RESEARCH ARTICLE

ROLE OF HRCT TEMPORAL BONE IN PRE-OPERATIVE EVALUATION OF CHOLESTEATOMA

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ABSTRACT
Background: Cholesteatoma is potentially dangerous condition as it can extend and erode into adjacent structures and can cause various serious complications. HRCT temporal bone very clearly depicts the anatomy of various small important structures in middle and inner ear cavity. Hence it is an excellent modality and investigation of choice in diagnosing and defining the extent of cholesteatoma. It has become essential investigation in preoperative planning for surgeon. Present study shows good correlation of various preoperative HRCT findings with intraoperative findings.
Aims & Objective: To study the role of HRCT temporal bone in pre-operative evaluation of cholesteatoma.
Material and Methods: Total 35 cases with clinically suspected cholesteatoma were selected for this study. All the patients were from Sir Sayajirao General Hospital, Vadodara and were scanned at the CT scan, Radiology Department of the hospital. The important intra-operative surgical findings were correlated with pre-operative HRCT findings. The results were analyzed, studied and compared with similar studies of the past.
Results: Present study shows good correlation between the preoperative findings of cholesteatoma by HRCT temporal bone and intraoperative surgical findings.
Conclusion: In present study HRCT enabled the pre-operative delineation of the cholesteatoma and the recognition of its manifestations and complications. HRCT is confirmed to be valuable in the diagnosis and in guiding the surgical management of cholesteatoma.
Key-Words: High Resolution Computed Tomography (HRCT); Temporal Bone; Cholesteatoma; Pre-Operative Evaluation

Introduction

Cholesteatoma is a sac of keratinizing squamous epithelium in the middle ear cleft. Acquired middle ear cholesteatoma, which is more common than congenital variety has been recognized clinically and radiologically for many years. Cholesteatoma is potentially serious condition as it can progressively enlarge and erode into neighbouring structures, giving rise to serious intracranial and extracranial complications. Cholesteatoma can be recognized by the presence of attic squames on otoscopic examination.[1] High Resolution Computed Tomography (HRCT) is most valuable for detection of non-dependent soft tissue opacification suggestive of cholesteatoma, as well as its extent and complications.[1-4] HRCT is fast becoming an important imaging modality in the diagnosis and preoperative management of the patients with middle ear cholesteatoma.

Materials and Methods

The present study of evaluation of middle ear cholesteatoma by high resolution computed tomography (HRCT) of temporal bone was carried out at Shree Sayajirao General Hospital and Medical College, Vadodara. Total 30 patients with clinically suspected cholesteatoma were selected for this study. No selection bias was exercised in terms of patients' age, sex. Out of 30 patients five patients had bilateral cholesteatoma, so total 35 cases of cholesteatoma were included in study. All the patients were from Sir Sayajirao General Hospital, Vadodara and were scanned at the CT scan, Radiology Department of the hospital.

The radiological demonstration of the cholesteatoma was done with high resolution computed tomography (HRCT). Scans were done using Philips Tomoscan EG. Scans were performed in axial and coronal planes. Parameters applied included 512 matrix, 200 field of view, 2 mm thick section, 120 KV and 50 mA exposure. Non-contrast CT was adequate in majority of patients. However, intravenous contrast medium was given in some patients when brain extension was suspected. Imaging characteristics of HRCT scan were recorded in all patients Out of 35 cases of cholesteatoma 33 cases were operated at E.N.T. Department, Sir Sayajirao General Hospital, Vadodara. The important intra-operative surgical findings were correlated with pre-operative HRCT findings. The results were analyzed, studied and compared with similar studies of the past.

Results

In this study all the cases (100%) showed non-dependent homogenous soft tissue in the middle ear cavity (Figure 1). The soft tissue was extending in aditus ad antrum (85.6%), mastoid antrum (82.9%), external auditory canal (31.4%), extra-temporal soft tissue (14.3%), eustachian tube (2.9%), labyrinth (5.7%) and internal auditory canal (2.9%).

Erosion of the long process or body of incus was seen in 85.7% of cases (90% sensitivity and 66.7% specificity) and long process of malleus was eroded in 45.7% of cases (81.3% sensitivity and 94.1% specificity). Stapes superstructure could not be visualized in 11 cases (31.4%) which were considered to be eroded (80% sensitivity and 95.7% specificity). (Figure 2)

Tympanic membrane was normal in 37.1% and retracted in 20 % of all cases. In 42.9% tympanic membrane was obliterated by soft tissue. Total 62.9% cases showed erosion of the scutum while 25.7% cases showed only blunting of it. Total 91.4% showed erosion of the Koerner's septum. Total 14.4% showed well cellular mastoid while 85.6% showed poorly cellular or acellular mastoid. In majority of the poorly or acellular mastoid, sclerosis of the mastoid air cells was marked. In 94.3% cases the mastoid air cells trabeculations were lost. Tegmen tympani erosion was seen in 51.4% cases with 93.8% sensitivity and 88.2% specificity (Figure 3), while sinus plate erosion was seen in 40% of cases with 91.7% sensitivity and 95.2% specificity.

