected cholesteatoma is present or there is bone destruction, the purulent discharge tends to be thick, scanty and fetid. Patients in whom clinically the diagnosis is not clear, HRCT Temporal bone will aid in detecting it.

Hearing loss: The most common type of hearing loss was moderate conductive hearing loss i.e. in 9 patients (30%) followed by mild and moderately severe conductive loss (26%).

Children with extensive disease at times may not present with severe hearing loss due to “cholesteatoma hearing.” Thus post-surgery when the cholesteatoma is removed, chances of the degree of hearing loss increases. This possibility should be explained to the parents as well as the patients.

HRCT Temporal bone findings

In our study soft tissue density and ossicular discontinuity was seen in all the 30 patients (100%). Erosion of scutum was seen in all the 30 patients.

Facial nerve dehiscence was seen in 4 patients (13.33%). Labyrinthine fistula was not detected. Sinus plate erosion was observed in 3 patients (10%) and dural plate erosion in 2 patients (6.67%).

HRCT Temporal bone and Intra-operative findings

The extent of soft tissue was seen equally in middle ear and mastoid in 25 patients (83.33%) on HRCT Temporal bone as well as intra-operatively. 5 patients (16.67%) showed soft tissue in only middle ear on both HRCT Temporal bone and intra-operatively. Thus the detection of the extent of disease was highly accurate on HRCT Temporal bone compared to the intra-operative findings.

Mafee and O'Riley have similar results, whereas Jackler and Garber found it to be less sensitive in differentiating cholesteatoma from granulations. Dural plate erosion was seen in 3 patients (10%) on HRCT Temporal bone, whereas Intra-operatively was seen only in 2 patients (6.67%).

Sinus plate erosion was seen in 2 patients (6.67%) on both HRCT Temporal bone and Intra-operatively. Erosion of scutum was observed in all 30 patients (100%) both intra-operatively as well as on HRCT Temporal bone. Similar to the findings in our study, Mafee et al. found bone destruction in nine out of nine cases of acquired cholesteatoma.

Also contributing to the above results, Jackler et al. and O'Donoghue et al, found cholesteatoma to be present in 80% of the explored cases with bony erosion.

Similarly in a prospective descriptive study performed by Mehrdad Rogha et al from January 2009 to May 2011 in 36 patients with cholesteatoma, the CT scans revealed excellent correlation for sigmoid plate erosion, widening of aditus, and erosion of scutum.

In a study of 36 patients, 30 cases (83.3%) had all, of the following radiological features: (a) a non-dependent tissue mass, (b) a location typical for cholesteatoma and (c) bony erosion.

In our study, ossicular status- On HRCT Temporal bone and Intra-operatively erosion of malleus was seen equally in 13 patients (43.33%) and absent malleus in 1 patient (3.33%).

On HRCT Temporal bone and intra-operatively incus erosion was seen in 23 patients (76.67%) and absent incus was seen in 7 patients (23.33%).

Stapes erosion was observed in 9 patients (30%) on HRCT Temporal bone, whereas intra-operatively it was observed in 12 patients (40%) in our study.

Thus the accuracy for malleus and incus was better, whereas there was some discrepancy in intra-operative findings and HRCT Temporal bone findings for stapes.

Facial nerve dehiscence was seen in 4 patients (13.33%) in HRCT Temporal bone and intra-operatively was seen in 5 patients (16.67%).

Lateral semicircular canal fistula was seen intra-operatively in 1 patient (3.33%), which was not detected on HRCT Temporal bone.

A good correlation for erosion of malleus and tegmen; moderate correlation for lateral canal fistula (LCF) and erosion of mastoid air cells; and poor correlation for facial nerve dehiscence (FND), incus, and stapeserosion.

The results of the study by Chee N W are comparable to our study for detection of erosion of malleus and the poor co-relation for stapes. But not comparable to our study while comparing erosion of incus.

With a few findings similar to our study, in the study of Chee N W the radiosurgical agreement was excellent for the malleus and incus as well as tegmen.

Although the sensitivity for tapes and semicircular canals was good in this study ; it is in contrast to the findings in our study.

Also detection of facial nerve dehiscence was fairly accurate in our study, it is in contrast to the findings of Chee N W et al which showed poor comparison of HRCT and intra-operative findings for the facial nerve canal.

Similar to our study, in a study by Raghav et al of 50 patients with cholesteatoma erosion of incus present in the 42 cases(84%) in HRCT finding while in intra operative finding erosion of incus present in the 44 cases(88%) which was the most commonly involved ossicle. Erosion of scutum present in the 15 cases in HRCT finding while in intra operative finding erosion of scutum present in the 15 cases. These are very similar to our study.

The facial nerve findings are also comparable to our findings. Facial canal dehiscence in 3 cases and erosion in 4 cases in HRCT finding while in intra operative findings facial canal dehiscence in 2 cases and erosion in 2 cases.

In our study HRCT showed dehiscence in 4 whereas intra-operatively it was seen in 5 patients.

In contrast to our study, semicircular canal erosion present in 4 (8%) of the 5 cases in which it occurred. Similar to our study , dural plate dehiscence in 2 cases and sinus plate dehiscence in 2 cases in HRCT finding while in intra operative finding dural plate dehiscence 3 cases and sinus plate dehiscence in 2 cases.

Swartz et al, has shown that the incus was involved in 100% of cases where the ossicular chain was damaged similar to our study.

Aquinoi et al shows partial or complete destruction of ossicles may be seen in 80% of patients with cholesteatomas.

In the study of Walshe et al, scutum erosion was present in 6 of the 20 patients in CT however in surgery scutum erosion was present in 7 patients.

