Comparison of High Resolution Computed Tomography with Intraoperative Findings in Patient with Chronic Suppurative Otitis Media, NAMS, Bir Hospital, Kathmandu, Nepal

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ABSTRACT

Introduction: Chronic suppurative otitis media (CSOM) is an important cause of middle ear disease and its complications challenge both otologist and radiologist.

Methods: This is an observational descriptive study conducted at NAMS Bir Hospital. Total of 30 patients, referred for HRCT from the department of ENT were studied.

Results: Out of 30 patients, 16 patients had CSOM with cholesteatoma and 14 patients had CSOM without cholesteatoma. HRCT presented sensitivity, specificity, positive predictive value, negative predictive value and accuracy of 87.5%, 85.7%, 87.5%, 85.7% and 86.7% respectively in diagnosing CSOM with cholesteatoma. HRCT presented sensitivity and specificity of 85.7% and 87.5% in identification of malleus erosion, sensitivity and specificity of 86.7% and 80%, in the identification of incus erosion. HRCT showed the specificity of 85% with relatively low sensitivity of 70% in identification of erosion of stapes. HRCT showed a sensitivity of 100% and specificity of 85.7%. HRCT presented sensitivity and specificity of 83.3% and 95.8% in diagnosing tegmen tympanum erosion. HRCT showed the highest sensitivity (100%) and specificity (100%) in diagnosing erosion of sigmoid sinus plate and mastoid cortex. HRCT showed relatively low sensitivity of 66.7% and 75% in diagnosing erosion of LSCC and facial canal respectively.

Conclusion: The HRCT has a valuable role in preoperative evaluation of a case of CSOM. It has high sensitivity in diagnosing CSOM with cholesteatoma. However, HRCT has relatively low sensitivity for LSCC and facial nerve canal erosion.

Keywords: HRCT, CSOM, Cholesteatoma, Preoperative evaluation

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INTRODUCTION

Chronic suppurative otitis media (CSOM) has been an important cause of middle ear disease since prehistoric times[1]. Despite the valuable contribution of antibiotics, (CSOM) remains a common disease and its complications challenge both otologists and radiologists[2,3]. A major advance in imaging of the ear structures has occurred with the development of High Resolution Computed Tomography (HRCT)[4,5]. Thin section HRCT with modern equipment allows by means of special algorithms, imaging of osseous structures up to a spatial resolution of 0.45 to 0.65mm

One of the important indications for preoperative HRCT scanning is Complications of CSOM. Its ability to determine the extent of soft tissue involvement of the antrum, middle ear and especially the posterior tympanic spaces may assist the surgeon in deciding between a canal wall up versus an open procedure[6]. However, there are concerns that CT cannot reliably distinguish cholesteatoma from mucosal disease and that it lacks guaranteed sensitivity for erosive Complications. Such concerns have cast doubts on its value[7].

The chronic otitis media is defined as an inflammatory process, infectious or not, focal or generalized in the middle ear. It is can be either tubotympanic (safe) or attrico-antral (unsafe) in location. CSOMis classified into two main clinical types: CSOM without cholesteatoma that is recognized clinically as safe type and CSOM with cholesteatoma, or unsafe type[8]. In the non-cholesteatomatous CSOM there are irreversible alterations in the middle ear epithelium that manifest as chronic otorrhea and perforation of the tympanic membrane, which requires surgical treatment for the disease control. The cholesteatomatous CSOM is defined as the presence of keratinized stratified squamous epithelium in any region of the middle ear which may be acquired or more seldom congenital. Unsafe CSOM, especially those associated with cholesteatoma, require surgical treatment.

The cholesteatoma have characteristics of growth, migration and osseous erosion and are thus locally destructive, the only treatment is their full surgical removal, since there is no effective clinical treatment for eradication of the disease so far [9-11].

Despite multiple modalities like X-ray, poly-tomography, three-dimensional CT and magnetic resonance, the HRCT is the most Common examination due to the anatomic information it provides[12]. It demonstrates presence of abnormal tissue in the middle ear with large accuracy, but cannot define whether there is cholesteatoma or not. Nevertheless, when connected to osseous erosion of some structures like ossicular chain, tympanic tegmen, bony labyrinth and lateral attic wall etc., it is strongly indicative of cholesteatoma[13]. So, we designed this study to examine its effectiveness and find out its importance.

