International Journal of Otorhinolaryngology and Head and Neck Surgery
Dashottar S et al. Int J Otorhinolaryngol Head Neck Surg. 2019 Jan;5(1):77-82
http://www.ijorl.com
pISSN 2454-5929 | eISSN 2454-5937

Original Research Article

DOI: http://dx.doi.org/10.18203/issn.2454-5929.ijohns20185070

Preoperative temporal bone HRCT and intra-operative findings in middle ear cholesteatoma: a comparative study

Sunita Dashottar[1], Atul Bucha[2]*, Shilpa Sinha[1], Devender Nema[1]

Department of Radiodiagnosis, [1]Command Hospital, [2]Base Hospital, Lucknow, Uttar Pradesh, India

Received: 28 September 2018
Accepted: 30 November 2018

***Correspondence:**
Dr. Atul Bucha,
E-mail: docatul10@hotmail.com

ABSTRACT

Background: Middle ear cholesteatoma is a potentially dangerous condition owing to the varied extra-cranial as well as intra-cranial complications, it can be associated with. Clinical suspicion and otologic examination sufficiently identifies the pathology but its entire extent and spread is delineated by HRCT examination only, which is presently the 'Gold Standard'. In this study we tried to evaluate the efficacy of HRCT temporal bone in depiction of extent of pathology in cases of cholesteatoma of middle ear and we tried to verify the findings of HRCT imaging with intra-op findings.

Methods: A prospective observational study comprising of 50 patients suspected of middle ear cholesteatoma was carried out at a tertiary care hospital in Lucknow, India. Pre-op evaluation with bilateral temporal bone HRCT imaging followed by suitable surgery was performed. Important pre-operative HRCT and intra-operative surgical findings were correlated for statistical significance.

Results: Mesotympanum involvement (96%) was the most common HRCT finding as far as location and extent were concerned and incus erosion (70%) was the most common bony complication. A high sensitivity and specificity (82% -100%) of HRCT was found in detection of Erosion of scutum, tegmen tympani and incus. For findings such as stapes erosion and facial canal erosion on HRCT, a sensitivity of 68.4% and 50% respectively was found when compared to intra-op findings.

Conclusions: HRCT temporal bone is a useful tool in pre-operative delineation of the extent of cholesteatoma and the recognition of its manifestations and complications. It can help the operating surgeon in appropriate surgical planning.

Keywords: Cholesteatoma, Middle ear, HRCT temporal bone, Mesotympanum, Tegmen tympani

INTRODUCTION

Cholesteatoma is a non-neoplastic lesion involving the temporal bone, which is derived from an abnormal growth of keratinizing squamous epithelium.[1] It has a propensity for local invasion and is capable of causing destruction of structures in the middle ear cleft. Middle ear cholesteatoma is thus a potentially dangerous condition and can lead to varied extra-cranial as well as intra-cranial complications. The annual incidence of cholesteatoma is reported as 3 per 100,000 in children and 9.2 per 100,000 in adults with a male predominance of 1.4:1. Middle ear cholesteatomas have a higher incidence in individuals younger than 50 years of age, whereas EAC cholesteatomas present predominantly at 40–70 years of age.[2] Cholesteatoma affecting young children has been found to be more severe as well as more invasive in nature.

Clinical suspicion and otologic examination is sufficient for diagnosis of cholesteatoma at its initial presentation. However, the otoscopic examination is limited in its ability of to effectively delineate the anatomical structures involved and to determine the full extent of the disease process.

Imaging of the temporal bone, particularly HRCT of the temporal bone is presently the 'Gold Standard' in imaging of cholesteatoma. High spatial resolution enables beautiful depiction of complex anatomy of the middle ear cavity. Though its accuracy for characterization of soft tissue mass in low, it is highly useful in determining the precise extent of disease process and is capable of detecting presence of gross or subtle erosions in the adjacent bones which can cause serious complications in patients who are suspected of harboring a cholesteatoma.

