Original Research Paper

VOLUME-6 | ISSUE-4 | APRIL - 2017 • ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46

Role of High resolution computed tomography (HRCT) in the evaluation of cholesteatoma

Radiology

KEYWORDS: HRCT, cholesteatoma, complications

Dr. Aditi Vohra	Associate Professor, Radiodiagnosis Department, M.M. Institute of Medical Sciences and Research, Mullana, Ambala.
Dr. Harvin Chopra	Resident, Radiodiagnosis Department, M.M. Institute of Medical Sciences and Research, Mullana, Ambala.
Dr.L.N. Garg	Professor, ENT department, M.M. Institute of Medical Sciences and Research, Mullana, Ambala.
Dr. Amit Mittal	Professor & Head, Radiodiagnosis Department, M.M. Institute of Medical Sciences and Research, Mullana, Ambala
Dr. Harneet Narula	Professor, Radiodiagnosis Department, M.M. Institute of Medical Sciences and Research, Mullana, Ambala

ABSTRACT

INTRODUCTION- Middle ear cholesteatoma is a relatively common disease that can lead to serious complications. High resolution computed tomography (HRCT) of temporal bone plays crucial role in diagnosis of cholesteatoma, assessing the disease extent and its various complications.

AIMS AND OBJECTIVES- To study the radiological findings and major complications of cholesteatoma diagnosed on computed tomography (CT) which requires early surgical management.

MATERIALS AND METHODS- This was a prospective study carried out on 30 patients who presented with ear discharge and conductive ear loss to the department of ENT, Mullana ,Ambala. HRCT was done in all the patients suspected of cholesteatoma with 128 slice MDCT, INGENUITY (Philips Medical SystemsUSA) in the Department of Radiodiagnosis and imaging.

RESULTS- Out of 30 patients 16 were male patients and 14 were female patients. The most frequently encountered symptoms were discharging ear, impaired hearing and headache. The most common space to be involved by cholesteatoma was epitympanum with mastoid cells opacification. Maximum erosion of the incus was seen. Tegmen tympani erosion was the most encountered complication.

CONCLUSION- HRCT by using its multiplanar qualities is highly accurate and specific in detecting cholesteatoma and its various complications.

INTRODUCTION

Cholesteatomas consists of keratinized squamous epithelium which is trapped within the temporal bone (either in the middle ear or mastoid). It grows and destroys the important structures within the temporal bone. Mechanism of bone destruction by cholesteatoma is by pressure of matrix of cholesteatoma and by enzymatic bone resorption.[1]

Classification of cholesteatoma :-

Cholesteatomas can be either **congenital** or **acquired**.

Congenital cholesteatomas usually occur in children with intact tympanic membrane who don't have history of otitis media. They arise from embryonic epithelial remains in 2% of cases.[2]

Acquired cholesteatomas are more commonly found and constitute approximately 98% of cases.[2] They are main complication of chronic otitis media with ingrowth of keratinized squamous epithelium from external auditory canal to middle ear through the tympanic membrane. They occur most commonly in the **pars flaccida** portion (82%) and less likely in **pars tensa** (18%).[3]

Hallmark of cholesteatoma is soft tissue mass like opacity in middle ear and mastoid antrum with associated smooth bony erosion of ossicles and expansion of adjacent structures.

Cholesteatomas arising in **pars flaccida** portion extends towards the Prussak's space. Ossicles in epitympanum (head of malleus and body of incus) are displaced medially. From Prussak's space, mass extends into the antrum and mastoid air cells through aditus ad antrum.[4]

Pars tensa cholesteatoma usually occurs in setting of perforated tympanic membrane. The mass then extends towards sinus tympani and facial recess of mesotympanum.[4]