METHOD

This is hospital based observational descriptive study conducted at National academy of medical science (NAMS), Bir Hospital. The study duration was one year from January 2016 to December 2016. Purposive convenient sampling was adopted for the collection of data. All the patients who came to the Radiology department for HRCT with clinical suspicion of CSOM undergoing for surgery during the study period was taken. Ethical clearance was taken from institutional review board of NAMS for this study. Data was collected using the pre-structured questionnaire. Inform consent was taken from all patients after fully explaining all the relevant details, its importance and implication.

All HRCT scans of temporal bone were performed on Phillips 16 slice Multidetector CT Scanner as per standard protocol for HRCT of temporal bone. After explaining the procedure, the patients were asked to lie in supine position on the CT table with his/her eyes closed. Image acquisition in axial projection was done by a high resolution algorithm using the following parameters: tube voltage of 120 kV, exposure factor of 175-200 mA, slice thickness of 1.25 mm with 1.25 mm collimation and 512 x 512 matrix. The axial plane

was defined as a line from the inferior orbital rim to the external auditory meatus. Coronal reconstruction of the obtained axial images was done. All images were displayed at a window level of 400 HU and a window width of 4000 HU.

Data obtained were entered into Statistical Package for Social Science (SPSS) version[22]. Statistical analysis to calculate specificity, sensitivity, false positive, false negative, true positive, true negative, Positive predictive value as well as negative predicative value was done by using 2x2 contingency table. Certain result data were entered in Microsoft Excel 2016 for generation of table, charts and diagrams. Results obtained from the study were then discussed with reference to current world literature. Comparison between findings of our study and similar studies in past were done. Conclusion was drawn based on these results.

RESULT

A total of 30 cases were confirmed as CSOM by surgery. In this study, the maximum number of cases of CSOM (n= 10) were seen in 11-20 years age group. Males were slightly more affected with CSOM than females.
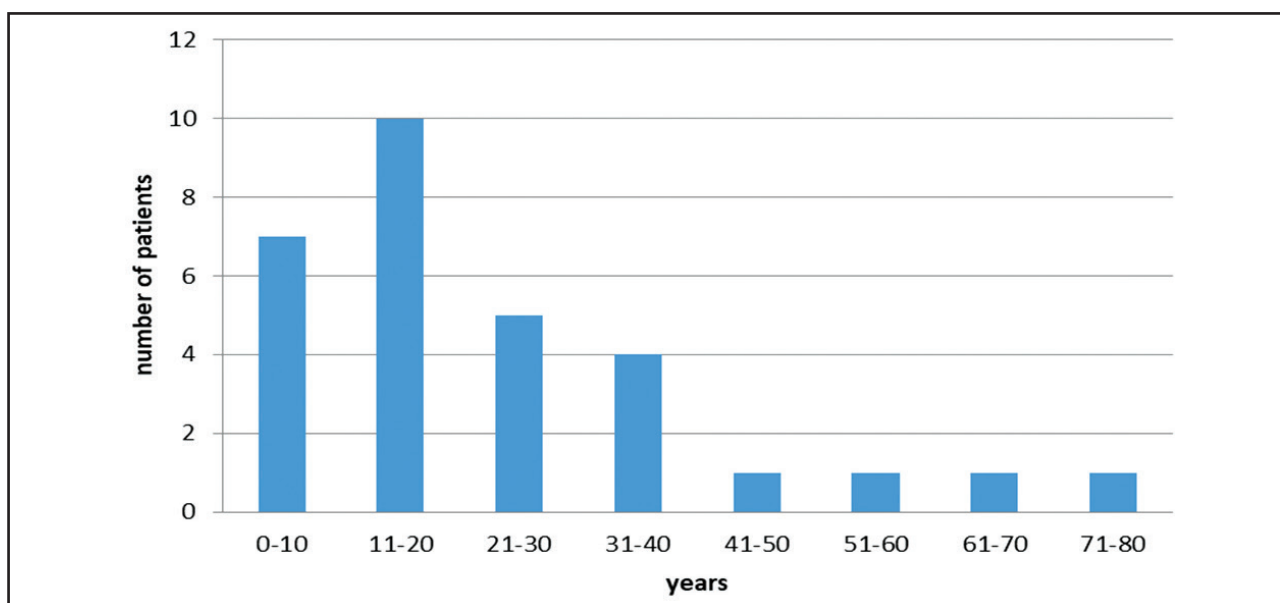

