



Role of High Resolution Computed Tomography of Temporal Bone in Patients with Cholesteatoma, in a Tertiary Care Health Center

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Abstract The aim of this study is to evaluate the necessity of high resolution computed tomography (HRCT) temporal bone in patients with active squamosal chronic otitis media, by comparing the preoperative HRCT temporal bone findings with intra operative findings in a tertiary care health center where patient load is tremendous. This study was conducted in the department of otorhinolaryngology, over a period of two years from November 2017 to November 2019 in which 100 patients with active squamosal chronic otitis media diagnosed clinically were taken. All patients underwent preoperative HRCT temporal bone and subsequent tympanomastoidectomy. The results of HRCT temporal bone of all the patients were evaluated and correlated with intraoperative findings which revealed that HRCT is highly sensitive for detecting, soft tissue extension, tympanic membrane perforation, ossicular erosion, tegmen erosion, sigmoid sinus erosion, facial canal dehiscence and lateral semicircular canal fistula, which helps in guiding the surgical approach and treatment plan preoperatively.

Keywords HRCT · Tympanomastoid surgery · Correlation

Introduction

Anatomical variation of the temporal bone is very common and is a significant source of concern in otologic surgeries [1]. In patients with active squamosal chronic suppurative

otitis media the pre operative assessment of facial canal, lateral semicircular canal, dural plate and sigmoid plate structures is important to avoid complications during surgery [2].

High-resolution computed tomography (HRCT), provides a direct visual window of the temporal bone providing vision of unavailable minute structural details [3]. Advantages of HRCT are its ability to detect the extent of cholesteatoma in temporal bone and hidden areas. It assists the surgeon to take decision regarding the type of surgical procedure, canal wall up or canal wall down [4].

The purpose of this study is primarily to determine the necessity of HRCT in diagnosis and detection of various pathological changes in the temporal bone in a case of chronic suppurative otitis media (CSOM). Facial canal erosion, lateral semicircular canal erosion, and dural plate defect can be seen in patients who have COM with or without cholesteatoma [5, 6]. Although LSC erosion increases the risk of developing labyrinthitis, dural plate erosion raises the probability of spreading the pathology to the brain, sigmoid sinus plate erosion may lead to venous sinus thrombosis and facial canal erosion may lead to facial nerve palsy. Having preoperative comprehensive knowledge of the anatomy and anomalies of these critical structures is crucial for preventing postoperative morbidity in patients who require surgery due to middle ear disorders and help in justifying the type of tympanomastoid surgery done like canal wall up or canal wall down procedure [7].

Aims and Objectives

The aim of this study is to evaluate the necessity of high resolution computed tomography (HRCT) temporal bone in patients with active squamosal chronic otitis media, by

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comparing the preoperative HRCT temporal bone findings with intra operative findings and providing preoperative counselling to the patient regarding type of the procedure to be done and prognosis of the disease.

Materials and Methods

This prospective study was conducted in the department of otorhinolaryngology over a period of 2 years from November 2017 to November 2019 in which 100 patients with active squamosal chronic otitis media diagnosed clinically with microscopic examination were taken. HRCT temporal bone was done in all cases. All the cases underwent surgery and intraoperative findings were noted. Comparison was done between HRCT and intraoperative findings. The parameters of comparison between preoperative HRCT findings and the intraoperative ones were calculated by using sensitivity, specificity, positive predictive value, negative predictive value. Chi-square test was used to detect any statistically significant difference in the findings of these two categories. A *P* value of less than 0.05 was considered as the cutoff point for statistical significance. The parameters of comparison were tympanic membrane perforation, oedema of middle ear mucosa, dural plate erosion, sigmoid sinus plate erosion, facial canal erosion, ossicular status, lateral semicircular canal erosion.

Results

The results of HRCT temporal bone of all the patients were evaluated and correlated with intraoperative findings. A total of 100 patients were included in the final analysis in which 64 (64%) were male and 36 (36%) were female who underwent tympanomastoid surgery, belonging to the age range of 9–50 years. The mean age of the patients was 28 years (Figs. 1, 2).

