Indian Journal of Basic and Applied Medical Research; September 2021: Vol.-10, Issue- 4, P. 133 – 140
DOI: 10.36848/IJBAMR/2020/29215.55660

Original article:

Evaluation of temporal bone in cholesteatoma patients by high resolution computed tomography

Dr.Ayush Gupta*; Dr.Siddesh MB**

*Junior Resident, Department of Radiodiagnosis, JJM medical college , Davangere;
** Professor , Department of Radiodiagnosis , JJM medical college, Davangere
Corresponding author*

ABSTRACT:

Introduction: The temporal bone and inner ear are highly complex organs and require precise surgical handwork . HRCT of temporal bone can provide excellent pre operative analysis for the cholesteatoma and its complication.

Aim:To determine the usefulness of HRCT temporal bone in pre operative analysis and correlate the findings with per operative and post operative notes.

Methods: 128 cases were studied on 64 slice Philips Computed tomography

Results: Mastoid sclerosis was seen in 100% of the cases, 92% cases showed ossicular erosions while aditus widening and scutum erosions were seen in 85.9% and 78 respectively.Facial canal involvement was seen in 18% ,semi-circular canal fistula in 14% and tegmen erosion in 3.1% of cases.These findings variably correlated with surgical findings.

Conclusion :Our study demonstrated that HRCT successfully predicted the status of middle ear involvement including the extent of cholesteatoma and its complications along with anatomical variants. HRCT can serve as a guide for the surgeon during middle ear surgeries and is a valuable and indispensible tool

BACKGROUND

The temporal bone is extremely complex and contains the organs of hearing and balance with various other components such as major vessels and nerves coursing through it. Since it has various important functions imagining of temporal bone has also been an area of interest since the earliest development of roentgenopraghy .High Resolution Computed Tomography and MRI have made it possible to obtain high quality images with exquisite demonstration of the normal temporal bone structures and various pathological process. HRCT provides excellent detail of the bony landmarks within temporal bone due to inherent contrast, its dense bone being surrounded by air of the tympanic cavity and mastoid air cells. It has also refined visualization of the soft tissue components within and adjacent to the temporal bone. Hence HRCT has allowed better understanding of the etiology, pathology, the disease course, earlier detection of complications and various treatment modality which has considerably decreased the morbidity and mortality. Infections of middle ear are common remain the most common cause of temporal bone surgery . Cholesteatoma has previously been diagnosed by otoscopic examination. The need for good imaging has been long overdue. This study determines the

usefulness of a pre-operative HRCT scan in showing the status of the middle ear structures in the presence of cholesteatoma.

Hassmann-Poznanska E et al, (1)compared in their study of 60 ears the preoperative CT scans with the post operative notes findings in retrospective analysis. They demonstrated in their study a good correlation in cholesteatoma for most middle ear structures with integrity of long process of incus being the only exception. Fuse T, Aoyagi M, Koike Y, Sugai Y. et al, (2) in their study of 26 patients compared preoperative CT findings of the ossicular chain with post operative notes and operative findings in patients with ossicular defects. Preoperative detection of the complete defect of the malleus head and the body and long process of the incus by HRCT was surgically demonstrated in all cases, while detection of the defect of the manubrium of the malleus could be seen in 33.3% while superstructure of the stapes could be made out in only 60%. O'Donoghue GM, Bates GJ, Anslow P, Rothera MP. et al, (3)in their study used HRCT in the preoperative analysis and evluation of 50 patients with cholesteatoma . It proved highly accurate in depicting the extent of soft tissue within the middle ear cleft and mastoid. The long process of the incus and the stapes being the exception, the condition and degree of erosion of the ossicular chain was correctly predicted in over 90% of cases.

Erosion of the labyrinth was exquisitely depicted in 4 out of the 5 cases in which it occurred.