Figure 1: Bar diagram showing age distribution of patients with CSOM
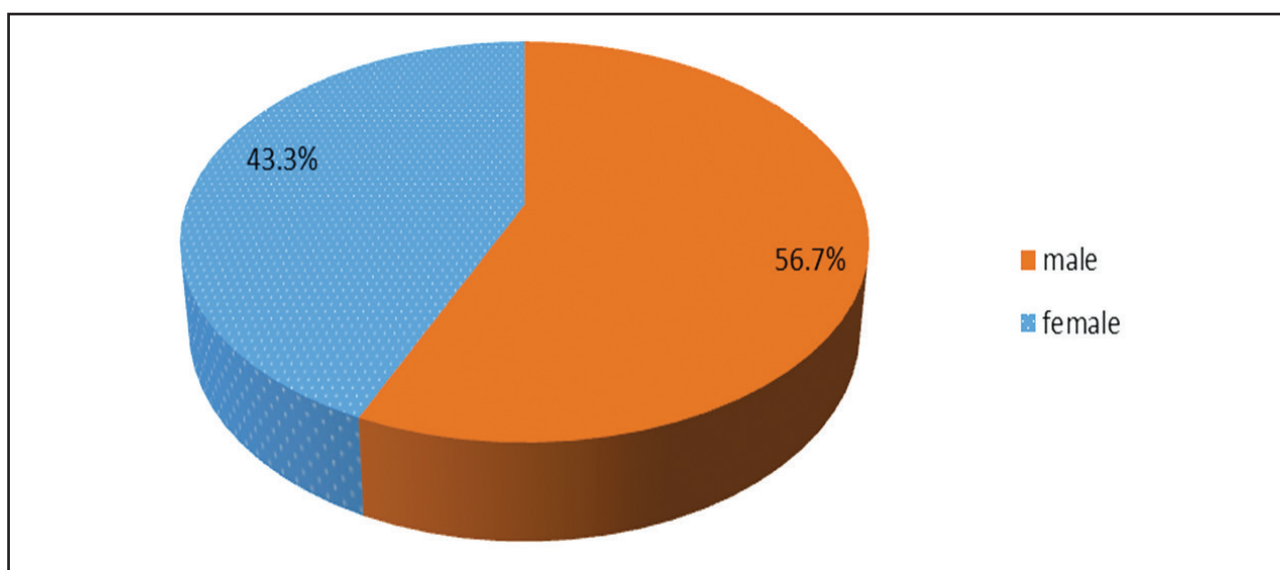

Figure 2: Pie chart showing gender distribution in patients with CSOM.