Owing to the destructive nature of cholesteatoma and its propensity to cause serious complications, it is pertinent to know the exact location as well as complete extent of the soft tissue mass in the middle ear cavity, for adequate preoperative planning and complete resection.

Aim

The present study was aimed at evaluating the efficacy of HRCT temporal bone in depiction of extent of pathology in cases of cholesteatoma of middle ear and subsequent verification of these findings with intra-op findings, to assess the diagnostic accuracy of HRCT.

METHODS

A prospective observational study comprising of a non-randomized sample of 50 patients with a clinical diagnosis of middle ear cholesteatoma was carried out from May 2016 to April 2017, at a tertiary care Defence Hospital in Lucknow, India. Necessary clearance from the institutional ethical committee was obtained and a written informed consent was taken from all the patients at the time of their enrolment into the study. The subjects underwent bilateral Temporal bone high-resolution CT (HRCT) imaging using 16 slice multi-detector CT scanner (Brilliance; Philips Medical Systems). Helical axial scanning of temporal bone was performed in a plane parallel to orbito-meatal plane with a slice thickness of 0.5 mm and inter-slice gap of 0.3 mm. Multi-planar reformatted images were then studied in detail. Radiologists at radiology workstation studied all the images and important findings were recorded. All patients who were found fit for surgery underwent surgery at an appropriate time after the initial imaging was performed. Important pre-operative HRCT and intra-operative surgical findings were then correlated for statistical significance.

Inclusion criteria

All age groups with clinical diagnosis of cholesteatoma.

Exclusion criteria

Exclusion criteria were pregnant women; all patients in whom CT is contraindicated or unfit for surgery/ anaesthesia or those who didn't undergo surgery after HRCT evaluation; patients diagnosed with middle ear pathologies other than cholesteatoma and congenital ear diseases; operated cases.

Statistical analysis

Data was recorded and managed on a Microsoft Excel worksheet. Statistical Package for Social Sciences (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) was used for Data analysis. Level of agreement between HRCT and surgical findings was analyzed using kappa-statistic. The diagnostic efficacy of HRCT temporal bones was evaluated in terms of sensitivity, specificity, predictive values and accuracy for different parameters. P value less than 0.05 indicated statistically significant association.

RESULTS

All 50 patients enrolled into the study managed to complete the study. Age of patients was diverse, ranging from 7 to 72 years with a mean age of 33.76 years. 11-20 years was the most commonly involved age group (Figure 1).

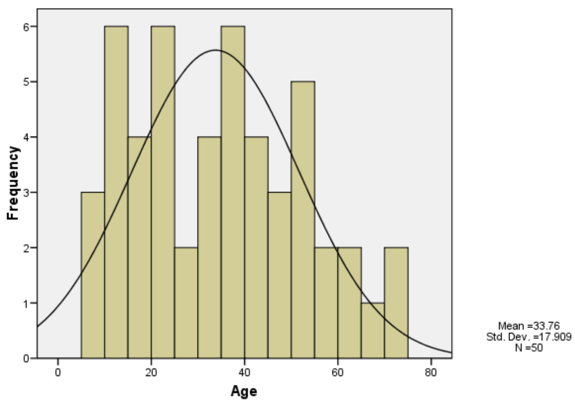

Figure 1: Histogram–age wise distribution of patients

52% of the patients in the study group were males. Right side involvement was seen in 32 (64%) patients while left sided involvement was seen in 18 (36%) patients (Figure 2).

Amongst HRCT findings, involvement of mesotympanum was seen in 48 patients (96%) and was the most common finding, followed by mastoid involvement in 40 patients (80%) and aditus widening in 24 (48%) patients. Amongst the complications, ossicular erosion was the most common finding with incus erosion seen in 35 (70%) patients and malleus erosion seen in 27 (54%) patients. 02 (4%) patients had lateral semicircular canal erosion and 08 (16%) patients had erosion of the facial canal. Erosion of tegmen plate was seen in 5 (10%) patients. No intracranial spread or complication was noticed in the patients who participated in this study. External bony canal was seen to be involved in 4 (8%) patients (Figure 3).