Chee NW, Tan TY. et al(4), in their study the CT-surgical agreement was excellent for the malleus (k=0.83), stapes (0.94) and semicircular canals (0.8),

CLASSIFICATION AND PATHOGENESIS

Cholesteatoma may be classified according to etiology into two general categories: congenital and acquired. Acquired cholesteatomas - further divided into primary and secondary. Congenital cholesteatomas arise from embryonal inclusions or rests of epithelial cells. This can be further classified according to location within the temporal bone. Numerous pathogenic mechanisms have been proposed to explain the development of acquired cholesteatomas.

Primary acquired cholesteatomas: the cause is due to underlying eustachian tube dysfunction resulting in retraction of the pars flaccid and poor which leads to drawing of the pars flaccida medially on top of the malleus neck. On development of the retraction pocket develops the accumulation of keratin starts and sac slowly enlarges to and around the ossicles, the attic walls, etc.

Theories :1) Implantation theory says that squamous epithelium becomes implanted into the middle ear as a result of surgery, foreign body (ventilating tubes), or blast injury. 2) The metaplasia theory explains that as a result of chronic or recurrent otitis media and in response to chronic irritation or infection there is keratin deposition. 3) Migration or epithelial invasion theory states that on permanent perforation of the tympanic membrane, the squamous epithelium begins to migrate along the perforation edge and hence can continue medially to the inferior surface of the tympanic membrane destroying the columnar epithelium.

MATERIALS AND METHODS

A total of 128 patients of whom 70 were males and 30 were females were studied in Department of radiodiagnosis , JJM medical college , Davangere. Age group was between the ages of 5 to 60 years. Patients were selected from out patient's clinic and wards of Otorhinolaryngology, , JJM medical college , Davangere. Period of study was from February 2020 to August 2021.Patients were included on the basis of their symptoms , physical and clinical findings suggestive of a lesion involving temporal bone such as refractory otorrhoea, otoscopically evident cholesteatoma and retracted tympanic membrane in its posterosuperior part.

CLINICAL SYMPTOMS IN DECREASING ORDER OF FREQUENCY

Symptoms	No of cases	% of cases
Ear discharge	84	56.25
Hard of hearing	44	34.38
Vertigo	06	4.69
Others	04	3.12
Tinnitus	02	1.56

RESULTS AND ANALYSIS

SOFT TISSUE DENSITY: Non-dependent, homogeneous soft tissue mass with focal areas of bone destruction is the typical appreance of acquired cholesteatomas on HRCT.In the most of our cases, the soft tissue density had mass-like features .The masses were homogeneous in 124 cases (96.87%), non-dependent in 126 (98.44%), and expansile in 118 (92.20%). The mass partially to almost completely occupied the middle ear cavity and antrum in 104 cases (81.25%).Few (11%) of these masses totally filled the whole middle ear cavity, or were focally localized to the attic and mastoid antrum (7.81%).

OSSICULAR CHAINS Out of the 118 (92.19%) cases with ossicular erosions, the incus was mostly eroded (75%) with the long process of the incus most commonly eroded. The stapes was the second most affected ossicular bone (65.62%) and was also totally eroded.Malleus was the least affected bone by erosion (40.64%).

FACIAL NERVE CANALS Out of the 128 cases 24 (18.8%) showed involvement with 18 (14%) partially eroded and 6 (4.69%) were totally destroyed.

SEMICIRCULAR CANALS: Due to its anatomical proximity to the medial wall of the attic, the semicircular canal is the most frequently eroded, lateral semi circular being the most common. Total of 36 cases (14%)

involving the lateral semicircular canals, 16 (6.25%) were positive for labyrinthine fistula and 20(7.81%) were found to be partially eroded .

TEGMEN:4 (3.13%) were positive for dehiscence (tegmental bone defect). In the remaining 124 (96.8%), the tegmen was intact.

SCUTUM (SPUR) Involvement of the scutum was present in even 100 cases (78%) in our series. Eighty cases (62.50%) were blunted and twenty (15.6%) were destroyed.

ADITUS AD ANTRUM:Cholesteatoma can erode the wall and widen the "waistline", that is aditus, resulting in the loss of the "figure of 8".There were 110 cases (85.9%) of involvement noted, 50 (39.06%) with loss of "figure of 8" and 36 (28.13%) of these had wall erosions .