The most common location and extent of disease on HRCT in our study was found to be holotympanic (40%)
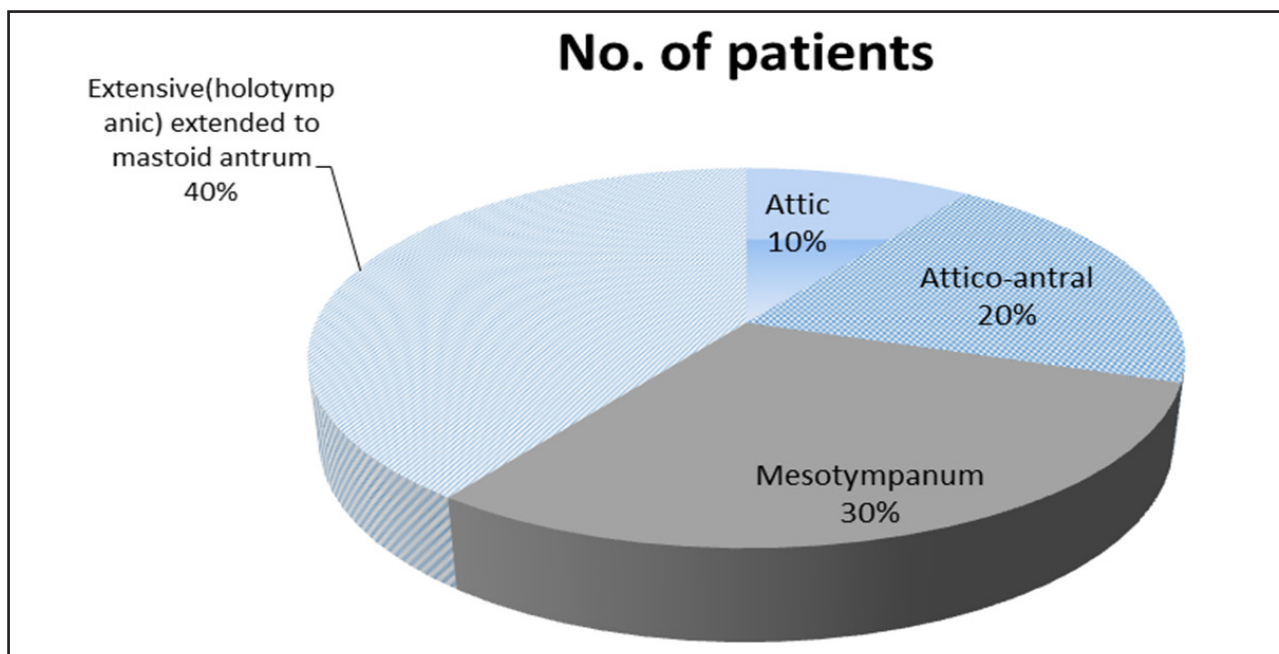
Figure 3: Pie chart showing location and extent of disease in cases of CSOM on HRCT

This study found that ossicular chain was 'intact' in 8 patients (26.7%) and 'not intact' in 22 patients (73.3%). The most commonly eroded ossicle was found to be incus (16 patients, 53.3%) followed by erosion of malleus (14 patients, 46.7%) and stapes (10 patients, 33.3%). All three ossicles were eroded in 6 patients (20%).
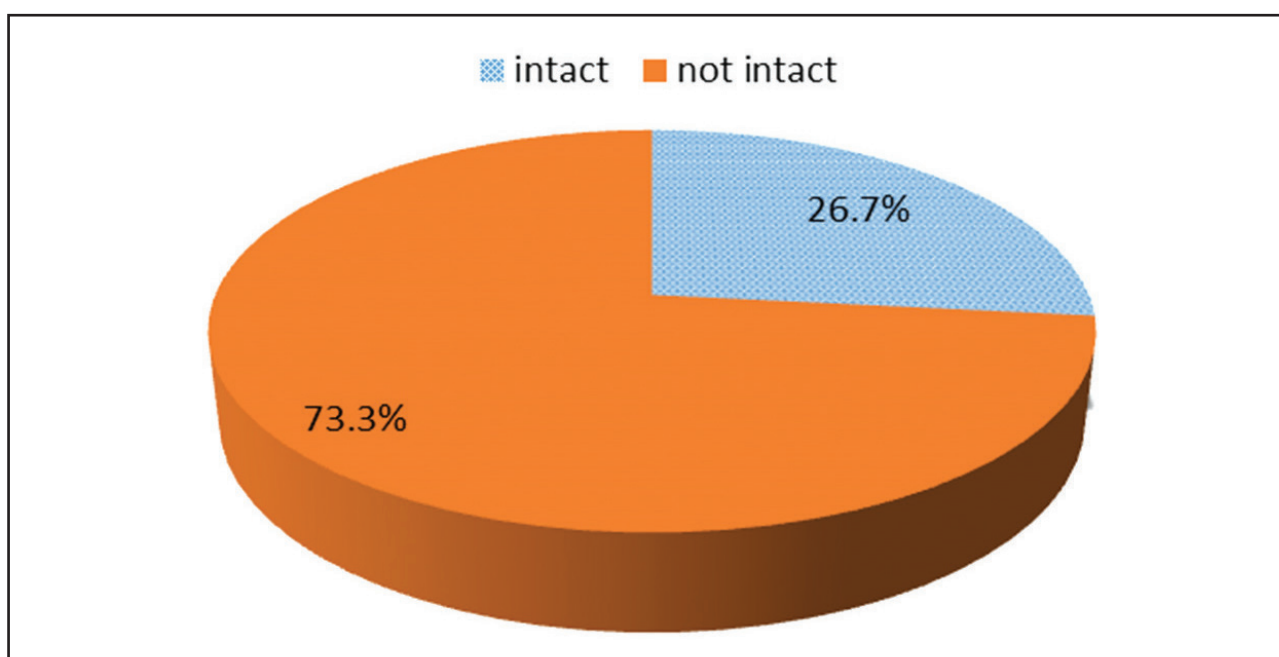

