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Spectrum Of High-Resolution Computed Tomography Temporal Bone Findings In Chronic Suppurative Otitis Media

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ABSTRACT

Introduction: When it comes to providing great anatomic information, HRCT of the temporal bone is the most dependable and helpful imaging modality among those employed in the evaluation of chronic otitis media. It offers a clear visual window into the temporal bone, allowing it to exhibit minute anatomical and pathological characteristics. Methods: The department of radiodiagnosis and imaging at Meenakshi Medical College Hospital & Research Institute, Enathur, Kanchipuram, conducted this prospective cross-sectional study. 50 participants in all were enrolled in the trial for a duration of 1 year. Data were recorded and the results were compared to the post-operative results. 64 slices of a multidetector CT scan were used for HRCT. Calculations were made for sensitivity, specificity, accuracy, negative predictive value, and positive predictive value of different parameters. Results: In the present investigation, 50 participants were enrolled. Of them, 48% (24) were men and 52% (26) were women. HRCT revealed 100% sensitivity for erosion of the sigmoid plate and lateral semicircular canal. Cholesteatoma had a sensitivity of 79.06% and a specificity of 42.85%. Additionally, it provided a sensitivity of 75% and 95%, accordingly, for tegmen tympani and facial nerve canal erosion. Conclusions: For the pre-operative assessment of chronic otitis media, high-resolution computed tomography is a dependable diagnostic tool. It supports the surgical approach that helps avoid likely surgical problems and assists the operating surgeon in assessing the anatomic nature of the disease processes.

KEYWORDS: HRCT, Chronic Suppurative Otitis Media, Sensitivity, Specificity.

INTRODUCTION

The term "chronic suppurative otitis media" (CSOM) refers to a persistent inflammation of the mastoid cavity and middle ear that manifests as recurring episodes of mucous material secretion from the ear through a tympanic membrane rupture that lasts anywhere from three months to six weeks. First of all The prevalence of it varies with country development, socioeconomic condition, and area. According to the 1993 World Development Report, 5.12 million disability- adjusted life years (DALYs) were lost due to otitis media; the majority of cases are found in developing countries, accounting for around 91% of cases. Tanzania has the greatest frequency of CSOM (14%), whereas India has the second-highest prevalence (7.8%) worldwide. One of the main causes of acquired hearing loss in children, particularly in developing nations, is chronic suppurative otitis media (CSOM). In almost 50% of instances, CSOM results in mild to moderate conductive hearing loss. Both conductive hearing loss and sensory hearing loss, or both combined (mixed hearing loss), may constitute the cause of hearing loss.2

A "cholesteatoma" is described as an epidermal and connective tissue structure that forms a sac and is made up of a desquamated keratin centre and a stratified squamous epithelial outer lining. It conforms to the middle ear cleft and has the ability to grow independently and progressive, involving the underlying bone and

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replacing the middle ear mucosa. It also has a tendency to recur. Both intradurally and extradurally might be used in the demonstration. Cholesteatomas spread extradurally into all segments of the petrous section of the temporal bone, including the external auditory canal, mastoid, and petrous apex. They most commonly affect the middle ear cavity (3). According to reports, the prevalence rates of COM's intracranial and extracranial problems range from 0.5 percent to 0.69%. (4,5)

By contiguously spreading, CSOM causes chronic mastoiditis. The lateral sinus, dura of the temporal lobe, membranous labyrinth, jugular bulb, and facial nerve may be exposed in a rare disorder involving the middle ear and mastoid cavity walls. Major consequences include meningitis, labyrinthitis, lateral sinus thrombosis, facial nerve paralysis, and brain abscess could result from this. Hematogenous or contiguous infection spread to the brain might result in potentially deadly and permanently incapacitating consequences.2

Conventional radiography has Limitations as it can only produces a composite single plane image of a tridimensional temporal bone. resulting in superimposition, where obscuring of smaller and less dense structures by larger and denser structures. HRCT provides excellent detail of bony landmarks within temporal bone due to inherent contrast. It has also added a whole new dimension to the evaluation of the temporal bone by allowing visualization of the soft tissue components within and adjacent to the temporal bone.6

The surgeon has the instruments necessary to appropriately diagnose CSOM, but they are limited in their ability to evaluate the disease's progression, the mastoid bone's condition, bony erosions, and disease complications. Additionally, they have little means of selecting a planned surgery among the various surgical techniques that are currently accessible. The morbidity and mortality associated with lesions in this region have significantly decreased thanks to HRCT's ability to assess these areas with previously unheard-of precision. This has allowed for a better understanding of the etio-pathology, progression of the disease, and the identification of complications, as well as the modification of curative methods for organising surgical procedures from various surgical modalities.

