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ORIGINAL ARTICLE

How Efficacious is HRCT Temporal Bone in Determining the Ossicular Erosion in Cases of Safe and Limited Squamous Type CSOM?

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Abstract HRCT temporal bone is a very valuable radiological investigation. However its still not widely used by otologists for routine surgeries. Ossicular erosion is often encountered unexpectedly in safe cases of CSOM and in limited squamous type of cases. If preoperative diagnosis of ossicular erosion is made then otologist can preoperatively plan ossicular reconstruction techniques leading to improved results. We conducted a study in 60 patients to evaluate the efficacy of HRCT temporal bone in determining ossicular erosion in cases of CSOM. It was a diagnostic observational study where surgical finding of ossicular erosion was taken as a gold standard. Sensitivity specificity; positive predictive value and negative predictive value of HRCT was calculated in detecting malleus; incus and stapes erosion. P value was calculated. Sensitivity and specificity for malleus erosion was 78.5% and 78.1% respectively. Sensitivity and specificity for incus erosion was 73.1% and 57.8% respectively. Sensitivity and specificity for stapes erosion was 52% and 57.1% respectively. P value was less than 0.05. We concluded that HRCT is a good adjunct for determining the ossicular erosion and its use should be encouraged by the otologist.

Keywords HRCT temporal bone · Ossicular erosion · Efficacy

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Introduction

Chronic otitis media is the term used to describe any chronic inflammatory pathology of middle ear. It has been an important cause of middle ear disease since prehistoric times. Despite the valuable contribution of antibiotics, chronic otitis media remains a common disease and its complications challenge both otologist and radiologists [1, 2]

1. Otitis media and resultant hearing loss remain a significant international health problem in terms of prevalence, economics, and sequelae. Short term and long term sequel of otitis media may be devastating. It can be avoided if recognised and treated properly [3, 4].

2. Radiological examination of temporal bone helps us to achieve this objective. It is the computed tomography which has made the most important contribution to radiology in otolaryngology. Though otitis media is essentially a clinical diagnosis but high resolution computed tomography (HRCT) is useful for showing evidence of ossicular erosion in acute and chronic mastoiditis, extent of pneumatisation of temporal bone and relationship of pathology of adjacent critical neurovascular structure such as dura, internal carotid artery, facial nerve and lateral sinus. It is now being claimed that a cholesteatoma as small as 3 mm in size can be diagnosed much earlier by the use of HRCT and also for a cholesteatoma behind an intact tympanic membrane imaging is important [5].

The main benefit of HRCT in cases where the cholestetoma with scarring, granulation tissue, or post-surgical changes in which the resulting soft tissue masses were indistinguishable. HRCT has a significant impact on

the medical and surgical management of individuals with middle ear disease. It confirms and expands upon otoscopic findings, resolves clinical doubts and in many circumstances, play a significant role in determining surgical efficacy. However routine HRCT scanning prior to all surgeries of cholesteatoma can only be justified if it can be shown to influence clinical management [6].

HRCT has not gained wide acceptance as an essential aid to plan a surgery, main objective of current study was to evaluate sensitivity and specificity of HRCT temporal bone in identifying ossicular necrosis preoperatively as compared with intra operative findings in chronic otitis media cases.

Methods and Materials

Present analytical observational study was carried out from January 2015 to December 2017 on consecutive 60 patients of chronic otitis media from inpatient department of ENT at Sri Guru Ram Das Medical College, Sri Amritsar. All patients were admitted in ENT department. Necessary permission and approval from ethics committee and authority, prior to starting the study was taken. Informed consent and assent was taken from patients according to protocol of ethics committee of our institution. Patient confidentiality was maintained at all the times during course of study.

Following were inclusion and exclusion criteria
Inclusion criteria:

1. Age group: 8–70 years
2. Chronic otitis media with hearing loss without complication

Exclusion criteria:

1. Chronic otitis media with complication

After selection of patients detailed history with regard to otorrhoea, deafness, otalgia, vertigo, tinnitus was taken and recorded in a systematic manner.

After general physical examination, a thorough and detailed otorhinolaryngological examination and routine physical examination, these patients were subjected to a pre- operative HRCT Temporal bone.