Figure 4: Pie chart showing status of ossicular chain in cases of CSOM

In this study, HRCT showed only erosion of lateral semicircular canal (LSCC) in five patients and erosion of LSCC along with cochlear sclerosis in one patient. Inner ear structures were intact in the remaining 24 patients. More than one inner ear structures were also involved in the same patient.
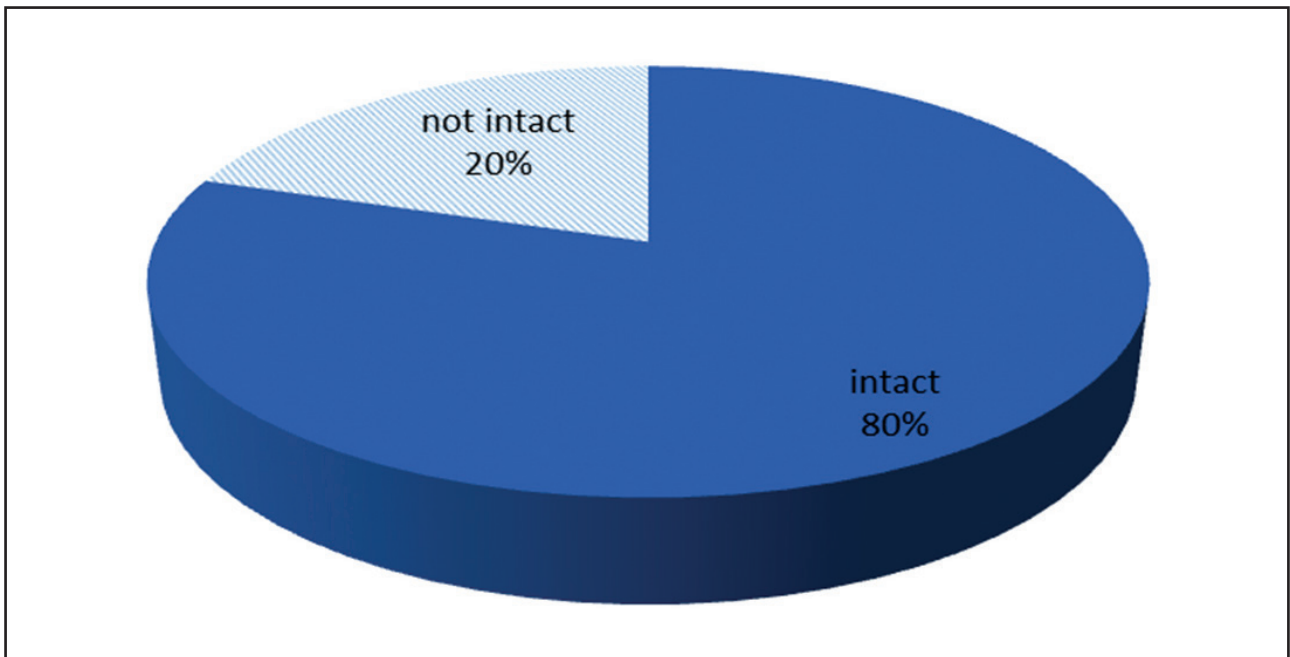
Figure 5: Pie chart showing status of inner ear structure in case of CSOM

HRCT showed erosion of the facial nerve canal in 8 patients (26.7 %) where the tympanic segment of facial nerve canal was most commonly eroded (5 patients, 16.7%).

Figure 6: Pie chart showing status of facial nerve canal on HRCT in cases of CSOM

Regarding status of bony plate most common finding is blunting of scutum in 12 patients (40%), More than one bony involvement were also present in the same patient.

