

Original Research Article

Utility of high resolution computed tomography in pre-operative evaluation of cholesteatoma

Amith Jacob, Sandeep Sreedhar*, Anwar Sadath Choolakkaparambu Aboobakker,
Nalakath Kunjhimon Bashir

Department of Otorhinolaryngology, MES Medical College, Malappuram, Kerala, India

Received: 11 May 2020

Revised: 12 June 2020

Accepted: 15 June 2020

*Correspondence:

Dr. Sandeep Sreedhar,

E-mail: sreedhar.sandeep@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Prior knowledge about temporal bone anatomy and extent of cholesteatoma may help the ENT surgeon to plan the surgery and avoid impending complications. This study aims to evaluate the role of pre-operative high resolution computed tomography (HRCT) in cholesteatoma and to compare HRCT findings with intra-operative findings.

Methods: A diagnostic evaluation study was performed among 30 atticointral cholesteatoma cases presenting in the ENT outpatient department of MES Medical College in Malappuram, Kerala over a period of one and half years. The intraoperative findings were considered as the gold standard to which the radiological features were compared and the sensitivity, specificity and predictive value of HRCT were determined.

Results: High sensitivity of HRCT was noted in detecting soft tissue in mesotympanum 94.4% and aditus ad antrum 94.1%. Low sensitivity 59% was noted in detecting stapes erosion when compared to malleus and incus erosions. Except in conditions of soft tissue in epitympanum, dural plate dehiscence and sclerotic mastoid, a high specificity of 100% was noted in all other findings.

Conclusions: This study reaffirms the usefulness of HRCT in pre-operative evaluation of cholesteatoma-atticoantral type.

Keywords: Cholesteatoma, HRCT, Sensitivity, Specificity, Predictive value

INTRODUCTION

The term cholesteatoma refers to a keratinized, desquamated epithelial collection in the middle ear or mastoid. Cholesteatomas can be congenital or may occur as primary lesions or secondary to tympanic membrane perforation and surgery. Primary acquired cholesteatoma can present with retracted or perforated tympanic membrane, scutum erosion and further progression will result in aural polyps and granulation tissue throughout the middle ear and mastoid air cell tracts. Tympanic membrane perforation may lead to a secondary acquired

cholesteatoma in a small percentage of cases, due to migration of squamous epithelium through the defect.¹ An iatrogenic form of secondary acquired cholesteatoma may develop if squamous epithelium implanted in the middle ear space during surgery such as tympanoplasty.² Congenital cholesteatomas can occur anywhere in the temporal bone but have a predilection for the anterosuperior quadrant of the middle ear, just above the eustachian tube opening.^{3,4}

The diagnosis of aural cholesteatoma is made by otoscopic examination, in microscopic evaluations or

during surgical exploration. Other imaging measures, such as high-resolution computed tomography (HRCT) and magnetic resonance imaging (MRI), suggests the occurrence of cholesteatoma inside the temporal bone and might be used to complement the clinical examination.⁵ HRCT is the image modality of choice for evaluation of the structures of the middle ear and its pathologies, such as cholesteatoma.⁶ A computed tomography (CT) scan is useful for planning the surgical approach, determining the extent and site of the cholesteatoma and its sac, evaluating the ossicles and the facial nerve, determining the dural, sigmoid and jugular bulb positions.⁷ HRCT findings of cholesteatoma acquired from the temporal bone involves the homogenous soft tissue mass with local bone erosion and opacification of the middle ear. Other findings include erosion of the scutum, aditus/antrum widening, erosion of the ossicles, labyrinthine fistula, facial canal dehiscence, dehiscence of the tegmen and sinus plate, mastoid destruction (automastoidectomy), and erosion of the roof of the external auditory canal.⁸

This study assesses the usefulness of a preoperative HRCT scan in depicting the status of middle ear structures in the presence of cholesteatoma and compares the preoperative temporal bone HRCT findings with intraoperative findings in patients with cholesteatoma.

METHODS

A diagnostic evaluation study was conducted over a period of one and half years from January 2017 to June 2018 among 30 patients clinically diagnosed with CSOM-atticoantral disease in the ENT outpatient department of MES medical college, Malappuram, Kerala. Only patients who consented to surgery and CT scan were included in the study. Patients presenting with granulomatous disease or those with a history of previous ear surgery were excluded. Written informed consent was taken from each study subject.

For all patients, a detailed clinical examination of the ear was done with careful otoscopic and microscopic examination. Audiological evaluation was performed using pure tone audiometry. HRCT temporal bone - both coronal and axial sections (with the plane of axial section being parallel to that of lateral semi-circular canal) was taken using Philips 16 slice multiplanar CT scanner and findings were noted.

All the scans were evaluated by a single radiologist. These patients were operated/assessed by the same otologist. This was done to ensure that there is no inter observer bias. The pre-operative HRCT scan findings were compared with the intra-operative findings.