HRCT has gained an important role in diagnosis and treatment of temporal bone disorders. HRCT is reliable for all the parameters like scutum erosion, ossicular erosion, mastoid pneumatization, cholesteatoma extension in middle ear and mastoid, presence of complications such as mastoid cortex dehiscence, sigmoid sinus plate erosion, facial canal dehiscence, tegmen antri and tympani erosion and labyrinthine canal fistula as well as intracranial complications.[5,6]

MATERIAL AND METHODS

This study was conducted in the Department of Radiodiagnosis of Maharishi Markandeshwar Institute of Medical sciences and Research, Mullana. Thirty patients presenting with ear discharge and conductive hear loss referred from the department of ENT were included in the study. Written informed consent was obtained from each patient and a detailed history was illicited from all the patients. Relevant past history will also be recorded. Findings of general physical examination were recorded in detail. Aim of imaging was to assess the extent of disease and its various complications. High resolution temporal bone (HRCT) is the most valuable for detection of cholesteatoma and its various complications including extra-temporal complications. At our institution, HRCT helical scanning was performed on Ingenuity CT (128 slice, Philips Medical Systems) with contiguous 1mm thick axial and reformatted coronal sections. i/v contrast was given in cases of extra-temporal complications of cholesteatoma. HRCT was taken at 120 Kv, 350mAs and rotation time of 0.5sec with pitch of 0.9 and rotation time of 0.4 sec. Images were reconstructed at 0.8mm and increment of 0.4mm in bone and soft tissue windows.

OBSERVATION AND RESULTS

This study was conducted on 30 patients with clinical diagnosis of cholesteatoma referred to the department of Radio-diagnosis at Maharishi Markendeshwar Institute of Medical Sciences & Research, Mullana, Ambala.

There were 30 patients in the age group of 0-90 years. Majority of

subjects belonged in the age group of less than 20 years (43.3%).

There was a greater incidence of male subjects in the present study, 16 subjects were males and 14 subjects were females.

Most common symptoms of the subjects were headache, impaired hearing and discharging ear which constituted 86.7%, 80% and 66.7% respectively.

Mastoid air cells opacification was seen in all 30 subjects (100%). Epitympanum was seen to be involved in 26 subjects (86.7%) with least involvement of the protympanum (Table-1) which was seen only in 1 subject (3.3%).

Antrum and aditus involvement in this study was seen in 27 subjects (90%). In this study maximum erosion of the incus was seen (Table-2) which was eroded in 25 subjects (83.3%). Stapes was the least involved with erosion seen in 19 subjects (63.3%).

Following complications were found in patients (Table-3). Facial nerve canal was eroded in five (16.7%) patients (Fig-2). Most common site of facial nerve compression was tympanic segment of facial nerve.

External auditory canal was involved in 16 subjects (53.3%) with no involvement of the internal auditory canal in any patient.

Tympanic perforation on HRCT was seen in 5 subjects (16.7%) with involvement of the inner ear in 02 subjects (6.7%). Labyrinthine fistula was found in two patients in whom there was dehiscence of the wall of lateral semicircular canal (Fig-3). One patient had labyrinthine ossificans with ossification of basal turn of cochlea near round window niche.

Two patients showed sinus plate erosion. One of them had lateral sinus thrombosis with extension of infection also into the internal jugular vein into the neck. CT examination with i/v contrast demonstrated the classic empty delta sign due to non-filling of thrombosed sinus and non-enhancement of internal jugular vein.
One patient showed otogenic neck abscess with extension of infection into the adjacent soft tissue (Fig-4).

Two patients showed automastoidectomy in which **c**holesteatoma drained externally spontaneously causing appearance of post-mastoidectomy state.

Intra-cranial complications including brain abscess and meningitis was seen in 1 subject (3.3%).

DISCUSSION

Present study was conducted in the department of radiodiagnosis in MMIMSR, Mullana, Ambala. This prospective study comprised of 30 patients with clinical history of ear discharge, headache and impaired hearing. All the patients underwent HRCT of the temporal bone, to assess the soft tissue mass, extent of the disease, ossicular destruction and associated complications. Majority of subjects belonged in the age group of less than 20 years (43.3%). The youngest subject in the present study was 12 years old and the oldest was 65 years. Mean age in present study 30.46 years.