Figure 7: Pie chart showing status of bony plate on HRCT in cases of CSOM

Table 1: Location of disease in Cholesteatomatous vs. Noncholesteatomatous CSOM

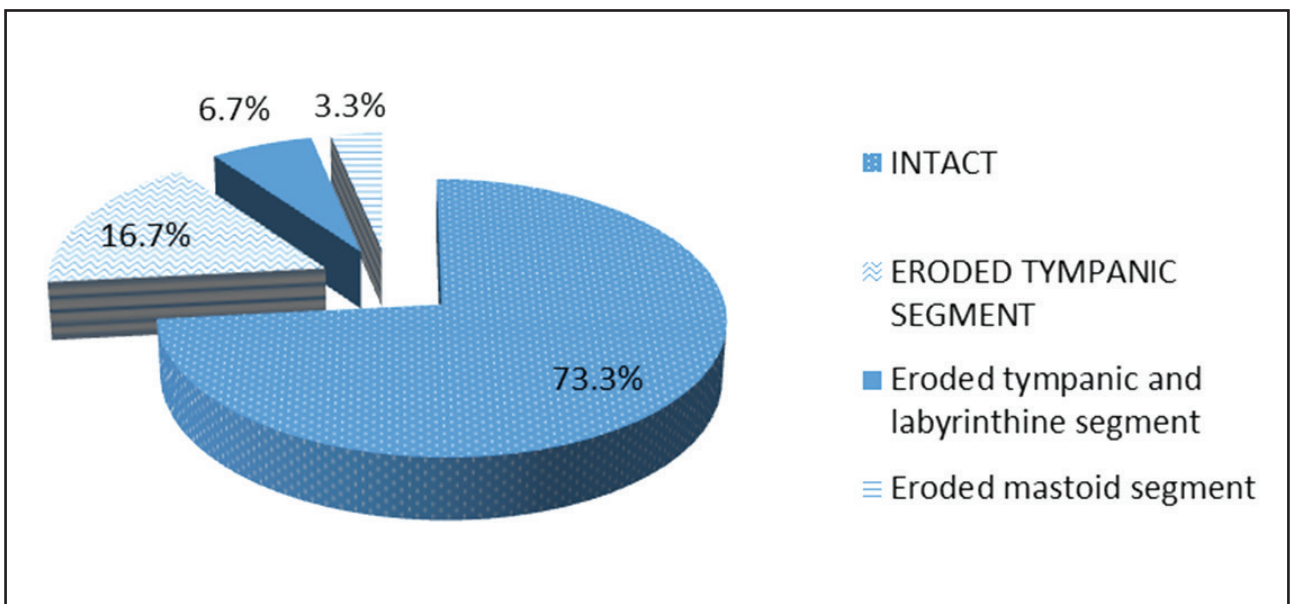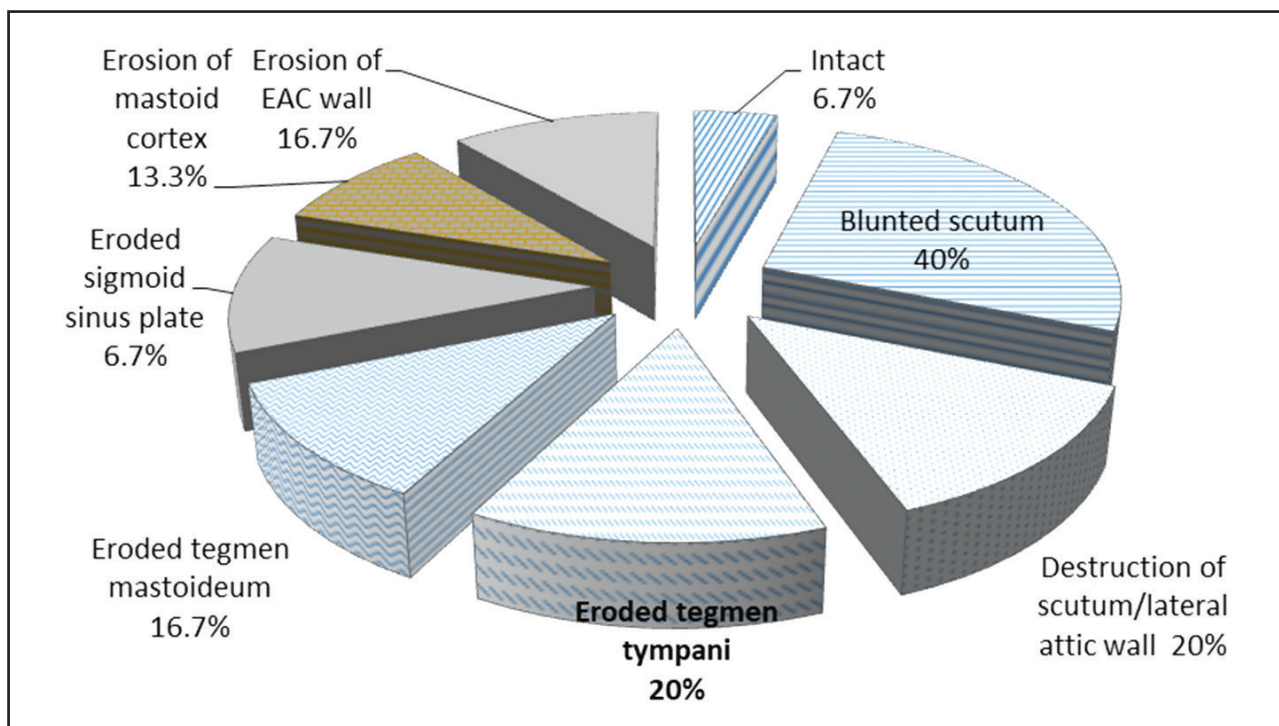| Location of disease	Type of CSOM, IOP (Intra-operative finding)	
	Non-cholesteatomatous (N=14)	Cholesteatomatous (N=16)
Attic/Attico-antral	3	8
Mesotympanic	4	2
Holotympanic	7	6
Total	**14**	**16**