On comparing the preoperative findings of the HRCT with the intraoperative findings, tympanic membrane perforation was reported in HRCT of 35 patients (35%);

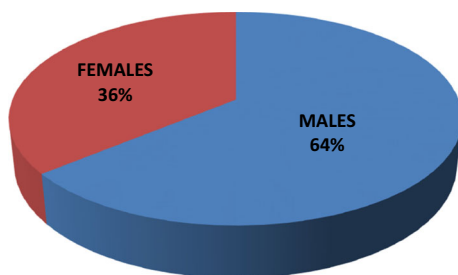


Fig. 1 Sex wise distribution of patients

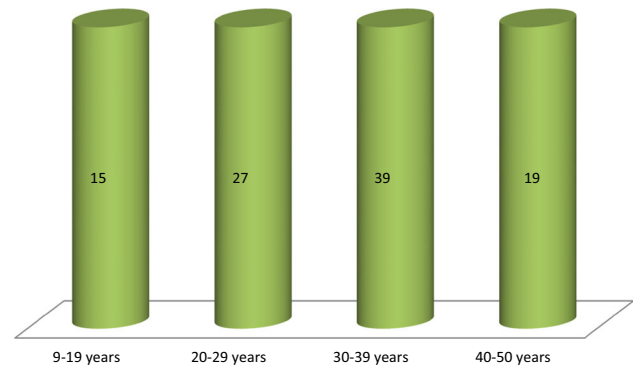


Fig. 2 The distribution of study participants according to various age groups

however intraoperatively tympanic membrane perforation was found in 40 patients (40%) (Table 1).

Sensitivity of HRCT temporal bone for tympanic membrane perforation was found out to be 87.5%, specificity is 100%, positive predictive value is 100%, negative predictive value is 92.31%, chi square value is 2.073 and *P* value 0.1499 which is insignificant.

Facial canal erosion was reported in HRCT of 25 patients (25%) and it was seen intraoperatively in 25 patients (25%). Tympanic segment was found to be eroded in 10 patients and mastoid segment was involved in 15 patients (Table 2).

Sensitivity of HRCT temporal bone for facial canal erosion was found out to be 100%, specificity is 100%, positive predictive value is 100%, negative predictive value is 100%, chi square test cannot be applied for the above data as both have similar results.

As for sigmoid plate erosion, there was similar observation in both preoperative HRCT and the intraoperative findings with 16 (16%) patients presenting with the finding of sigmoid plate erosion on both HRCT temporal bone and intraoperatively (Table 3).

Sensitivity of HRCT temporal bone for sigmoid sinus plate erosion was found out to be 100%, specificity is 100%, positive predictive value is 100%, negative predictive value is 100%, chi square test cannot be applied for the above data as both have similar results.

Dural plate erosion was reported on HRCT in 33 (33%) patients while intraoperatively it was found to be eroded in 35 (35%) patients (Table 4).

Sensitivity of HRCT temporal bone for dural plate erosion was found out to be 94.29%, specificity is 100%, positive predictive value is 100%, negative predictive value is 97.01%, chi square value is 0.089, and *P* value is 0.7659 which is insignificant.

Edema of middle ear mucosa was reported in 10 (10%) patients on HRCT temporal bone whereas only 5 (5%)

Table 1 : Comparison of tympanic membrane perforation finding

Tympanic membrane	HRCT (%)	Intraoperative findings (%)
Perforation	35 (35%)	40 (40%)
Intact	65 (65%)	60 (60%)
Total	100 (100%)	100 (100%)

Table 2 : Comparison of facial canal erosion

Facial canal	HRCT (%)	Intraoperative findings (%)
Erosion	25 (25%)	25 (25%)
Intact	75 (75%)	75 (75%)
Total	100 (100%)	100 (100%)

Table 3 : Comparison of sigmoid sinus plate erosion

Sigmoid plate	HRCT (%)	Intraoperative findings (%)
Erosion	16 (16%)	16 (16%)
Intact	84 (84%)	84 (84%)
Total	100 (100%)	100 (100%)

Table 4 : Comparison of dural plate erosion

Dural plate	HRCT (%)	Intraoperative findings (%)
Erosion	33 (33%)	35 (35%)
Intact	67 (67%)	65 (65%)
Total	100 (100%)	100 (100%)

patients intraoperatively showed edematous middle ear mucosa (Table 5).

Sensitivity of HRCT temporal bone for edematous middle ear mucosa was found out to be 100%, specificity is 94.74%, positive predictive value is 50%, negative predictive value is 100%, chi square value is 1.793, and *P* value is 0.1806 which is insignificant.

Malleus appeared to be eroded in the CT in 28 cases (28%) whereas the intraoperative observation showed that

39 (39%) cases had eroded malleus. On the other hand, eroded incus was reported in 86 (86%) cases based on CT and similarly intraoperatively. Stapes erosion was reported in 31 (31%) on CT and intraoperatively found to be eroded in 32 (32%) cases (Table 6).

P value for malleus erosion is 0.09, *P* value for stapes erosion is 0.88, while *P* value for incus erosion is not applicable as both HRCT and intraoperative findings have similar results. Since the *P* values for all three ossicles

Table 5 : Comparison of edematous middle ear mucosa

Middle ear mucosa	HRCT (%)	Intraoperative findings (%)
Edematous	10 (10%)	5 (5%)
Normal	90 (90%)	95 (95%)
Total	100 (100%)	100 (100%)

Table 6 : Comparison of ossicular erosion

Ossicles	HRCT (%)	Intraoperative findings (%)
Malleus erosion	28 (28%)	39 (39%)
Incus erosion	86 (86%)	86 (86%)
Stapes erosion	31 (31%)	32 (32%)

erosion is > 0.05 , thus proving there is no significant difference between HRCT temporal bone and intraoperative findings.

