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A Study to Evaluate the Role of High Resolution Ct Temporal Bone in Preoperative Assessment of Ossicular Chain Status In Chronic Suppurative Otitis Media Patients

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Abstract : *High Resolution Computed Tomography (HRCT) which provides minute structural details in the temporal bone is very important preoperative radiological investigation for CSOM cases. This study was planned to investigate the usefulness of a preoperative high-resolution computed tomography (HRCT) scan in depicting the status of ossicles in chronic suppurative otitis media (CSOM) of attico antral disease and also to compare the correspondence between preoperative CT findings and intraoperative ossicular chain status in these patients . 60 patients of all age groups suffering with CSOM of attico antral disease are included in the study. HRCT scanning was done for all patients before surgical exploration of the middle ear and mastoid. The sensitivity and specificity of preoperative HRCT in our study for diagnosing erosion of malleus were 100% and 98% respectively; and for erosion of incus were 91% and 100% respectively. Erosion of stapes was diagnosed by HRCT with 67% sensitivity and 100%specificity. According to the results of our study, HRCT scan acts a good preoperative imaging modality for the otologist to predict ossicular status during the surgery and to explain the possible hearing outcomes to the patient.*

Keywords: *Cholesteatoma, High-resolution computed tomography scan, Ossicular status.*

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I. Introduction

HRCT plays a significant role in the surgical management of individuals with CSOM particularly in patients with atticoantral disease. Conventional techniques of temporal bone imaging like X Ray Mastoid bones are replaced by High Resolution Computed Tomography (HRCT) these days. It has become essential investigation in preoperative planning for surgeon. HRCT scan plays a significant role in determining the surgical technique preoperatively by confirming the clinical otoscopic findings and defining the nature and extent of disease. The decision for the choice of surgical technique is of particular importance to preserve a higher hearing rate and prevent complications. HRCT imaging of the temporal bone, is playing an increasingly important role for diagnosis, surgical decision, and follow up. However, routine HRCT scanning prior to surgery in every patient of CSOM can only be justified if it can be shown to influence clinical management. We conducted this study to evaluate the role of preoperative HRCT in defining the extent and severity of the ossicular pathology in patients with CSOM of atticoantral disease and how it helps to plan for ossicular reconstruction and improve hearing outcome.

II. Aims And Objectives

1. To compare the veracity of computed tomography findings on patients undergoing surgery for Chronic Otitis Media (COM) with the surgical findings.
2. To determine to what extent the preoperative Computerized Tomography (CT) findings are useful to the surgeon to predict ossicular status during the surgery and plan for ossiculoplasty.
3. To determine to what extent the HRCT scan can act as preoperative imaging modality for the otologist to explain the possible outcomes to the patient.
4. To evaluate the results and compare data with similarly published studies.

III. Materials And Methods

This prospective study was conducted at a tertiary care hospital in Guntur between 2015 and 2016 in the Department of ENT. Study was carried out on 60 patients of CSOM with atticoantral disease. Patients with recurrent CSOM and patients with revision surgery, history of temporal bone fracture, known cases of temporal

bone neoplastic/granulomatous disease, cases unsuitable for surgery or scanning (such as ischemic heart disease or pregnancy), and those with a history of head and neck radiotherapy were excluded from the study. All these 60 patients underwent preoperative CT scanning followed by surgical exploration of the middle ear and mastoid. Initially, all patients ears were examined with otoscope in outpatient clinic before surgery. All patients had undergone pure tone audiometry (PTA) examination for hearing assessment. In HRCT, serial 1mm thick high resolution sections were taken in both axial and coronal planes. Axial images were taken parallel to the orbitomeatal plane. Coronal sections were taken parallel to vertical ramus of the mandible. Radiographs were evaluated with particular reference to ossicular status and without knowledge of the operative findings. All the scans were reported or verified by single senior radiologist. Mastoid exploration was done in all patients and the type of surgery determined by the clinical diagnosis, HRCT findings and intraoperative findings. The intraoperative extent of disease was studied. Operative notes were recorded and data collected on the status of the ossicles. Operative findings were compared with pre-operative HRCT scans in order to correlate the status of ossicular chain. The results were analyzed, studied and compared with similar studies of the past.

IV. Observations

Sixty patients were recruited in the study, 35 males and 25 females [TABLE 1]. In this study, the youngest patient was aged 7 years and the oldest patient was of 65 years. Twenty five percent (15) of patients were of the age group of 11 to 20 years. [TABLE 2] shows the age distribution of patients.