This study found that holotympanic location of disease on HRCT was common in both cholesteatomatous and non-cholesteatomatous CSOM as per intra-operative findings.

Table 2: HRCT findings and operative findings of CSOM with or without cholesteatoma

Types of CSOM	HRCT	IO	TP	TN	FP	FN	Accuracy	SEN (%)	SPE (%)	PPV (%)	NPV (%)
With cholesteatoma	16	16	14	12	2	2	86.7	87.5	85.7	87.5	85.7
Without cholesteatoma	14	14	12	1 4	2	2	86.7	85.7	87.5	85.7	87.5

Abbreviations: IO = Intraoperative, TP = True positive, FP = False Positive, FN = False Negative, TN = True Negative, SEN = Sensitivity, SPE = Specificity, PPV = Positive predictive value, NPV= Negative predictive Value

There were 2 false positive cases of cholesteatomatous CSOM which are false impression of erosion of bony walls, may be due to partial volume averaging. Two cases were falsely diagnosed as 'Non-cholesteatomatous CSOM' on HRCT which may be the early case of cholesteatoma not complicated by bony erosion and hence falsely labeled as 'Non-cholesteatomatous CSOM' on HRCT.

Table 3: HRCT findings and operative findings of ossicular status

Ossicles status	HRCT	IO	TP	TN	FP	FN	Accuracy (%)	SEN (%)	SPE (%)	PPV (%)	NPV (%)
Intact	8	7	6	21	2	1	90	87.7	91.3	75	95.5
Incus erosion	16	15	13	12	3	2	83.3	86.7	80	81.3	85.7
Malleus erosion	14	14	12	14	2	2	86.7	85.7	87.5	85.7	87.5
Stapes erosion	10	10	7	17	3	3	80	70	85	70	85

Table 4: HRCT findings and operative findings of bony plate

Features	HRCT	IO	TP	TN	FP	FN	Accuracy (%)	SEN (%)	SPE (%)	PPV (%)	NPV (%)
Scutum	18	16	16	12	2	0	93.3	100	85.7	88.9	100
Tegmen tympani erosion	6	6	5	23	1	1	93.3	83.3	95.8	83.3	95.8
Mastoid cortex erosion	4	4	4	26	0	0	100	100	100	100	100
Sigmoid sinus plate erosion	2	2	2	28	0	0	100	100	100	100	100
LSSC erosion	6	6	4	22	2	2	86.7	66.7	91.7	66.7	91.7
Facial nerve canal erosion	8	8	6	20	2	2	86.7	75	90.9	75	90.9

Erosion of mastoid cortex was seen in four cases by HRCT which was seen in all four of them. Out of the remaining 26 patients in whom mastoid cortex was intact on HRCT, none of them had erosion at surgery. Hence the SEN, SPE, PPV, NPV and accuracy of HRCT in detecting mastoid cortex erosion were all 100%. HRCT detected soft tissue mass in the middle ear/mastoid with sensitivity, specificity, positive predictive value and negative predictive value of 100%. HRCT features of confirmed cases of CSOM with cholesteatoma and CSOM without cholesteatoma.