METHODOLOGY

This prospective cross-sectional investigation was conducted at the Meenakshi Medical College Hospital & Research Institute in Enathur, Kanchipuram, by the Department of Radiodiagnosis. May 2022–April 2023 is a year. We used convenient sampling with a purpose to gather data. The trial comprised 50 patients in total. The institutional review committee (IRC) of the radiodiagnosis department of Meenakshi Medical College Hospital & Research Institute, Enathur, Kanchipuram, granted ethical approval. The study includes all patients, regardless of age or gender, who have a clinical suspicion of CSOM and are referred to the radiology department for an HRCT temporal bone scan. Exclusions from the study include patients with a history of trauma, ear surgical history, suspected or confirmed cancer, and those deemed unsuitable for anaesthesia or surgery. Data was collected using standard proforma. Informed consent was taken from patients and relevant details were explained. Using the normal methodology, HRCT temporal bone was carried out on a Siemens 64-slice Multidetector CT scanner.

The patients were instructed to lie supine on the CT table with their eyes closed after the procedure was explained. Regular scout footage was acquired. In a supine position, the axial sections were acquired by drawing a line from the external auditory meatus to the inferior orbital rim. Images were seen in multiplanar reconstruction after coronal and sagittal reconstruction was completed. Next, a comparison was made between the intraoperative and HRCT results. A lone radiologist interpreted the CT results, and the same surgeon's intraoperative findings were obtained. The collected data were analysed in SPSS after being entered. A was used to calculate the following metrics: sensitivity, specificity, positive predictive value, and negative predictive value using a 2x2 table. The analyzed data were compared with similar studies in the past and a conclusion was drawn.

RESULTS

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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. Females were slightly more affected than males.

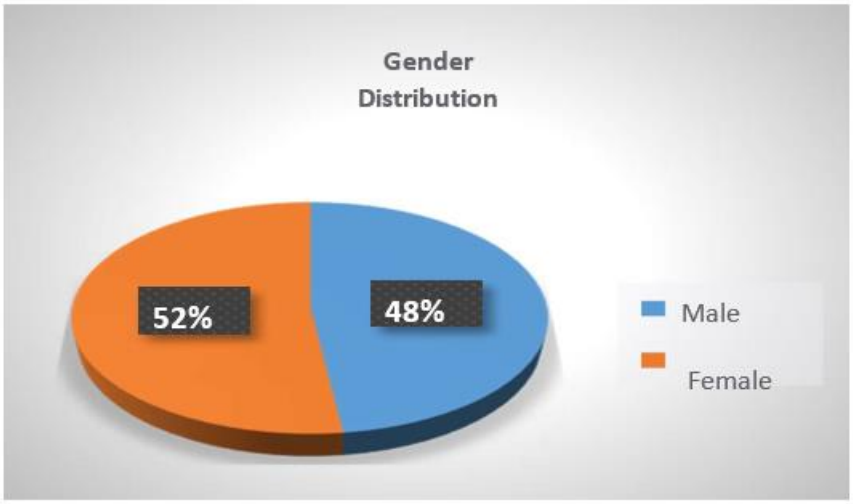

Figure 1: Gender distribution

In our analysis, the epitympanum accounted for 56% (28) of all cases of otitis media, with hypotympanum following at 24% (12) and mesotympanum at 20%. (Show Figure 3) In thirty cases, the ossicular chain was degraded, but in twenty cases, it remained intact. In 4%(2) of the cases, the inner ear structures were eroded; in the other cases, they remained intact. In 54% of the instances (27), the facial nerve canal was damaged; in 46% of the cases (23), it remained intact. In 22%(11), 30%(15), and 48%(24) of the patients, the tegmen tympani was degraded, thinned, or normal. In 54%(27) of the instances, the scutum was eroded; in 46%(23), it was healthy. 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.