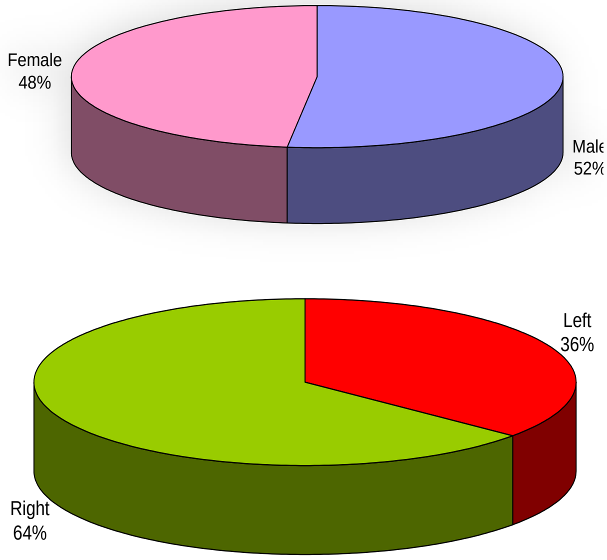

Figure 2: Gender wise distribution and side involvement of cases.

Intra-operatively, the most common finding was mesotympanum involvement in 48 patients (96%) followed by mastoid involvement, 35 patients (70%) and aditus widening comprising (54%) of cases. Amongst the complications, incus erosion was most common finding seen in 39 (78%) patients, malleus erosion was seen in 21 (42%) patients, attic involvement in 20 (40%), stapes erosion in 19 (38%), scutum erosion in 13 (26%), facial canal erosions in 06 (12%) patients and tegmen erosions in 03 (6%) patients. EBC involvement was seen in 06 (12%) patients. However no lateral semicircular canal erosion was seen on surgery (Table 1).

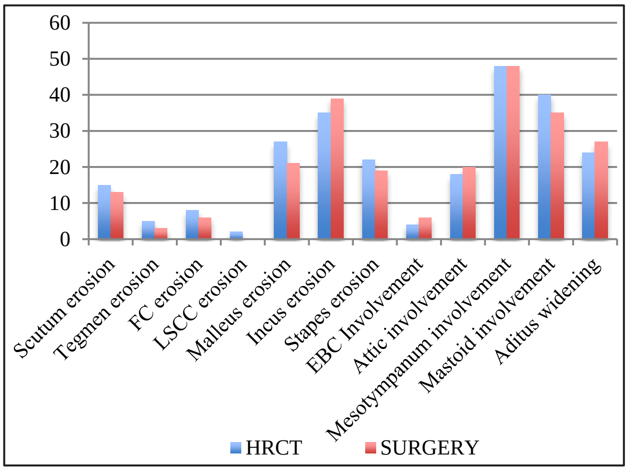

Figure 3: Clustered bar diagram comparing HRCT findings with intra-op findings.

Table 1: Correlation of HRCT and surgical findings.

S No	Finding	HRCT detection rate	Surgical detection rate	HRCT sensitivity	HRCT specificity	HRCT PPV	HRCT NPV	HRCT sccuracy
1.	Scutum erosion	30.0	26.0	92.3	91.9	80.0	97.1	92.0
2.	Tegmen erosion	10.0	6.0	100.0	95.7	60.0	100.0	96.0
3.	FC erosion	16.0	12.0	50.0	88.6	37.5	92.9	84.0
4.	LSCC erosion	4.0	0	-	-	-	-	-
5.	Malleus erosion	54.0	42.0	90.5	72.4	70.4	91.3	80.0
6.	Incus erosion	70.0	78.0	84.6	81.8	94.3	60.0	84.0
7.	Stapes erosion	44.0	38.0	68.4	71.0	59.1	78.6	70.0
8.	EBC involvement	8.0	12.0	50.0	83.3	11.1	97.6	82.0
9.	Attic involvement	36.0	40.0	50.0	83.3	11.1	97.6	82.0
10.	Mesotympanum involvement	96.0	96.0	100	100	100	100	100
11.	Mastoid involvement	80.0	70.0	91.4	46.7	80.0	70.0	78.0
12.	Aditus widening	48.0	54.0	81.5	91.3	91.7	80.8	86.0
Overall agreement rate								55.17