PETROSQUAMOSAL SEPTUM (KOERNER'S SEPTUM) is a pointed bony projection originating from the antral roof. There were 114 cases (89%), with 76 (59.38%) partially eroded and 38 (29.68%) completely destroyed. In only 10 cases (7.81%) showed the septum preserved.

MASTOID AIR CELLS: In all 128 (100%) cases sclerotic mastoid air cells were seen.

MASTOID ANTRUM: In our series, the antra were replaced by soft tissue densities in 110 cases (85.94%), while 96 cases (75%) were expanded and 30 cases (23.43%) showed partial smooth bony erosions.

EXTENSIONS: In our series, 96 cases (75%) were obstructed. The remaining 32 (25%) remained patent and clear. Extensions in the facial recess in 98 cases (77%), in the tympanic recess (sinus tympani) in 90 cases (70%), in the protympanum in 82 cases (41%), and in the external auditory canal in 28 cases (22%).

EXTENSION BEYOND THE MIDDLE EAR: 4 cases were found to have destruction of the tegmen and 2 case sigmoid sinus plate destruction .

OCCURRENCE OF POSITIVE FINDINGS

CT findings	No of cases	% of cases
Ossicular erosion	118	92.18
Mastoid sclerosis	128	100.00
Aditus ad antrum widening	110	85.93
Scutum erosion	100	78.12
Facial canal involvement	24	18.75
Semicircular canal fistula	18	14.06
Tegmen erosion	4	3.12

DISCUSSION

Cholesteatoma is usually diagnosed on otologic examination. In difficult cases HRCT of temporal bone is done for characteristic ossicular displacement and erosion of bone. HRCT can even reveal cholesteatoma in hidden areas such as the posterior tympanic recess which are not detected by otologic examination. HRCT of temporal bone can also reveal anatomical variants as well as complications of cholesteatoma . On HRCT of temporal bone cholesteatoma presents as soft tissue density in the middle ear cavity, ossicular erosions and displacement , smooth erosions of the middle ear borders and adjacent structures. Associated with bony expansion of the middle ear cavity, these changes are highly suggestive of cholesteatoma.

This study revealed cholesteatoma findings suggest a diagnosis of middle ear consists of non-dependent polypoidal soft tissue density of the middle ear cavity and antrum, with associated expansion and smooth erosion of the walls, ossicular erosions and displacement. .Since cholesteatomas are usually sequale of chronic mastoiditis, our study also demonstrated similar findings. When the mastoid air cells appear "cloudy" but maintain their thin irregular trabecular pattern, or whenever there is obliteration of mastoid antrum and periantral cells by sclerotic/increased reactive bone formation, chronic mastoiditis without cholesteatoma is indicated[3].

In cases with antrum enlargement with presence of air-fluid level, the finding was suggestive of infected cholesteatoma[24]. In our study, non-dependent, homogeneous polypoidal soft tissue density in the mastoid antrum and middle ear cavity defined cholesteatoma. Cholesteatoma in antrum is characterized by a smooth cavity that is usually larger than normal owing to bony erosions. Out of 128 cases, 114 (89%) in our series demonstrated Koerner's septum erosion.Signs indicative of cholesteatoma in the attic consist of erosion /destruction of scutum or spur , widening of the aditus, erosions and widening of the antral wall, ossicular erosions and destruction, erosion of medial attic wall which may lead to facial nerve canal involvement, lateral semicircular canal erosion which may result into fistula formation (middle ear -semicircular canal fistula) , dehiscence of tegmen tympani, dehiscence of sigmoid sinus plate, erosion of the external auditory canal (EAC), and automastoidectomy.

Though otoscopic recognition of cholesteatoma is usually reliable, imaging modalities such as HRCT temporal bone should be used on all patients suspected of cholesteatoma to determine the presence of gross or subtle changes and the presence of complications due to bone erosions. HRCT can detect early bone changes and erosions and detailed imaging of the soft tissue extent of middle ear cholesteatoma and also provides information that may affect their surgical resection.