Sirigiri and Dwaraknath et al showed that HRCT had 100% sensitivity and 90% specificity, to detect cholesteatoma.[7]

In present study mastoid opacification was seen in all 30 patients (100%). Rogha et al found mastoids almost universally involved in cholesteatoma. He found poorly pneumatised mastoids in 96% cases and pneumatised mastoid in only 4% cases.[8]

In present study maximum erosion of the incus was seen followed by malleus and stapes. These findings correlated well with studies by Anbarasu et al. [9] It occurs in 75% of pars flaccida and in upto 90% of pars tensa cholesteatoma.

Garber and Dort et al, [10] reported that HRCT has sensitivity ranging from 70 to 96.88% in detection of ossicular erosion which is comparable to the present study.

In present study 5 subjects had facial canal dehiscence, 2 had lateral semicircular canal fistula, 18 had tegmen tympani erosion, 2 had sinus plate erosion and 1 had intracranial complications as seen on HRCT. Tegmen tympani erosison was the most encountered complication on HRCT. Previous studies by Sirigiri et al[7] who suggested 90% sensitivity and 100% specificity for cholesteatoma complications.

Yetiser et al. have found 83.3% dehiscent facial canal in patients facial paralysis due to cholesteatoma with the most common sites being at second genu and horizontal portions.[11]

Gaurano et al found cholesteatoma with a fistula between the middle and inner ear usually involves the Lateral semicircular canal.[12]

Jackler et al stated that hallmarks of cholesteatoma on CT scan are a soft tissue mass in the attic" and antrum along with smooth bony expansion, scalloping of the mastoid, erosion of lateral attic wall, erosion of anterior tympanic spine and erosion of ossicles.[13]

Chandrashekharayya et al found lateral sinus thrombosis to be danger complication of cholesteatoma.[14] Proximity of middle ear and mastoid air cells to dural venous sinuses predisposes them to thrombosis and thrombophlebitis secondary to infection and inflammation in middle ear and mastoid. Thrombus may propagate upwards upto the confluence of sinuses and even into superior sagittal sinus.Inferiorly thrombus may propagate into the internal jugular vein and extend along it into the neck.

Bezold abscess is another rare complication of cholesteatoma with superimposed mastoiditis.There is erosion of mastoid tip and lateral wall of mastoid with extension of infection into the adjacent soft tissue of neck. If left untreated, abscess may spread into the carotid, prevertebral and retropharyngeal spaces and as far as mediastinum with poor prognosis.[15]

Ossification of membranous labyrinth usually occurs as a sequelae to previous infection. Tympanic labyrinthitis usually occur via spread of infection from middle ear to labyrinth via oval or round window or via labyrinthine fistula.[16] The most common site is basal turn of cochlea near round window niche. Labyrinthitis ossificans results in profound hearing loss and also due to ossification process can prevent cochlear implant.

Maharaj et al found that out of 181 patients with cholesteatoma: recurrent residual disease intracranial complications, 51% had a brain abscess and only 12% had meningitis. Even today it is still not rare to see brain abscess secondary to otogenic infection.[17] It usually occurs due to erosion/destruction of tegmen with dural involvement that primarily starts as meningitis. Spread of infection into brain can also occur via dural venous sinuses most commonly lateral sinus thrombophlebitis. Late intra-axial complications include intracranial infections with formation of brain abscess. Otitic hydrocephalus and intracranial extension of cholesteatoma are some of the rare intracranial complications.[18,19] Aggressive surgical therapy is mandatory.

In our study HRCT showed presence of brain abscess and meningitis in 1(3.3%) subject respectively.