DISCUSSION

"Cholesteatoma", a misnomer and commonly described as "skin in wrong place", is a non-neoplastic temporal bone lesion, which is an expansile collection of exfoliated keratin produced by keratinizing stratified squamous epithelium.[1] Cholesterol crystals may or not be a component of the debris. Most common variety encountered is the middle ear cholesteatoma, other variants such as mural cholesteatoma and external auditory canal cholesteatoma are also described in literature.[3-5]

Middle ear cholesteatoma may be congenital or acquired, with the acquired variety forming the bulk (approx. 98%) of the cases of middle ear cholesteatoma.[6] These cholesteatoma arise from either the pars flaccida or pars tensa of the tympanic membrane and are further subclassified as either primary acquired or secondary acquired cholesteatoma based on the presence or absence of a prior history of middle ear pathology such as otitis media.[6]

Most cases of acquired cholesteatoma are postulated to arise from retraction pockets that develop in the tympanic membrane due to reduced intra-tympanic pressure.[7] These retraction pockets are associated with disrupted normal migration of skin present on the lateral surface of tympanic membrane, which ultimately leads to ingrowth of squamous epithelium into the middle ear cavity thereby resulting in accumulation of keratin debris. This debris can then absorb moisture and progressively enlarge into a soft tissue mass that can erode into the adjacent structures.

Cholesteatoma follows a fairly typical growth pattern. The site of origin of acquired cholesteatoma determines the region of spread as well as its extent. Cholesteatoma arising in the 'Pars flaccida' often start at Prussak's space and cause medial displacement of the ossicular chain with extension into the attic, mastoid antrum and later on into the mastoid air cells.[3] 'Pars tensa cholesteatoma' causes lateral displacement of the ossicular chain and usually extends into the tympanic recess, facial recess and sinus tympani. Cholesteatoma that develops in the anterior epitympanic recess anterior to the malleolar head frequently causes facial nerve involvement at the level of geniculate ganglion.[8]

Almost all the complications associated with the disease process are attributable to the bony erosions caused by the mechanical pressure exerted by expansion of the cholesteatoma tissue. Ossicular erosion is the most common complication leading to conductive deafness.[5] Other complications include episodic vertigo, due to development of labyrinthine fistula (lateral semi-circular canal being most common site), facial nerve palsy (due to facial nerve involvement) and epidural extension due to tegmen tympani / sinus plate erosion.[9-12]

HRCT is the modality of choice in pre-operative assessment of extent of underlying pathology and structures involved and is extremely helpful in planning surgical intervention. It has a high sensitivity with a high negative predictive value for a middle ear or mastoid, which is free of any pathology. However, in the case of a middle ear soft tissue mass, its specificity is low because the soft tissue may depict granulation tissue, effusion, cholesterol granuloma, or neoplasm. The location of the soft tissue mass and the absence or presence of bony erosions may then provide the clinician some hints to the pathology involved.

In the present study, mesotympanum involvement (96%) was the most common HRCT finding (Figure 4) as far as location and extent are concerned and incus erosion (70%) was the most common bony complication. There was a substantial variation in the imaging findings in different studies. This may be due to varied methods of reporting by different radiologists.

Figure 4: Coronal HRCT Rt temporal bone showing soft tissue attenuation mass filling the epitympanum, surrounding the ossicular chain with erosion of ossicles.