COMPARATIVE ANALYSIS

There was high correlation between surgical and pre operative finings (96.88%) (Table 1). Out of 128 cases, evaluation of the malleus correlated with the post- operative results in 60 cases (94%). In 8 cases, no erosions were seen in HRCT but erosions were then found in surgery. In the assessment of

the incus, 122 cases (96%) matched with the CT- surigcal findings. Subtle erosions in 6 cases seen in HRCT images were not found in surgery. The stapes showed correlation in 118 cases (92%) in both pre-operative scans and surgical finddings . Out of the 56 cases (43.75%) with an unclear degree of erosion on HRCT scans, the surgical reports found total destruction of the stapes in 52 cases (40.63%) while 4 (3.13%) were found to have been severely eroded. The remaining 10 cases (7.81%) showed subtle erosions as analyzed on HRCT, but were normal in surgery. The HRCT temporal bone-surgical evaluation of the lateral semicircular canal demonstrated 126 cases (94.44%) in agreement. CT- surgical correlation deonstrated partial erosions in 10 cases(7.81%). 8 cases (6.25%) had labyrinthine fistula in HRCT but mere 6 (4.69%) were in agreement with the surgical correlation. However, remaining case (1.56%) had marked erosion with dehiscence on post operative reports.

In our series, 110cases (86%) had CT-surgical agreement of facial canal involvement .

Among partially eroded canals, 24 (18.7%) positive cases were shown by CT. Only 14 cases (10.9%) were noted in surgery, 4 (3.13%) of which had dehiscence. The other 10 cases with very subtle marginal irregularities in HRCT were negative in surgery.

In 6 cases (4.69%) with facial nerve canal destruction, 4 (3.13%) had similar changes in surgery while in 2(1.56%) more than 50% dehiscence was reported in surgery.

Indian Journal of Basic and Applied Medical Research; September 2021: Vol.-10, Issue- 4, P. 133 – 140
DOI: 10.36848/IJBAMR/2020/29215.55660

TABLE NO: 1 – PRE-OPERATIVE CT AND SURGICAL CORRELATION

Diagnosis	Pre-op CT	Surgery
Cholesteatoma	124	122
Cholesteatoma with Other pathology	4	_
Granulation tissue	_	2
Aural polyp	_	4
Total	128	128

TABLE NO 2:

	Surgical Finding	Radiological Findings		Kappa
		Intact	Abnormal	
Malleus	Intact	64	04	0.811
	Eroded	08	52	
Incus	Intact	28	6	0.867
	Eroded	0	96	
Stapes	Intact	34	10	0.817
	Absent	0	84	
Facial canal	Intact	86	10	0.633
	Dehiscent	8	24	
Labryinth	Intact	108	2	0.938
	Fistula	0	18	

CONCLUSION

The new age of HRCT scans of the temporal bone has significantly increased the quality of the pre-operative evaluation of cholesteatoma. Our study demonstrated that HRCT successfully predicted the status of middle ear involvement including the extent of cholesteatoma and its complications along with anatomical variants. HRCT can serve as a guide for the surgeon during middle ear surgeries and is a valuable and indespensible tool .

BIBLIOGRAPHY

1. Hassmann-Poznanska E, Goscik E, Olenski J, Skotnicka B. Computerised tomography in pre-operative imaging of middle ear cholesteatoma. Otolaryngol Pol 2003;57:243-9.
2. Fuse, T, et al. "Diagnosis of the Ossicular Chain in the Middle Ear By High-resolution CT." ORL; Journal for Oto-rhino-laryngology and Its Related Specialties, vol. 54, no. 5, 1992, pp. 251-4.
3. O'DONOGHUE G. M., BATES G. J., ANSLOW P. & ROTHERA M. P. (1987) Clin. Otolaryngol. 12, 89-96
4. Chee, N & Tan, Tiong. (2001). The value of pre-operative high resolution CT scans in cholesteatoma surgery. Singapore medical journal. 42. 155-9.