Table 1: Sex distribution of patient studied

Sl.No.	Sex	Number of patients	percentage
1	Males	35	58%
2	Females	25	42%

Table 2: Age distribution of patient studied

Sl.No.	Age Group	Number (n=60)	Percentage
1.	<10 Years	8	13%
2.	11-20 Years	15	25%
3.	21-30 Years	14	24%
4.	31-40 Years	5	8%
5.	41-50 Years	7	12%
6.	51-60 Years	5	8%
7.	>60 Years	6	10%

83% of patients had otorrhoea as their presenting complaints, followed by decreased hearing (70%) and (25%) earache [TABLE 3].

Table 3: Presenting symptoms and their distribution

SI.No	Chief complaints	No. of cases (n=60)	Percentage
1	Otorrhoea	50	83%
2	Decreased Hearing	42	70%
3	Earache	15	25%
4	Headache	8	13%
5	Tinnitus	5	8%
6	Giddiness	5	8%
7	Facial Paralysis	1	2%

All patients were examined with otoscope and microscope which revealed retraction pocket with cholesteatoma flakes in 18 patients (30%), cholesteatoma with granulations in 14 patients (23%) and only granulations in 13 patients (22%). Polyp was observed in 10 patients (17%) and marginal perforation in 5 patients (8%) [TABLE 4]. Modified radical mastoidectomy was performed on 32 patients, and simple mastoidectomy with tympanoplasty on 22 patients and simple mastoidectomy with myringoplasty on 6 patients.

Table 4: Distribution of patients according to their otoscopic findings.

SI.No	Otoscopic Findings	No. of cases (n=60)	Percentage
1	Retraction Pocket with Cholesteatoma	18	30%
2	Cholesteatoma with Granulation tissue	14	23%
3	Granulation Tissue	13	22%
4	Polyp	10	17%
5	Marginal Perforation	5	8%

In diagnosing Cholesteatoma, HRCT was found to be very sensitive (96%) but it could not differentiate cholesteatoma from granulations and hence was less specific (87%) [TABLE 5].

Table 5: Correlation of HRCT findings and surgical findings regarding cholesteatoma.

Correlation	Clinical examination	HRCT	Surgery	Cases in agreement	False +ve	False -ve	Sensitivity	Specificity
Evidence of cholesteatoma	52	53	51	50	3	1	96%	87%

Commonest overall ossicular pathology is erosion of incus in 56 patients (93%) with next erosion of handle of malleus in 20 patients (33 %,) followed by erosion of head of malleus in 16 patients (27%), least ossicular pathology seen is stapes erosion in 12 patients (20%)[TABLE 6].

Table 6: Intra - operative ossicular status (n=60)

SI.No	Ossicular status	No of patients	Percentage
1	Malleus- Head erosion	16	27%
2	Malleus-Handle erosion	20	33%
3	Incus erosion	56	93%
4	Stapes erosion	12	20%

HRCT scan diagnosed erosion of malleus with 100% sensitivity and 98% specificity. Diagnosis of erosion of incus was made with 91% sensitivity and 100% specificity and that of erosion of stapes with 67% sensitivity and 100% specificity. HRCT showed inconsistent visualization of stapes in our study and has less sensitivity for detecting erosive changes of stapes, hence more cases were found with normal ossicles in CT compared to per-operative findings [TABLE 7].

Table 7: Correlation of HRCT findings and surgical findings regarding ossicular involvement.

Finding	HRCT	Surgery	Cases in agreement	False Positive	False Negative	Sensitivity	Specificity
Malleus-Head erosion	17	16	16	1	0	100%	98%
Malleus-Handle erosion	21	20	20	1	0	100%	97%
Incus erosion	54	56	56	0	2	91%	100%
Stapes erosion	7	12	7	0	5	67%	100%

V. Discussion

The exact role of HRCT in the preoperative assessment of patients with chronic otitis media is controversial [1]. Some authors have reported a high degree of accuracy in the diagnosing the pathology of ossicular chain and inner ear conditions [2] while others have concluded that HRCT should not be relied as it has a poor ability to diagnose cholesteatoma [3]. Our study confirmed that HRCT is substantially reliable in the determination of the status of the ossicular chain. This result conforms to other studies [2, 3, 5]. Presurgical knowledge of the status of the ossicular chain would allow the surgeon to be ready for ossicular chain reconstruction and to better advise the patient on the degree of hearing attainable after surgery.While a definitive diagnosis of cholesteatoma can only be made at the time of surgery, the scan picture may at times influence the decision and timing of surgical exploration. Scan evidence of cholesteatoma with significant bony destruction or other complications could prompt the surgeon to operate earlier, particularly if polyps or a tortuous bony canal obscures visualization of the tympanic membrane and hinders clinical diagnosis. Therefore, HRCT findings enable the surgeon to be informed of the risk factors and to be prepared for the possibility of complications.