In this study, HRCT temporal bone was found to have a high sensitivity and specificity (82% - 100%) in detection of Erosion of scutum, tegmen tympani (Figure 5) and incus. While it demonstrated high sensitivity (90.5%) in detection of malleus erosion but its specificity (72.4%) was low.

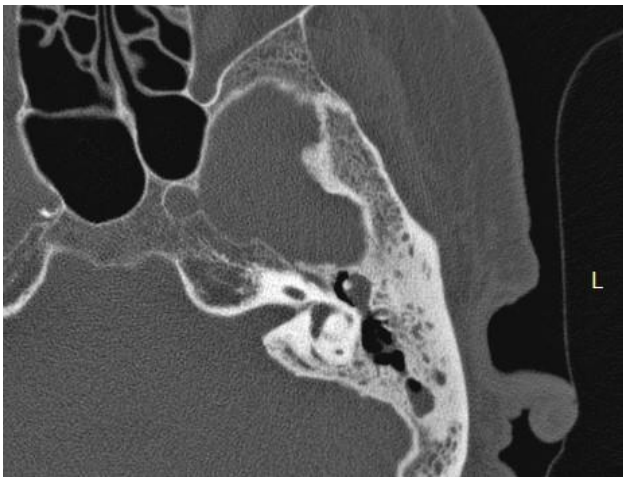

Figure 5: Axial HRCT Lt temporal bone shows erosion of head of malleus and incus with soft tissue mass in mesotympanum and mastoid.

For findings such as stapes erosion and facial canal (FC) erosion on HRCT (Figure 6), we reported a sensitivity of 68.4% and 50% respectively compared to intra-op findings. Similarly, in their study, Sreedhar et al could not demonstrate adequate agreement for findings of stapes erosion with intra-op findings, whereas they found low specificity (66.7%) for malleus erosion as compared to our study.[13]

Sreedhar et al in their study reported attic (80%), mastoid (76%) and mesotympanum involvement (56%) as major location and extent related findings and incus erosion (88%) as the most common bony complication.[13]

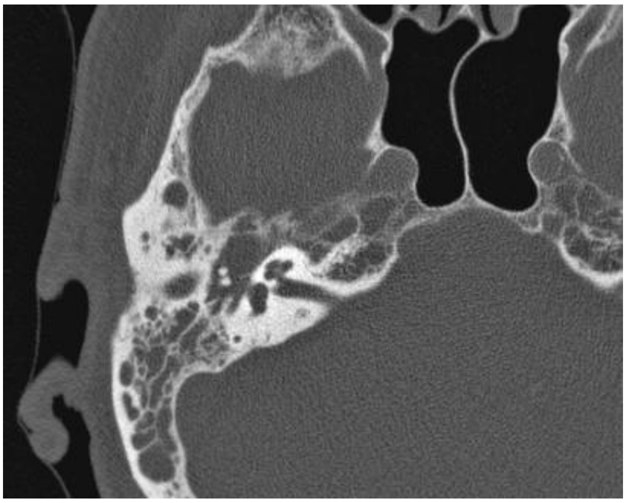

Figure 6: Axial HRCT Rt temporal bone showing soft tissue cholesteatoma involving the middle ear cavity and mastoid air cells with erosion of bony facial canal and ossicular system.

Chatterjee et al and Sreedhar et al were able to obtain 100% accuracy for localization of disease on HRCT; however, our study could not achieve such high accuracy for most of the locations except for mesotympanum involvement (where 100% accuracy was achieved).[13,14]

Our study depicted EBC involvement on HRCT in 8% cases; however, Sarin et al didn't detect EBC involvement in any case on HRCT, but intra-operatively, EBC involvement was detected in 12.5% cases.[15] Similar to our study, they reported tegmen erosion and LSCC erosion as less common findings (15% and 10% cases respectively).

Since our study was conducted in an academic environment where most of the HRCT evaluations were done by resident doctors, limitations with respect to experience and learning curve can be a contributory factor in attainment of low overall agreement rate in this study. Further studies with larger sample size are required to obtain a better consensus between HRCT and surgical findings in patients with cholesteatoma.