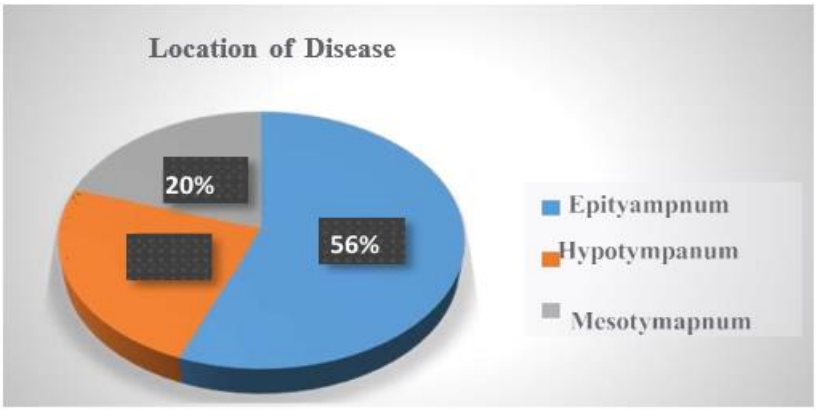

Figure 2: Location of disease in cases of otitis media on HRCT

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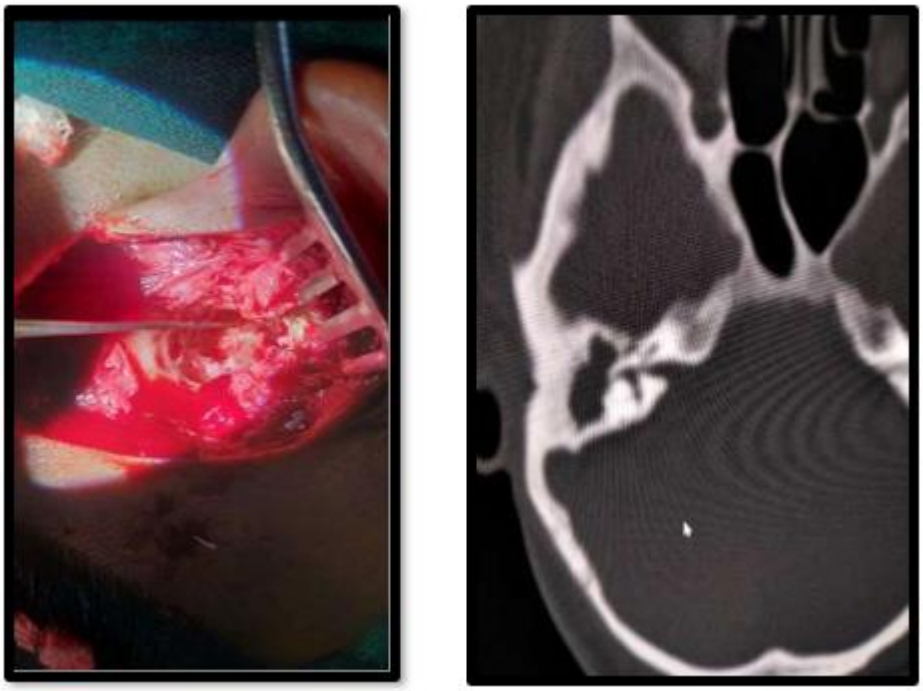

Figure 3: A: HRCT temporal bone axial section showing a defect in the right lateral semicircular canal. B: Intraoperative image showing a defect in lateral semicircular canal confirming labyrinthine fistula

