

An Exploratory Study of High Resolution Computed Tomography of Temporal Bone in Chronic Otitis Media

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ABSTRACT

Introduction:

Among various modalities used in the evaluation of chronic otitis media, HRCT of the temporal bone is the most reliable and valuable imaging modality as it provides excellent anatomic information. It can display minute anatomical and pathological details by providing a direct visual window into the temporal bone.

Methods:

This is a prospective cross-sectional study done at the department of Radiodiagnosis and imaging of Birat Medical College, Teaching hospital over 1 year with a total of 50 patients enrolled in the study. The findings were compared with the post-operative findings and data were entered. HRCT was done on 64 slices of multidetector CT scan. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of various parameters were calculated.

Results:

Out of 50 patients were enrolled in this study. Among them 52% (26) were females and 48% (24) were males. HRCT showed 100% sensitivity for the lateral semicircular canal and sigmoid plate erosion. The sensitivity and specificity of cholesteatoma were 79.06% and 42.85% respectively. It also offered a sensitivity of 75% and 95% for the erosion of the facial nerve canal and tegmen tympani respectively

Conclusions:

High-resolution computed tomography is a reliable diagnostic tool for the pre-operative evaluation of chronic otitis media. It helps the operating surgeon to evaluate the anatomical extent of the disease process and aids in the surgical approach that helps prevent probable complications during surgery

Keywords: *Complications; Cholesteatoma; Sensitivity; Specificity*

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INTRODUCTION

Otitis media (OM) is middle ear inflammation with a spectrum of diseases including acute otitis media (AOM), otitis media with effusion (OME; 'glue ear') and chronic suppurative otitis media (CSOM). Most OM may resolve spontaneously without any complications, but it can have associations with loss of hearing and life-long sequelae.¹ CSOM and its complications pose a challenge to both otologists and radiologists despite the valuable contribution of antibiotics for their treatment.^{2,3} With the development of high-resolution Computed Tomography (HRCT), there has been a major advance in imaging of the ear structures.^{4,5}

Chronic otitis media (COM), is a disease of the middle ear and can either be acquired or congenital. Pathologically it is defined by the presence of keratinized stratified squamous epithelium in any region of the middle ear. The cholesteatomas cause local destruction resulting in osseous erosion. Since these cholesteatomas have no effective clinical treatment for the eradication of disease, the only treatment is their full surgical removal.⁶⁻⁸

Various imaging modalities have been used in the evaluation of CSOM like X-rays, polytomography, and magnetic resonance imaging but High-resolution computed tomography (HRCT) is the most common and valuable imaging modality as it provides excellent anatomic information.⁹ It is a modification of routine computed tomography (CT) and displays minute anatomical and pathological details by providing a direct visual window into the temporal bone. The findings of cholesteatoma on tomography scan of the temporal bone include soft tissue mass that causes erosion of local bone, scutum and ossicles, middle ear opacification, widening of audits and antrum and occasionally labyrinthine fistula.

METHODS

This is a prospective cross-sectional study done at Birat Medical College, Teaching hospital over 1 year from May 2021 to April 2022. Purposive convenient sampling was adopted for the collection of data. A total of 50 patients were included in the study. Ethical clearance was obtained from the institutional review committee (IRC) of Birat Medical College. Patients with clinical suspicion of CSOM sent to the Radiology department for HRCT temporal bone irrespective of age and gender are included in the study. Patients who are suspected or diagnosed as having malignancy, a history of trauma, previous ear surgery or those who are found unfit for surgery or anaesthesia are

excluded from the study. Data was collected using standard proforma. Informed consent was taken from patients and relevant details were explained.

HRCT temporal bone was performed on Siemens 64 slice Multidetector CT using the standard protocol. After explaining the technique, the patients were asked to lie supine on the CT table with their eyes closed. Routine scout films were obtained. The axial sections were obtained in a supine position by a line drawn from the inferior orbital rim to the external auditory meatus. Coronal and sagittal reconstruction was done and images were viewed in multiplanar reconstruction. The HRCT findings were then compared with the intraoperative findings. Interpretation of CT findings was done by a single radiologist and intraoperative findings of the same surgeon were obtained.