Mafee et al reported in his series of 48 patients with cholesteatoma that 46 of them (96%) were diagnosed correctly using preoperative HRCT scans. One of the important advantages of the HRCT scan is the detection of early cholesteatoma with subtle bony erosion or ossicular displacement. This early detection by HRCT scan with the

VOLUME-6 | ISSUE-4 | APRIL - 2017 • ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46

use of a simple noninvasive surgical technique (atticotomy) will solve the problem and preserve hearing.[20]

In our study on a total of 30 subjects the extent of involvement of middle ear and mastoid in cholesteatoma was significantly sensitive and specific which were consistent with previous studies. Our study suggests that HRCT temporal bone is a reliable investigation modality for preoperative evaluation of cholesteatoma and its complications.

CONCLUSION

Various extra-temporal complications of cholesteatoma including extra-cranial and intra-cranial complications are rare in today's antibiotic era. CT is the modality of choice in the diagnosis of cholesteatoma and its various complications. It enables physicians to institute prompt therapy and prevent life threating consequences. Therefore CT temporal bone should be performed as early as possible in patients suspected of cholesteatoma. This imaging approach can help in planning effective surgical treatment.

TABLES

Table 1

Extent of disease of spaces involved on HRCT

Spaces involved	Frequency	Percentage(%)
Protympanum	01	3.3
Mesotympanum	25	83.3
Posterior Tympanum	02	6.6
Epitympanum	26	86.7
Hypotympanum	20	67
Antrum	27	90.0
Prussak space	26	86.7
Aditus	27	90.0
Mastoid opacification	30	100.0

Table 2

Ossicular erosion on HRCT

Ossicles involved	Frequency	Percentage(%)
Malleus	22	73.3
Incus	25	83.3
Stapes	19	63.3
Inco-stapedial articulation	09	30.0

Table 3 Complications on HRCT

Complications	Frequency	Percentage(%)
Facial canal dehiscence	05	16.7
Lateral semi circular canal Fistula	02	6.7
Labyrinthine ossificans	01	3.3
Tegmen tympani erosion	18	60.0
Sinus plate erosion	02	6.7
Lateral sinus thrombosis	01	3.3
Otogenic neck abscess	01	3.3
Automastoidectomy	02	6.7
Brain abscess	01	3.3
Meningitis	01	3.3

IMAGES

Figure 1. Axial image shows soft tissue mass in middle ear cavity with complete destruction of ossicles.

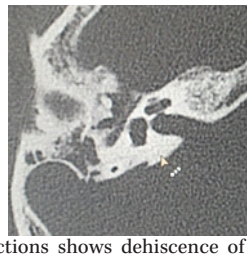

Figure 2. Axial sections shows dehiscence of the lateral wall of tympanic segment of facial nerve canal.

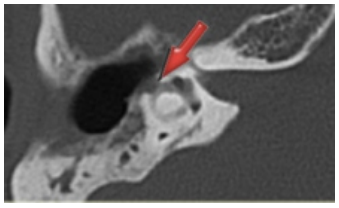

Figure 3. Axial HRCT shows erosion of the wall of lateral semicircular canal by middle ear cholesteatoma s/o fistula.

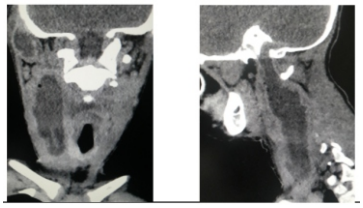

Figure 4a and4b. CECT in coronal and sagittal sections show lateral sinus thrombosis extending into the internal jugular vein. IJV is distended and non-enhancing with few air foci seen within s/o infected thrombosis.