Bone erosion occurs more commonly in the long process of the incus, the body of the incus, and the handle of the malleus. Cholesteatoma of the pars tensa extends to the long process of the incus and the superstructure of the stapes. On HRCT, malleus and incus could be visualised with ease but that is of clinical value only when the whole ossicular chain can be demonstrated. A sensitivity of 81.4% in identifying incus erosion was reported by O'Donoghue *et al*.[2]. HRCT predicted the status of malleus with 100% sensitivity [2]. Jackler *et al.* were able to predict the status of ossicular chain in only 7% of their cases [6]. The handle of malleus, long processes of incus and the stapes suprastructure are the components most at risk in CSOM but are also the most difficult to demonstrate on HRCT [7]. Phleps and Wright doubted that HRCT could demonstrate the ossicular chain reliably because of partial volume averaging and tissue silhouetting [8]. The minimal accuracy for stapes erosion observed may be the result of the small size of the bone. Previous studies have used 2–3 mm slices of temporal bone CT scan to detect stapes status [9]. Some findings with a low specificity due to the partial volume effect can be improved by employing finer cuts of the CT scan. False positive results may be due to a partial volume effect and can be improved by fine slices of CT. In our study, HRCT correctly detected ossicular erosion in 85.7% cases which is similar to studies by Mafee *et al*. [5], Garber and Dort [3] and Jackler *et al*. [6]. The sensitivity and specificity of preoperative HRCT in our study for diagnosing erosion of malleus were 100% and 98% respectively and for erosion of incus were 91% and 100% respectively. Erosion of stapes was diagnosed by HRCT with 67% sensitivity and 100%specificity. In our study, HRCT detected malleus erosion and incus erosion correctly. It was less sensitive for identifying stapes involvement (sensitivity value of 67%). The presence of a soft tissue density around the stapes made it difficult in identifying the erosion of this bone. We found CT scan having a high sensitivity in detecting the ossicular destruction, except for the stapes. This is in agreement with the studies by Mafee *et al*. [5], Garber and Dort [3], Jackler *et al.* [6]. The specific issues that must be assessed on imaging studies and that will affect the surgical treatment are bone erosion and the degree of extension. HRCT is sensitive for the detection of early bone erosions and detailed imaging of the soft tissue extent of middle ear cholesteatoma. The hallmarks of the cholesteatoma are the presence of non-dependent soft tissue density in middle ear cavity, ossicular erosion, smooth erosions of the middle ear borders and adjacent structures. These changes when associated with bony expansion of the middle ear cavity and aditus ad antrum are highly suggestive of cholesteatoma. Erosion of the ossicles is commonly seen with cholesteatomas, as they enlarge and come in contact with contiguous structures in the middle ear. Total absence of the ossicle suggests its complete erosion. The HRCT scan gives a good to excellent radiosurgical correlation for the middle ear ossicles in our cases, and this is also the experience that others have reported [2,4,5,6,10,12,13,14]. Prior knowledge of the status of ossicles decides the likelihood of hearing preservation achieved after surgery. Patients with intact stapes tend to show better hearing preservation as compared to those where the superstructure is absent [4,10,14,15,16,17].

VI. Conclusion

In conclusion, the results of this study suggest that the preoperative HRCT scan imaging in cases of cholesteatoma and ossicular chain erosion have good correlation with intraoperative findings. HRCT of the temporal bone is therefore a useful guide to the surgeon in managing patients with CSOM with atticoantral disease. We believe that HRCT is a guide as to the nature of the disease (destructive/non-destructive), potential dangers (such as SCC fistula) and possible complications and this information can assist the surgeon in the choice of surgery to be performed (simple or radical mastoidectomy, with or without tympanoplasty). As it is important to recognize the disease early to adopt a surgical procedure, to save the patient from loss of hearing and to prevent the grave intracranial complications, advising patients a routine HRCT prior to surgery can be justified. It can predict the outcome of the surgery and also helps in discussing these possibilities with the patient.

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