Ethical clearance was obtained from Institutional Ethical Committee of MES medical college, Kerala prior to commencement of study. Data were entered into MS Excel and analysed using statistical software Epi Info 7.0. Descriptive data were expressed in frequencies and

percentages. The intra operative findings were considered to be the gold standard and were compared with the HRCT findings to calculate the sensitivity and specificity of HRCT temporal bone.

Ethical approval

The study was approved by the Institutional Ethics Committee of MES medical college, Malappuram, Kerala.

RESULTS

Of the 30 participants, more than 40% were in the age group of 31-50 years (Table 1). The mean age of the study subjects was 34.6 ± 16.9 years. The mean age of males was higher when compared to females.

Table 1: distribution of study subjects according to age and gender.

Age group (in years)	Females (%)	Males (%)	Total (%)
11 to 30	5 (35.7)	6 (37.5)	11 (36.7)
31 to 50	9 (64.3)	4 (25)	13 (43.3)
51 to 70	0	6 (37.5)	6 (20)
Total	14 (100)	16 (100)	30 (100)

High specificity 100% of HRCT was noted in ruling out the presence of soft tissue in almost all middle ear areas except in epitympanum (specificity=55.6%).

HRCT was found to be less sensitive in detecting stapes erosion (sensitivity=58.8%) when compared to malleus and incus erosions. Specificity was found to be 100% in all three ossicular erosions.

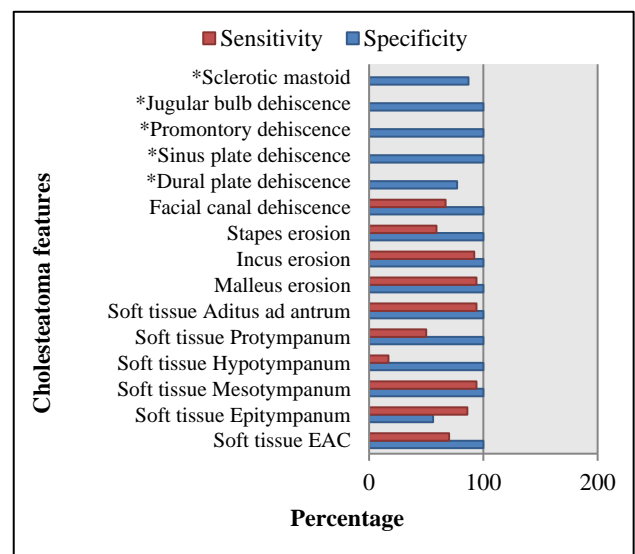


Figure 1: Sensitivity/specificity of pre-operative HRCT in cholesteatoma.

*Sensitivity not applicable.

Table 2: Comparison of pre-operative HRCT and intra-operative cholesteatoma findings.

	Number of patients		Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
	HRCT (%)	Intra operatively (%)				
Presence of soft tissue in middle ear						
EAC	7 (23.3)	10 (33.3)	70	100	100	86.9
Epitympanum	22 (73.3)	21 (70)	85.7	55.6	81.8	62.5
Mesotympanum	17 (56.6)	18 (60)	94.4	100	100	92.3
Hypotympanum	1 (3.3)	6 (20)	16.7	100	100	82.7
Protympanum	1 (3.3)	2 (6.6)	50	100	100	96.5
Aditus ad antrum	16 (53.3)	17 (56.6)	94.1	100	100	92.8
Ossicular erosions						
Malleus	16 (53.3)	17 (56.6)	94	100	100	92.8
Incus	23 (76.6)	25 (83.3)	92	100	100	71.4
Stapes	10 (33.3)	17 (56.6)	58.8	100	100	65
Other findings						
Facial canal dehiscence	2 (6.6)	3 (10)	66.7	100	100	96.4
Dural plate dehiscence	7 (23.3)	0	NA	76.7	NA	100
Sinus plate dehiscence	0	0	NA	100	NA	100
Promontory dehiscence	0	0	NA	100	NA	100
Jugular bulb dehiscence	0	0	NA	100	NA	100

Facial canal dehiscence was detected with a low sensitivity of 66.7%. No cases were noted with sinus plate, promontory or jugular bulb dehiscence intraoperatively. Hence the sensitivity could not be determined. But HRCT imaging was useful in ruling out the presence of facial canal dehiscence, sinus plate dehiscence, promontory and jugular bulb dehiscence (specificity=100%).

Low specificity of 76.7% was noted, with HRCT detecting 7 cases of dural plate dehiscence while none was observed peri-operatively. Sclerotic mastoid was detected with a specificity of 86.7% (Table 2 and Figure 1).