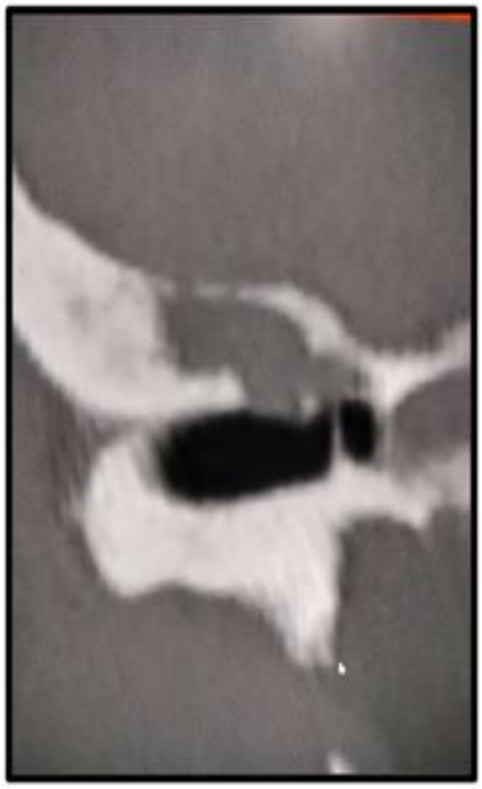

Figure 6: Coronal HRCT temporal bone showing soft tissue opacification of the middle ear with the destruction of ossicles, erosion of scutum and tegmen tympani

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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

The age range in which otitis media was most common in our study was 21 to 30 years old. This age group is close to the 35.1.7 mean age group found in the study by Paparella, Kim, et al. Our population's comparatively younger age range for otitis media may account for the slight variance in our study. According to Sirigiri and Dwaraknath et al., 12% of HRCT cases have erosion of the mastoid cortex (3 patients).8 Rai et al. discovered that it was 8% (4 out of 50 patients) in their investigation.9. Our study is similar to the studies described previously.

According to a research by O'Donoghue et al., 88% of cholesteatomas could be detected by HRCT.10 Our research found slightly lower sensitivity as compared to this one. Less sample size was most likely the cause of this, as relatively few samples turned out to include just granulation tissue. Pre-operative HRCT of the temporal bone properly identified 46 out of 48 (96%) cholesteatomas, according to a related study by Mafee et al.11

The majority of experts concur that CT can identify soft tissue in the middle ear and can measure its length, but they also all agree that CT cannot identify a particular kind of tissue (granulation tissue vs. cholesteatoma, for example). 12 Additionally, we discovered that every otitis media patient had soft tissue in their middle ear.

Nonetheless, HRCT has a 79.06% sensitivity for cholesteatoma. Tegmen erosion and sigmoid plate erosion have 100% sensitivity and specificity, according to Karki et al.Thirteen The research conducted by Jackler et al. and Rogha et al. showed similar findings.14,15 Similar findings with low specificity of tegmen erosion were also seen in our investigation. Tatlipinar et al., in contrast, observed a fairly low sensitivity of 33% with a 100% specificity.16 Additionally, Jackler et al. discovered a low sensitivity rate for tegmen erosion detection.14 Rogha et al. reported sensitivity and specificity of HRCT in detecting lateral semicircular canal erosion were 75% and 87.5% respectively.17 Sirigiri et al. also obtained 100 and 94% sensitivity and specificity, respectively.8 According to a different study, the lateral semicircular canal erosion detection sensitivity and specificity were 77.78% and 98.2%, respectively.21 Our research demonstrates that lateral semicircular canal erosion has 100% sensitivity and specificity. This is due to the fact that we only discovered 2/50 individuals with LSCC erosion, and both of those patients had eroded during surgery. Our results line up with a research conducted by Datta et al.22 Comparable to our work, Datta et al. showed a sensitivity of 75% in detecting facial canal erosion. Their specificity, negative predictive value, and positive predictive value, however, were all higher than those of our investigation. Magliulo et al. found that facial canal erosion could be identified with a 69% sensitivity and an 87% specificity.18Our 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.

CONCLUSION

A trustworthy diagnostic method for the pre-operative assessment of chronic otitis media is high-resolution computed tomography (HRCT). It supports the surgical approach that helps avoid likely surgical problems and assists the operating surgeon in assessing the anatomical extent of the disease process. For ossicular chain erosion and tegmen tympani, HRCT shows a high sensitivity. Additionally, it is highly sensitive in the diagnosis of facial canal erosion and cholesteatoma. In order to assess the middle ear condition prior to surgery in cases of otitis media, HRCT of the temporal bone might be utilised.

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