The HRCT was done using a SIEMENS SOMATOM EMOTION 6 to get images in the axial and coronal plane, reformatting was done to a slice thickness of 0.6. Axial projection was obtained by serial 1–2 mm thin sections of the temporal bone with the line joining the infraorbital rim and external auditory meatus perpendicular to the table. The pre-operative scans were evaluated by a single experienced radiologist for the following main areas of interest

1. Malleus necrosis
2. Incus necrosis
3. Stapes necrosis

Although other parameters like bony erosions, soft tissue mass and facial nerve dehiscence were included in reporting but our main areas of evaluation for this study were concentrated on above said three findings. After thorough review of clinical findings, radiological findings and pathology of the disease, a surgical plan was formulated. General anesthesia fitness was taken and then surgery was performed. Canal wall up and canal wall down procedures were performed depending upon extent of the disease. Operative findings were recorded on a standard proforma under same parameters as above.

The pre-operative HRCT findings and intraoperative findings were then compared for each patient. A thorough Statistical evaluation was done, comparative tables were formulated for specific parameters to be studied.

McNemar test was used to formulate cross tabs comparing the pre-operative HRCT findings and intraoperative findings and hence, true positive, false negative, false negative, false positive and true negative patients were calculated for each of the malleus necrosis, incus necrosis, stapes necrosis. Using this data P values were calculated and so were the sensitivity, specificity, postive predictive values and negative predictive values of HRCT temporal bone in diagnosing the ossicular necrosis that was confirmed intraoperatively, considering intra operative findings the gold standard for comparison.

Following formulae were used

$$\text{Sensitivity} = \text{True positive (TP)}/\text{True positive (TP)} + \text{False negative (FN)} \times 100$$

$$\text{Specificity} = \text{True negative (TN)}/\text{False positive (FP)} + \text{True negative} \times 100$$

$$\text{Positive predictive values (PPV)} = \text{TP}/(\text{TP} + \text{FP}) \times 100$$

$$\text{Negative predictive values (NPV)} : \text{TN}/(\text{FN} + \text{TN}) \times 100$$

Results

HRCT showed incidence of malleus erosion in about 29 out of 60 patients. Out of these only 22 confirmed malleus erosion intraoperatively. HRCT didn't detect malleus erosion in 6 patients. The sensitivity was 78.5% and specificity 78.1% (Table 1; Fig. 1). HRCT detected incus erosion in 38 patients out of which only 30 were confirmed to have incus erosion on surgery. It had a sensitivity and specificity of 73.1 and 57.8% respectively (Table 2; Fig. 2). Stapes was found to be eroded in 28 patients on HRCT out of

Table 1 Malleus erosion on HRCT in comparison to intraoperative findings

	Intraoperative		Total
	−ve	+ve	
HRCT −ve	25	6	31
HRCT +ve	7	22	29
Total	32	28	60

TP = 22, FP = 7, TN = 25, FN = 6; sensitivity = 78.5%, specificity = 78.1%; PPV = 75.8%, NPV = 80.6%
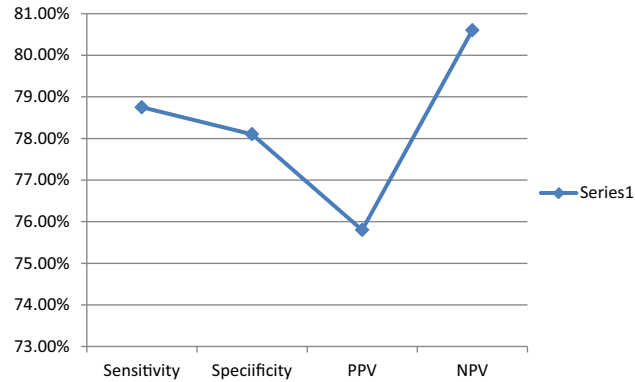

Fig. 1 Depicting various parameters of HRCT in evaluating malleus erosion

Table 2 Incus erosion on HRCT in comparison to intraoperative findings

	Intraoperative		Total
	−ve	+ve	
HRCT −ve	11	11	22
HRCT +ve	8	30	38
Total	19	41	60