DISCUSSION

Our study found HRCT to be highly effective in identifying those without soft tissue mass in various middle ear cleft areas (specificity=100%) while it was not found to be very effective in correctly identifying those with soft tissue mass (sensitivity ranging from 16 to 94.4%). PPV was found to be 100%. Hence, the accuracy of HRCT as a diagnostic test in this regard was acceptable. A study done by Payal et al showed similar results with a sensitivity of 89.6%, specificity of 100% and PPV of 100%.⁹ Reddy et al found the sensitivity of HRCT in diagnosing soft tissue mass to be 86-100% while specificity was 66-100%, which was much lower when compared to our study.¹⁰

The present study found HRCT sensitivity in detecting malleus, incus and stapes erosion to be 94%, 92% and 59%. The specificity was found to be 100%. Malleus erosion was predicted with greater accuracy (sensitivity=90.4%) followed by incus erosion

(sensitivity=87%) in a study done by Datta et al.¹¹

The current study did not find sinus plate dehiscence, promontory dehiscence and jugular bulb dehiscence intraoperatively in any of the study subjects. This was corroborated by HRCT (specificity=100%). Previous studies found sensitivity in detecting sinus plate dehiscence to be 100% and specificity was also 100%.^{10,11} Payal et al found lower sensitivity 66.6% and specificity 92.6% in detecting sinus plate erosion.⁹ Jugular canal wall erosion was detected with a sensitivity of 100% and specificity of 100%.¹¹ Even though there were no cases intraoperatively, dural plate dehiscence was radiologically suspected in 7 cases lowering the specificity to 76.7%. A study done by Khavasi et al radiologically found dural plate erosion in 6 cases while only 4 cases were intraoperatively found to have the same.¹² Facial canal dehiscence was detected with a sensitivity of 66.7% in our study. A much lower sensitivity of 40% was noted in the study done in Delhi.⁹ Sclerotic mastoid was noted radiologically with a specificity of 86.7%. The study done in Shimla¹¹ found the number of sclerotic mastoid cases detected radiologically and intraoperatively to be the same while Payal et al found a much lower specificity of 66.6%.⁹

CONCLUSION

HRCT temporal bone significantly enhances the preoperative evaluation of cholesteatoma. HRCT scan is superior to other conventional modalities of radiological imaging in the pre-operative diagnosis of cholesteatoma. The higher specificity results compared to sensitivity in our study suggest that HRCT is good at excluding presence of soft tissue in middle ear, ossicular erosions and other findings in cholesteatoma while it is not good

enough to detect them. Despite its drawbacks, the HRCT findings assist the surgeon in planning appropriate management and prevent impending complications.

ACKNOWLEDGEMENTS

We acknowledge the contribution of Dr Ramya Ramachandran, Department of Community Medicine, MES medical college, Malappuram for her valuable input.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Persaud R, Hajioff D, Trinidad A, Khemani S, Bhattacharyya MN, Papadimitriou N, et al. Evidence-based review of aetio-pathogenic theories of congenital and acquired cholesteatoma. J Laryngol Otol. 2007;121(11):1013-9.
2. Vikram BK, Udayashankar SG, Naseeruddin K, Venkatesha BK, Manjunath D, Savantrewa IR. Complications in primary and secondary acquired cholesteatoma: a prospective comparative study of 62 ears. Am J Otolaryngol. 2008;29(1):1-6.
3. Potsic WP, Korman SB, Samadi DS, Wetmore RF. Congenital cholesteatoma: 20 years' experience at The Children's Hospital of Philadelphia. Otolaryngol Neck Surg. 2002;126(4):409-14.
4. Koltai PJ, Nelson M, Castellon RJ, Garabedian EN, Triglia JM, Roman S, et al. The natural history of congenital cholesteatoma. Arch Otolaryngol Neck Surg. 2002;128(7):804-9.
5. Semaan MT, Megerian CA. The pathophysiology of cholesteatoma. Otolaryngol Clin North Am. 2006;39(6):1143-59.
6. Gaurano JL, Joharjy IA. Middle ear cholesteatoma: characteristic CT findings in 64 patients. Ann Saudi Med. 2004;24(6):442-7.
7. Banerjee A, Flood LM, Yates P, Clifford K. Computed tomography in suppurative ear disease: does it influence management. J Laryngol Otol. 2003;117(6):454-8.
8. Mohammadi G, Naderpour M, Mousaviagdas M. Ossicular erosion in patients requiring surgery for cholesteatoma. Iran J Otorhinolaryngol. 2012;24(68):125.
9. Payal G, Pranjal K, Gul M, Mittal MK, Rai AK. Computed tomography in chronic suppurative otitis media: value in surgical planning. Indian J Otolaryngol Head Neck Surg. 2012;64(3):225-9.
10. Sirigiri RR, Dwaraknath K. Correlative study of HRCT in attico-antral disease. Indian J Otolaryngol Head Neck Surg. 2011;63(2):155-8.
11. Datta G, Mohan C, Mahajan M, Mendiratta V. Correlation of preoperative HRCT findings with surgical findings in Unsafe CSOM. J Dent Med Sci. 2014;13(1):120-5.
12. Malashetti S. An evaluation of preoperative high-resolution computed tomography of temporal bone in cholesteatoma. Int J Otorhinolaryngol Head Neck Surg. 2018;4(2):413.

Cite this article as: Jacob A, Sreedhar S, Aboobakker ASC, Bashir NK. Utility of high resolution computed tomography in pre-operative evaluation of cholesteatoma. Int J Otorhinolaryngol Head Neck Surg 2020;6:1278-81.