The radiologists play a key role in helping us to plan the surgical management in a better manner depending on the ossicular status and the extent of disease .Thus on HRCT Temporal bone, a pre-operative decision can be taken quite accurately about the type of surgery.

Thus HRCT Temporal bone has proved to be a valuable pre-operative investigation which helps in detecting the cholesteatoma, mapping the extent of the disease and pre-operative planning the of surgical procedure.⁸

In our study all 30 patients (100%) underwent canal wall down mastoidectomy. This decision was based on many factors. It was based on the CT scan findings and intra-operative findings of extensive disease. It is an established fact that canal wall down mastoidectomy has shown lower recurrence rates. Also the patients with ear discharge initially present to general physicians in primary and secondary healthcare centres and not to the specialists, where they usually receive symptomatic treatment. Thus most patients by the time of presentation in our tertiary centre have extensive disease which requires aggressive management in the form of canal wall down tympanomastoidectomy with the aim of complete disease clearance.⁹

In our condition post-operative follow-up is poor due to lack of awareness and poor socio-economic status. So canal wall down mastoidectomy which is a single stage procedure, with good results was preferred.

Depending on the ossicular status, 18 patients (60%) had type 3 tympanoplasty where stapes supra-structure was present which was good surgical option as patient post-operatively had serviceable hearing. The rest of the 12 pateints (40%)underwent type 4 tympanoplasty.¹⁰

Ossicular chain involvement at the time of presentation was associated with more extensive disease as seen by Shirazi and colleagues.

Hirsch et al. favor the canal wall down approach for removal of cholesteatoma in children. The majority of the patients required a canal wall down procedure including modified radical

mastoidectomy and radical mastoidectomy. Rates of recidivistic disease were 11% for tympanoplasty, 19% for intact canal wall mastoidectomy, 5% for modified radical mastoidectomy, and 0% for radical mastoidectomy.

Thus the type of mastoidectomy has to be decided by the surgeon on individual basis. It depends on the extent of the disease, severity of the disease, compliance of the patient for follow-up etc. There is no hard and fast rule regarding the type of mastoidectomy that should be done.

CONCLUSION

In our study most patients presented with a long duration of disease which was due to lack of awareness in our country regarding the disease. During the initial presentations the patients were often evaluated by general physicians and not otorhinolaryngologists in primary and secondary centres. These patients usually received only symptomatic treatment initially and were referred to higher centre when the disease did not respond to the same. Hence by the time patients present to us, the disease was already extensive.

HRCT Temporal bone proven to be accurate in detecting the soft tissue, extent of the disease, scutum erosion, ossicular involvement especially malleus and incus, sinus plate erosion. Dural plate erosion was over diagnosed which was a blessing in disguise as surgeon was more prepared mentally to deal with the disease ; whereas stapes involvement, labyrinthine fistula was under-diagnosed .But this could also be due to smallsample size in our study.

HRCT Temporal bone was helpful in mapping the disease appropriately and showing the surgeon important areas of involvement. The findings on HRCT Temporal bone helped in deciding the type of management required and forewarned the surgeon on the impending extra or intra-cranial extension one might face during the surgery.

Eradication of disease is the primary surgical goal, followed by maintenance or restoration of hearing. There is no universally accepted strategy for management of cholesteatoma in children. The final decision regarding the type of surgery has to be individualized by the operating surgeon depending on factors like severity, extent of the disease, follow-up of the patients. Thus in our set-up we found it best to operate the patients with canal walldown surgery.

REFERENCES

1. Quinton Gopen, Pathology and Clinical course of the Inflammatory diseases of the middle ear, Glasscock –Shambaugh Surgery of the Ear ,6th edition, p425-436, 3-27, 515-527.
2. Maroun T .Semaan, Cliff A. Megerian, The Pathophysiology of Cholesteatoma, Otolaryngologic clinics of North America, Cholesteatoma, December 2006, volume 39 ,Number 6, p1143-1159, 1221-1235, 1097-1113, 1081-1094.
3. George G Browning, Saamil N Merchant, Gerard Kelly , Chronic Otitis Media, Scoot-Brown's Otorhinolaryngology, Head and Neck Surgery ,7th edition, p3394-3445.

4. David R.Edelstein,SimonC.Parisier, Jin Cheng Han, Acquired cholesteatoma in the pediatric age group, *The Otolaryngologic Clinic of North America volume 22/ number 5 October 1989, p955-966,847-857,859-868,869-881,883-896*
5. PL Dhingra, Shruti Dhingra and Deeksha Dhingra. Diseases of Ear, Nose and Throat & Head and Neck Surgery, 6/e. 2014; 2-8, 68, 69
6. Bachi T. Hathiram, D.S Grewal. Chronic suppurative otitis media, ENT simplified 2nd edition, Bhalani publishers 2002; 4-20, 84-87
7. Peter Valentine,Tony Wright,Anatomy and embryology of the external and middle ear,Scott-Brown's Otorhinolaryngology Head and neck ,8th edition,p525-543,977-1019
8. Soldati D, Mudry A. Knowledge about cholesteatoma, from the first description to the modern histopathology. *Otol Neurotol.* 2001;22(6):723-30.
9. Spilsbury K, Miller I, Semmens JB, Lannigan FJ. Factors associated withdeveloping cholesteatoma: a study of 45,980 children with middle ear disease. *Laryngoscope.* 2010;120(3):625-30.
10. Koltai PJ, Nelson M, Castellon RJ, Garabedian EN, Triglia JM, Roman S, etal. The natural history of congenital cholesteatoma. *Arch Otolaryngol Head Neck Surg.* 2002;128(7):804-9.