TP = 30, FP = 8, TN = 11, FN = 11; sensitivity = 73.1%, specificity = 57.8%; PPV = 78.9%, NPV = 50%
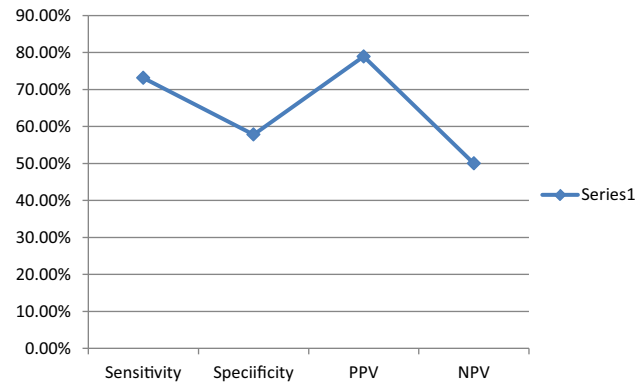

Fig. 2 Depicting various parameters of HRCT in evaluating incus erosion

Table 3 Stapes erosion on HRCT as compared to intraoperative finding

	Intraoperative		Total
	−ve	+ve	
HRCT −ve	20	12	32
HRCT +ve	15	13	28
Total	35	25	60

TP = 13, FP = 15, TN = 20, FN = 12; sensitivity = 52%, specificity = 57.1%; PPV = 46.2%, NPV = 62%
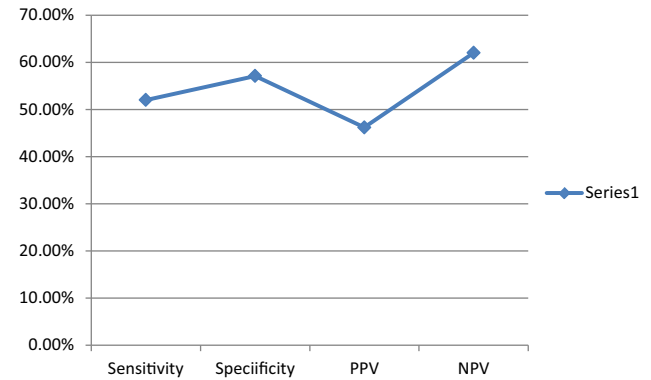

Fig. 3 Depicting various parameters of HRCT in evaluating stapes erosion

which only 13 were confirmed on surgery with sensitivity of 52% and specificity of 57.1% (Table 3; Fig. 3). *P* value was 0.05.

Discussion

The advent of HRCT in 1980 has allowed excellent preoperative imaging of anatomy, evidence of extent of disease and screen for asymptomatic complications. It had not gained wide acceptance as an essential aid in planning surgery as most clinicians preoperative scanning for selected cases such as complication, revision surgeries or with congenital anomalies. Routine HRCT can be justified if it is shown to influence the clinical management, thus converting surgery into planned surgery.

The present study was carried out to find out specificity and sensitivity of HRCT temporal bone in determining the status of ossicular chain preoperatively. According to this diagnostic Observational study done in 60 patients, with preoperative scanning being done in every patient posted for tympanomastoid surgery and findings being confirmed intraoperatively it documented particularly that HRCT has high specificity and sensitivity in cases of ossicular erosion.

Although present study was limited to cases of chronic otitis media but some cases of unsafe pathology were also

included. It was found that HRCT was effective in preoperative diagnosis of ossicular necrosis in such cases. Though the strength of this study was that it was a prospective study with a well balanced cohort and accurate data collection by same radiologist preoperatively and same surgeon intraoperatively in all cases but the drawback was that randomization was not done. Therapeutic plan was well framed and executed for all cases keeping surgical findings as gold standard for deciding extent of intervention in all cases. Study parameters were kept same for preoperative HRCT findings and intraoperative findings for balanced comparison, sensitivity, specificity, positive predictive negative predictive values were calculated according to standard formulas and P values was sorted out for each observation.

In present study of 60 cases, the sensitivity of HRCT in malleus erosion was 78.5% and specificity was 78.1%, and this was high as compared to sensitivity and specificity of stapes erosion which was 52.3 and 57.1% respectively, however P value for both malleus erosion and stapes necrosis was significant, giving evidence that HRCT is good diagnostic modality for preoperative identification of malleus and stapes necrosis. However reason for low sensitivity in cases of stapes erosion can be due to non consistent visualisation and when seen it appears as a soft tissue density in oval window niche and for these reasons it was not possible to distinguish between destruction of stapes and its mere entrapment by soft tissue.