Preoperatively HRCT showed erosion of lateral semicircular canal in 33 (33%) patients and intraoperatively 35 (35%) patients found to have lateral semicircular canal erosion (Table 7).

Sensitivity of HRCT temporal bone for lateral semicircular canal erosion was found out to be 94.29%, specificity 100%, positive predictive value is 100%, negative predictive value is 97.01% chi square value is 0.089, and *P* value is 0.7659 which is insignificant.

Discussion

High resolution computed tomography of temporal bone is considered as the most important imaging technique for assessing the extent of cholesteatoma in mesotympanum, hypotympanum, status of facial canal and labyrinthine canal which cannot be evaluated by otomicroscopy [7, 8]. HRCT provides the direct visual bony window of the temporal bone providing minute structural details of the critical structures before surgery. HRCT provides the roadmap to surgeons, especially for complex cases and revision surgery [9, 10]. It provides post operative prognosis of the patient beforehand and also helps in counseling the patient regarding morbidity he/she will have after surgery.

Based on our observations, most common eroded ossicle was incus which was found in 86 (86%) patients on both HRCT and intraoperatively. There was a significant relation between incus erosion intraoperatively and incus erosion on CT with 100% sensitivity and 100% specificity which was similar to the study done by karki et al., who

studied the correlation between preoperative HRCT findings and the surgical findings in cases with CSOM [11]. As for other ossicles, we found that malleus was eroded in 28 (28%) cases on CT while intraoperatively it was found to be eroded in 39 (39%) patients. Stapes was reported eroded in 31 (31%) cases on CT and 32 (32%) patients were found to have eroded stapes intraoperatively. Erosion of either the incus or the stapes was detected by the preoperative CT scan with high accuracy. The results were similar to the study done by Datta et al. [12] which showed ossicles destruction with 89% sensitivity and 85% accuracy. In contrast to our study Rogha et al., [6] found that the stapes was not consistently visualized by the preoperative CT; however when it is seen it usually appeared as a structure of soft tissue density in the oval window niche Therefore, finer slice of temporal bone CT are required to help detect the status of stapes. Previous knowledge of status of ossicles decides likelihood of hearing preservations achieved after the surgery [13] and also tell about requirement of ossiculoplasty intraoperatively.

We found 100% sensitivity and specificity of CT scan and intraoperative observation to detect sigmoid sinus plate erosion which was similar to the study done by Rogha et al. [6]. They found that the CT scan correlation was excellent for the sigmoid plate erosion

In our study HRCT showed erosion of lateral semicircular canal in 33 cases and intraoperatively found to have erosion in 35 patients, thus showing sensitivity of 94.29% and specificity of 100%. Reddy et al. [14] showed sensitivity 60% and specificity 90%. In the study done by Datta et al. [13] and Gomma et al. [12, 15] observed erosion of LSC on HRCT showed 100% sensitivity and specificity Study done by Prata et al., [16] showed sensitivity 100% and specificity 96%. In the study done by Payal et al., [17] sensitivity was 66% and specificity was 83%. HRCT

Table 7 : Comparison of lateral semicircular canal erosion

Lateral semicircular canal	HRCT (%)	Intraoperative findings (%)
Erosion	33 (33%)	35 (35%)
Normal	67 (67%)	65 (65%)
Total	100 (100%)	100 (100%)

depicts bone erosion even in the absence of fistula, which helps the surgeon intraoperatively in careful removal of cholesteatoma to prevent labyrinthine fistula formation [13]. and also helps in knowing whether patient will have post operative giddiness or not.

As observed in our study, facial canal erosion was seen in 25 cases on HRCT and intraoperatively also all 25 patients were found to have eroded facial canal showing 100% sensitivity and 100% specificity. The results were similar to the study done by Dutta et al., [4] Reddy et al., [5]

So overall, we found a good correlation between preoperative HRCT and intraoperative findings. It is confirmed to be valuable radiological diagnostic tool and helps in guiding the surgical management.

Conclusion

HRCT has shown good results with significant correlation of diagnostic value with the findings intraoperatively. It provides useful information on anatomical variations of temporal bone and also enhances preoperative evaluation of cholesteatoma, its extension, erosions and complications. Therefore HRCT temporal bone is one of the most useful guide for the surgeon for early detection of cholesteatoma, planning type of surgery, before hand explaining the patient about the prognosis, morbidity, post operative hearing results, despite its pitfalls as radiation exposure and high cost.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval Study was approved by ethical committee.

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