Collected data were entered in SPSS and analyzed. Sensitivity, specificity, positive predictive value and negative predictive value were calculated using a 2x2 table. The analyzed data were compared with similar studies in the past and a conclusion was drawn.

RESULTS

A total of 50 patients were enrolled in this study. Out of which, 52%(26) were females and 48% (24) were males. (Figure1) The Maximum number of cases (n=13) were seen in 21-30 years. (Figure 2) Females were slightly more affected than males.

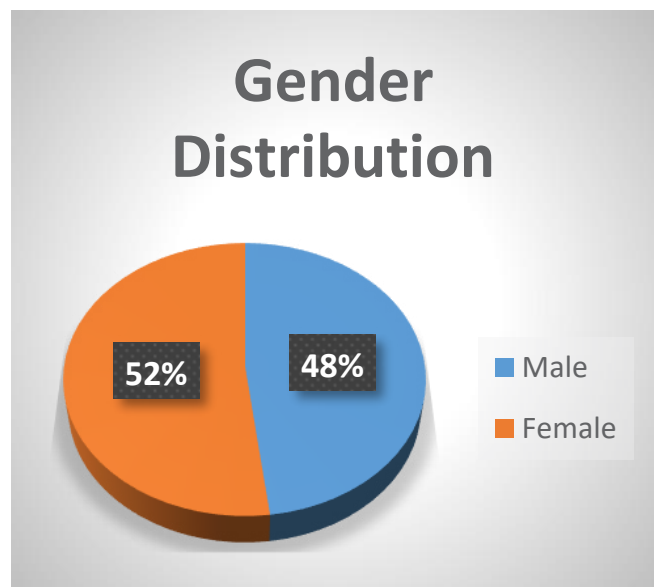


Figure 1: Gender distribution

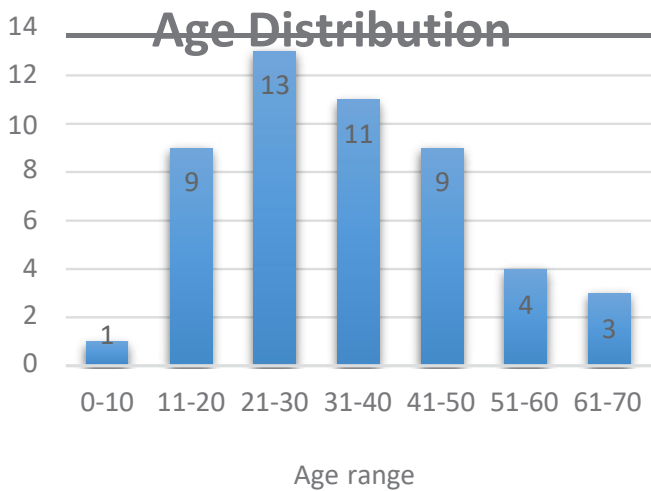


Figure 2: Age distribution

The most common location for otitis media in our study was epitympanum consisting of 56%(28) of cases followed by hypotympanum 24%(12) and mesotympanum 10(20%). (Figure 3) The ossicular chain was eroded in 60%(30) cases and intact in 40%(20) cases. Inner ear structures were eroded in 4%(2) cases and intact in the remaining cases. The facial nerve canal was eroded in 54%(27) of cases and intact in 46%(23) of cases. Tegmen tympani was eroded in 22%(11), thinned in 30%(15) and normal in 48%(24) cases. Scutum was eroded in 54%(27) and normal in 46%(23) cases. The bony anterior wall of EAC was eroded in 14%(7) and normal in 86%(43) cases. Sigmoid plate erosion was found in 18%(9) and was normal in 82%(41) cases. Mastoid cortex erosion was found in 8%(4) and the post-aural fistula was found in 4%(2) cases. (Figures 4&5) (Table 1)