CONCLUSION

HRCT temporal bone provides useful information regarding extent and location of disease and also the presence of complications in patients suspected of having cholesteatoma. This study despite certain limitations, highlight the relevance of HRCT to the operating surgeon for pre-surgical evaluation of all patients with clinical suspicion of cholesteatoma.

ACKNOWLEDGEMENTS

We would like to acknowledge everybody who contributed in the completion of the study including the technical staff. We also hereby transfer, assign, or otherwise convey all copyright ownership, including any and all rights incidental thereto, exclusively to the journal, in the event that such work is published by the journal.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Moran WB Jr. Cholesteatoma. In: English GE, ed. Otolaryngology. New York: Harper & Row; 1980.
2. de Aquino JEAP, Filho NAC, de Aquino JNP. Epidemiology of middle ear and mastoid cholesteatomas: study of1146 cases. Brazilian J Otorhinolaryngol. 2011;77(3):341–7.
3. Schwartz JD, Harnsberger HR. The Middle Ear and Mastoid. In: Schwartz JD, Harnsberger HR. Imaging of the Temporal Bone. New York: Thieme; 1998:102.
4. Nardis PF, Teramo M, Giunta S, Bellelli A. Unusual cholesteatoma shell: CT findings. J Comput Assist Tomogr. 1988;12:1084–5.
5. Dubach P, Ha¨usler R. External auditory canal cholesteatoma: reassessment of and amendments to its categorization, pathogenesis, and treatment in 34 patients. Otol Neurotol. 2008;29:941–8.
6. Fisch U. Tympanoplasty, Mastoidectomy, and Stapes Surgery. New York: Thieme; 1994: 146.
7. Svane-Knudsen V, Halkier-Sørensen L, Rasmussen G, Ottosen PD. Altered permeability barrier structure in cholesteatoma matrix. Eur Arch Otorhinolaryngol. 2002;259:527–30.
8. Schwartz JD, Harnsberger HR. The Middle Ear and Mastoid. In: Schwartz JD, Harnsberger HR. Imaging of the Temporal Bone. New York: Thieme; 1998: 87.
9. Magliulo G, Terranova G, Sepe C, Cordeschi S, Cristofar P. Petrous bone cholesteatoma and facial paralysis. Clin Otolaryngol Allied Sci. 1998;23:253–8.
10. Burggraaff B, Luxford WM, Doyle KJ. Neurotologic treatment of acquired cholesteatoma. Am J Otol. 1995;16:480–5.
11. Axon PR, Fergie N, Saeed SR, Temple RH, Ramsden RT. Petrosal cholesteatoma: management considerations for minimizing morbidity. Am J Otol. 1999;20:505–10.
12. Sanna M, Zini C, Gamoletti R, Frau N, Taibah AK, Russo A, et al. Petrous bone cholesteatoma. Skull Base Surg. 1993;3:201-13.
13. Sreedhar S, Pujary K, Agarwal AC, Balakrishnan R. Role of high-resolution computed tomography scan

in the evaluation of cholesteatoma: A correlation of high-resolution computed tomography with intra-operative findings. Indian J Otol. 2015;21:103-6.

14. Chatterjee P, Khanna S, Talukdar R. Role of High Resolution Computed Tomography of Mastoids in Planning Surgery for Chronic Suppurative Otitis Media. Indian Journal of Otolaryngology and Head Neck Surg. 2015;67(3):275-80.
15. Sarin V, Kaur T, Sood AS. Role of Pre-operative High Resolution Computed Tomography of Temporal Bone in Squamous Chronic Otitis Media. Pakistan J Otolaryngol. 2015;31:51-5.

Cite this article as: Dashottar S, Bucha A, Sinha S, Nema D. Preoperative temporal bone HRCT and intra-operative findings in middle ear cholesteatoma: a comparative study. Int J Otorhinolaryngol Head Neck Surg 2019;5:77-82.