In this study, 16 out of 30 CSOM patients were found to have cholesteatoma at surgery (53.3%). HRCT showed erosion of external auditory canal wall in 5 cases (31.3%), facial nerve canal in 6 cases (37.5%), tegmen tympani in 5 patients (31.25%), tegmen-mastoideum in 5 patients (31.5%), mastoid cortex in 4 patients (25%), lateral semicircular canal in 4 patients (25%), of sigmoid sinus plate in 2 patients (12.5%), and sclerosis of cochlea in 1 patient (6.2%). HRCT showed erosion of scutum in most of the case (14, 87.5%). HRCT showed incus was the most common ossicle to be eroded (13 patients, 81.3%) followed by malleus (12, 75%) and stapes (7, 43.8%).

In this study, 14 (46.7%) out of 30 patients had non-cholesteatomatous CSOM at surgery. HRCT showed erosion of scutum in only 2 of them (14%). HRCT

showed facial canal erosion in 2 patient, lateral semicircular canal erosion in 2 patient and tegmen tympani erosion in 1 patients (all were false positive). There was no patient with EAC erosion or mastoid cortex erosion or sigmoid sinus plate erosion. HRCT showed intact ossicular chain in 12 patients (85.7%).

DISCUSSION

The exact role of HRCT in the preoperative assessment of patients with CSOM is still controversial[14]. Some authors have found a high degree of accuracy of HRCT in the diagnosis of various complications of CSOM while others have concluded that it has poor ability to diagnose cholesteatoma and its complications[15]. The results of our study suggests that cholesteatoma can be reliably diagnosed by HRCT based on characteristic findings on HRCT scans and various complications of CSOM and cholesteatoma can be detected with an acceptable accuracy.

In the study done by Payal et al[17], erosion of malleus, incus and stapes was found in 40%, 56.7% and 56.7% cases of CSOM respectively. In the study done by Sirigiri and Dwaraknath[16], erosion of malleus was seen in 52% and erosion of incus in 60%. Result of our study is comparable with the studies done by Sirigiri and Dwaraknath16 and Payal et al[17]

In the study done by Sirigiri and Dwaraknath[16], HRCT showed erosion of mastoid cortex in 12% (three patients). Rai[18] found it to be 8% (4 out of 50 patients). Our study is comparable with that of Sirigiri and Dwaraknath[16] and Rai.[18] Our study is comparable with that of Sirigiri and Dwaraknath[16] and Rai.[18] Mafee et al[19] reported in his series of 48 patients with cholesteatoma that 46 of them (96%) were diagnosed correctly using preoperative HRCT scans. O'donoghue et al[20] reported 88% sensitivity of HRCT for cholesteatoma in their study. Our study is comparable with the studies of O'donoghue et al[20] and Mafee et al[19]

In the study done by Gaurano et al[21], all the patients with cholesteatoma had soft tissue density in the middle ear. In the study done by Roghae al[22], soft tissue mass in the middle ear or mastoid was seen in 100% patients. In our study also, HRCT showed soft tissue density in the middle ear/mastoid in all 16 patients (100%) which is comparable with the study of Gaurano et al[21] and Rogha et al[22]

CONCLUSION

The HRCT has valuable role in preoperative evaluation of case of CSOM. It has high sensitivity in diagnosing CSOM with cholesteatoma. Soft tissue lesion, erosion of ossicular chain and bony plate is best predicted with high level of sensitivity and specificity. However HRCT has relatively low sensitivity in diagnosing LSCC and facial nerve canal erosion. It is also helpful to differentiate cholesteatomatous CSOM from non cholesteatomatous CSOM.

HRCT should be routinely used for better preoperative planning. However, to avoid false interpretations, meticulous analysis of both axial and coronal sections of HRCT temporal bone is recommended before labeling any erosion of the various structures of the tympanomastoid compartment.

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