References:

1. Dornelles C, Rosito LP, Meurer L, Costa SS, Argenta A, Alves SL. Hystology findings correlation between the ossicular chain in the transoperative and cholesteatomas. Braz J Otorhinolaryngol. 2007;73:738-43.
2. Barath K, Huber AM, Stampfli P, Varga Z, Kollias S. Neuroradiology of cholesteatomas. AJNR 2011;32:221-29.
3. Avila AFA,Aburjeli BOM,Moreira W,Motta EGPC,Ribeiro MA,Diniz RLFC.Imaging eval uation of middle ear cholesteatoma: iconographic essay. Radiol Bras. 2013;46:247-51.
4. Fatterpekar GM, Doshi AH, Dugar M, Delman BN, Naidich TP, Som PM. Role of 3D CT in the evaluation of the temporal bone. Radiographics 2006;26:S117-S132.
5. Shim HJ, Choi AY, Kwan KH, Yeo SG. The value of measuring Eustachian tube aeration on temporal bone CT in patients with chronic otitis media. Clin Exp Otorhinlaryngol. 2010;3:59-64.
6. O'Donoghue GM, Bates GJ, Anslow P, Rothera MP. The predictive value of high resolution computerized tomography in chronic suppurative ear disease. Clin Otolaryngol Allied Sci.1987;12:89–96.
7. Sirigiri RR, Dwaraknath K. Correlative Study of HRCT in Attico-Antral Disease. Indian J Otolaryngol Head Neck Surg 2011;63:155-8.
8. Rogha M, Hashemi SM, Mokhtarinejad F, Eshaghian A. Comparison of Preoperative Temporal Bone CT with Intraoperative Findings in Patients with Cholesteatoma. Iran J Otorhinolaryngol .2014; 26:7-12.
9. Anbarasu A, Chandrasekaran K, Balakrishnan S. Soft tissue attenuation in middle ear on HRCT: Pictorial review. Indian J Radiol Imaging. 2012;22:298-304.
10. Garber LZ and Dort JC. Cholesteatoma: Diagnosis and Staging by CT scan. J Otolaryngol 2003;23:121-24.
11. Yetiser S, Tosun F, Kazkayasi M. Facial nerve paralysis due to chronic otitis media. Otology and Neurotology.2002;4: 580–88.Gaurano JL, Joharjy IA. Middle ear cholest eatoma: characteristic CT findings in 64 patients. Ann Saudi Med. 2004;24:442-7.
12. Gaurano JL, Joharjy IA. Middle ear cholesteatoma: characteristic CT findings in 64 patients. Ann Saudi Med. 2004;24:442-7.
13. Jackler RK, Dillon WP, Schindler RA. Computed tomography in supurative air disease, a corelation of surgical and radiographic findings. Laryngoscope. 1984;94:746-52.
14. Chandrashekharayya SH, Kavitha MM, Handi P, Suligaui SS, Doddamani SS. The Management of Otogenic Lateral Sinus Thrombosis-A 6year Experience at a Tertiary Care Hospital in North Karnataka, India. JCDR. 2012;6:1272-75.
15. Chen YL, NG SH, Wong HF, Wong MC, Wai YY, Wan YL.Otogenic Deep Neck Abscess: A Rare Complication of Cholesteatoma with Acute Mastoiditis. Chin J Radiol. 2002;27:251-56.
16. Weissman JL, Kamerer DB. LabyrinthitisOssificans. American Journal of Otolaryngology. 1993;14:363-5.
17. Singh, B. and T.J. Maharaj. Radical mastoidectomy. Its place in otitic intracranial. complications. J. Laryngol. Otol.1993;107:1113-118.
18. Cvijovic A, Blazic I, Nedeljkovic S, Janeski N, Vasilski. CT manifestations of rare intracranial complications in patients with acquired cholesteatoma. Poster ECR 2015/C-0655. doi:10.1594/ecr2015/C-0655.
19. Maksimovic Z, Rukovanjski M. Intracranial complications of cholesteatoma. Acta Oto-rhino-laryngologicaBelgica 1993;47:33-36.
20. Mafee MF, Levin BC, Applebaum EL, Campus CF. Cholesteatoma of middle ear and mastoid. Otolaryngol. 1988;21:256-68.