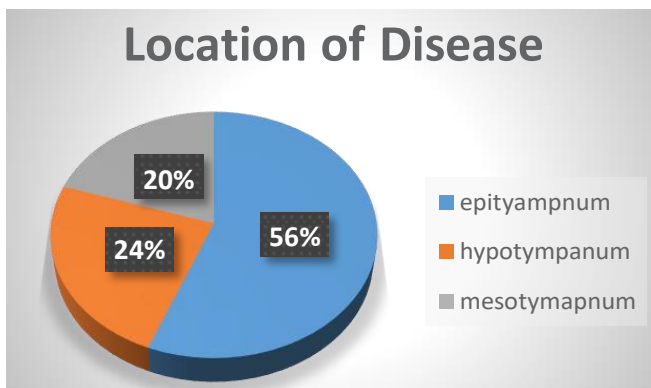


Figure 3: Location of disease in cases of otitis media on HRCT

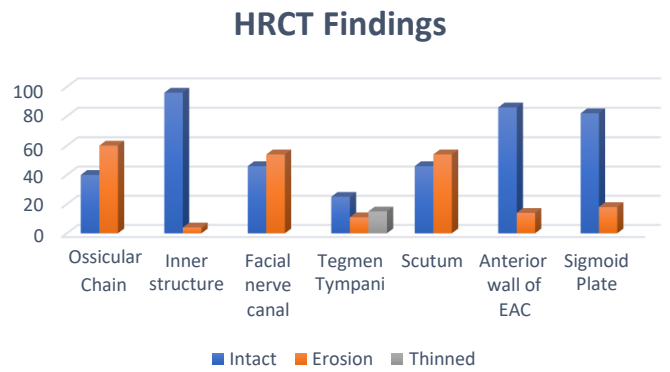


Figure 4: Bar diagram showing status of middle and inner ear structures on HRCT



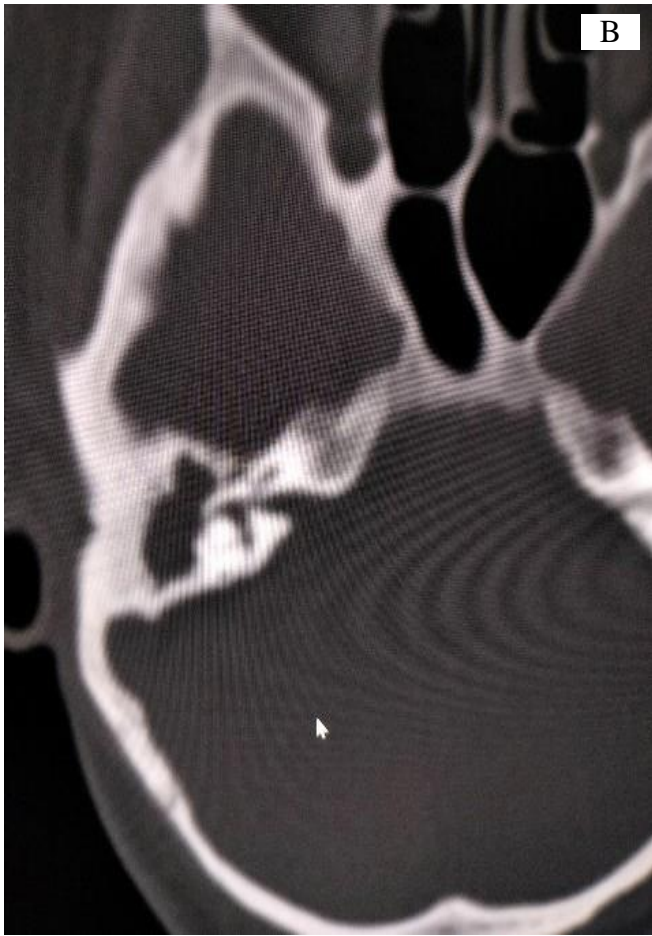


Figure 5: *A: HRCT temporal bone axial section showing a defect in the right lateral semicircular canal. B: Intraoperative image showing a defect in lateral semicircular canal confirming labyrinthine fistula*



Figure 6: *Coronal HRCT temporal bone showing soft tissue opacification of the middle ear with the destruction of ossicles, erosion of scutum and tegmen tympani*

Table 1: *TP(True positive), TN(True negative), FP(False positive), FN(False negative), S (Sensitivity), E(Specificity), PPV(Positive predictive value), NPV(Negative predictive value).*