In a study by conducted Rogha et al. [7] and Garg et al. [8] have reported that sensitivity of malleus erosion in both studies were 82.4 and 90% and specificity of 87 and 89.47% for malleus erosion, sensitivity and specificity for stapes necrosis came out to be 61.9, 66.7, 40 and 26.67% respectively. These studies correlated with the evidence suggested by present study.

However preoperative erosion of incus was seen in 63% cases (n = 60) while it was confirmed in 50% cases, there were 11 false negative cases, hence bringing sensitivity to 73.1% while specificity of HRCT dropped to 57.8%, positive predictive value 78.9% and negative predictive value was 50%, calculated P value was significant inferring that HRCT is good investigation for diagnosing incus necrosis preoperatively.

Present study correlated for diagnosing incus erosion in studies conducted by Shah et al., Zhang et al., Chee and Tan, Gomma et al., Datta et al., Rogha et al., O ' Donoghue et al., which showed sensitivity 90, 85, 85, 85.7, 87, 90.6, 81.4% and specificity of Shah et al. and Rogha et al. was 66.7 and 50% respectively [7, 9–14]. After correlation with above mentioned national and international literature it is our impression HRCT has a role in in evaluation of chronic otitis media cases preopratively.

Conclusion

HRCT is good preoperative diagnostic modality for identifying malleus, incus and stapes necrosis preoperatively and its use by otologist is to be encouraged for better adjunctive preoperative assessment and better surgical outcome.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no competing interests.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

1. Mafee MF, Kumar A, Yannias DA, Valvassori GE, Applebaum EL (1983) CT of the middle ear in evaluation of cholesteatoma and other soft tissue masses comparison with pluridirectional tomography. Radiology 148(2):465–472
2. Hughes GB (1979) Cholesteatoma and the middle ear cleft. A review of pathogenesis. Am J Otol 1:109–114
3. Beaumont GD (1980) Radiology in management of chronic suppurative otitis media. Australas Radiol 24:238–245
4. Goycoolea MV (1982) Otitis media: definitions and Pathogenesis. In: Paparella MM, Goycoolea MV (eds.) Clinical problems in otitis media and innovations in surgical otology. Ear Clinics International volume II. Williams & Wilkins, Baltimore, p 154
5. Jackler RK, Dillon WP, Schindler RA (1984) Computed tomography in suppurative ear disease: a correlation of surgical and radiographic findings. Laryngoscope 94:746–752
6. Swartz JD, Goodman RS, Russell KB et al (1983) High resolution computed tomographyof the middle ear and mastoid. Part II tubotympanic disease. Radiology 148:455–459
7. Rogha M, Hashemi SM, Mokhtarinejad F, Eshaghian A, Dadgostar A (2014) Comparison of preoperative temporal bone CT with intraoperative findings in patients with cholesteatoma. Iran J Otorhinolaryngol 26:7–12
8. Garg P, Kulshreshtha P, Motwani G, Mittal MK, Rai AK (2012) Computed tomography in chronic suppurative otitis media: value in surgical planning. Indian J Otolaryngol Head Neck Surg 64(3):225–229
9. Shah C, Shah P, Shah S (2014) Role of HRCT temporal bone in preoperative evaluation of cholesteatoma. Int J Med Sci Public Health 3(1):69–72
10. Zhang X, Chen Y, Liu Q, Han Z, Li X (2004) The role of high-resolution CT in the pre-operative assessment of chronic otitis media. Lin Chung Er Bi Yan Hou Ke Za Zhi 18:396–398
11. Chee NW, Tan TY (2001) The value of pre-operative high resolution CT scans in cholesteatoma surgery. Singap Med J 42:155–159
12. Gomma MA, Karim AR, Ghany HSA, Elhiny AA, Sadek AA (2013) Evaluation of temporal bone cholesteatoma and the correlation between high resolution computed tomography and surgical findings. Clin Med Insight Ear Nose Throat 6:21–28
13. Datta G, Mohan C, Mahajan M, Mendiratta V (2014) Correlation of preoperative HRCT findings with surgical findings in unsafe CSOM. Inter Organ Dent Med Sci 13(1):120–125
14. O'Donoghue GM, Bates GJ, Anslow P, Rothera MP (1987) The predictive value of high resolution computerized tomography in chronic suppurative ear disease. Clin Otolaryngol Allied Sci 12:89–96