	TP	TN	FP	FN	S (%)	E (%)	PPV (%)	NPV (%)	Accuracy (%)
Cholesteatoma	34	3	4	9	79.06	42.85	89.47	25.00	74.00
Facial canal erosion	21	16	6	7	75.00	72.72	77.77	69.56	74.00
Ossicular chain erosion	25	14	5	6	80.06	73.68	83.33	70.00	78.00
Tegmen Tympani erosion	19	23	7	1	95.00	76.66	73.07	98.83	84.00
Scutum erosion	20	17	7	6	76.92	70.83	74.07	73.91	74.00
Lateral semicircular canal erosion	2	48	0	0	100	100	100	100	100
Sigmoid plate erosion	8	41	1	0	100	97.61	88.88	100	98.00
Anterior wall of EAC erosion	5	43	2	0	100	95.55	77.77	100	96.00

DISCUSSION

In our study, the maximum number of otitis media was seen in 21-30 years. This age group approximates the study done by Paparella and Kim et al., which shows a mean age group of 35.1.¹¹ Slight variation in our study is might be because otitis media occurs in a relatively younger age group in our population.

Sirigiri and Dwaraknath et al. showed that erosion of the mastoid cortex in HRCT is found in 12%(3 patients).¹² Similarly Rai et al. in their study found it to be 8%(4 out of 50 patients).¹³ Our study approximates the above-mentioned studies.

A study done by O'donoghue et al. reported sensitivity of HRCT for cholesteatoma was 88%.¹⁴ As compared with this study, slightly low sensitivity was reported in our study. This probably is due to less sample size and very few were found to be granulation tissue only. A similar study done by Mafee et al. found that 46 out of 48(96%) cholesteatoma were correctly diagnosed by doing pre-operative HRCT of the temporal bone.¹⁵

It is agreed by most of the authors that CT can detect the presence and extension of soft tissue in the middle ear but also there is a consensus that CT cannot distinguish the type of tissue (i.e. granulation tissue vs. cholesteatoma).¹⁶ we also found the presence of soft tissue within the middle ear in all the patients of otitis media. However, the sensitivity of HRCT for cholesteatoma was 79.06%.

Karki et al. reported the sensitivity and specificity of tegmen erosion and sigmoid plate erosion to be 100% respectively.¹⁷ Similar results were reported in a study done by Jackler et al. and Rogha et al.^{18,19} Our study also showed similar results with low specificity of tegmen erosion. Contrary to this, Tatlipinar et al. reported a very low sensitivity of 33% with a specificity of 100%.²⁰ Jackler et al. also found a low sensitivity rate for detecting tegmen erosion.¹⁸

Rogha et al. reported sensitivity and specificity of HRCT in detecting lateral semicircular canal erosion were 75% and 87.5% respectively.¹⁹

Similarly, Sirigiri et al. reported a sensitivity and specificity of 100 and 94% respectively.¹² Another study reported the sensitivity and specificity in detecting lateral semicircular canal erosion as 77.78% and 98.2% respectively.²¹ Our study shows 100% sensitivity and specificity of lateral semicircular canal erosion. This is because we found only 2/50 patients of LSCC erosion and both of them were found eroded intra-operatively. Our findings correspond to one study done by Datta et al.²²

Datta et al. reported a sensitivity of 75% in detecting facial canal erosion, which is similar to our study. However, their specificity, positive predictive value and negative predictive value were higher than our study.²² Magliulo et al. reported a sensitivity of 69% and specificity of 87% in detecting facial canal erosion.²³ Our study showed higher sensitivity as compared with this but low specificity.

The results of our study showed the importance of pre-operative HRCT temporal bone in delineating the location and extent of the disease. A similar conclusion was drawn in previous studies.²⁴ Similarly, another study concluded the importance of pre-operative HRCT as a useful diagnostic tool for planning a surgery, however, also concluded that some of the lesions cannot be completely evaluated by CT scan and intraoperative assessment is helpful.²⁵

CONCLUSION

High-resolution computed tomography (HRCT) is a reliable diagnostic tool for the pre-operative evaluation of chronic otitis media. It helps the operating surgeon to evaluate the anatomical extent of the disease process and aids in the surgical approach that helps prevent probable complications during surgery.

HRCT has a high sensitivity for tegmen tympani and ossicular chain erosion. It also possesses good sensitivity in diagnosing cholesteatoma and facial canal erosion. Thus HRCT of the temporal bone can be used in cases of otitis media to evaluate the middle ear status before surgery.

CONFLICT OF INTEREST

None

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None

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