In 22.9% cases facial nerve canal was found to be eroded with sensitivity of 75% and specificity of 89.6% (Figure 4). The tympanic segment of the facial nerve canal was most commonly affected. Only 1 case showed the erosion of the descending (mastoid) part of the facial nerve canal and 1 case showed the erosion of the labyrinthine segment of the facial nerve canal.

Erosion of the lateral semicircular canal was seen in 22.9% cases (sensitivity of 85.7% and specificity of 96.1%), erosion of the superior semicircular canal was seen in 5.7% cases (sensitivity specificity of 100%) and posterior semicircular canal erosion was seen in 5.7% cases (sensitivity of 50% and specificity of 100%) (Figure 5). Cochlear erosion was seen in 5.7% cases, vestibule erosion was detected in 11.4% cases and internal auditory canal erosion was seen in 2.9% cases, all with 100% sensitivity and 100% specificity. Adjacent soft tissue inflammatory changes were seen in 20% cases. Extraaxial collection was detected in 5.7% cases. Total 5.7% cases showed subperiosteal abscess which were associated with erosion of the outer wall of mastoid cortex. Total 8.6% cases had cerebral/cerebellar abscess out of which one had right temporal lobe abscess and two had left cerebellar abscess. Venous sinus thrombosis affecting sigmoid and straight sinus was and resultant hemorrhagic venous infarct in left temporal lobe were seen in 2.9% cases.

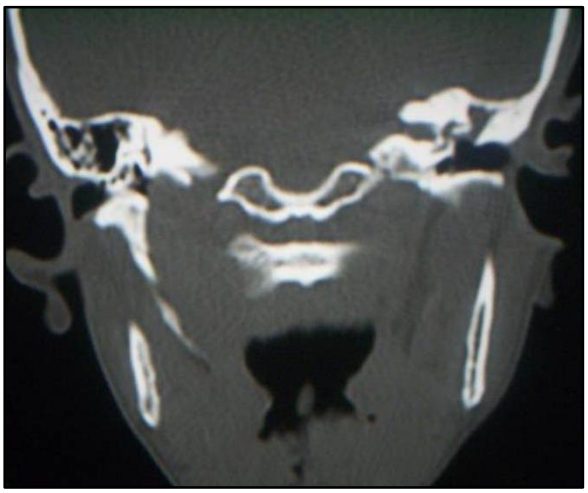

Figure-1: Coronal section showing nondependent hypodense soft tissue in left middle ear cavity in region of attic

Figure-2: Coronal section shows hypodense soft tissue in right middle ear cavity with erosion of malleus, part of incus and stapes

Figure-3: Coronal HRCT section shows right middle ear cholesteatoma with erosion of tegmen tympani

Figure-4: Coronal section showing bilateral middle ear cholesteatoma. On right side erosion of tympanic segment of facial nerve canal as compared to preserved facial nerve canal on left side

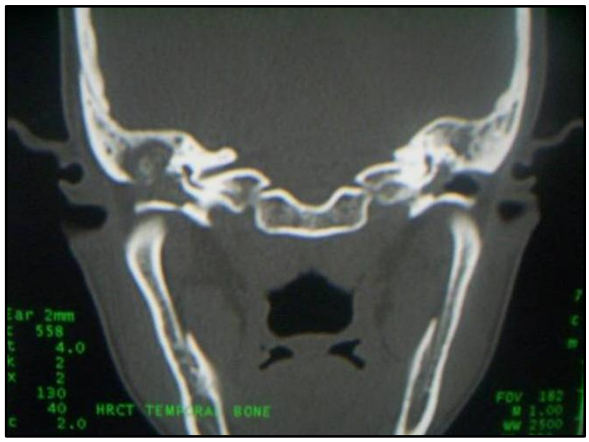

Figure-5: Coronal section showing right middle ear cholesteatoma causing erosion of right sided lateral semicircular canal

Discussion

The diagnosis of the cholesteatoma is usually made on otologic examination.[1] Although otoscopic recognition of the cholesteatoma is often reliable, imaging modalities should be used in all patients suspected of harbouring a cholesteatoma to determine the presence of gross or subtle changes and the presence of complications, which are mostly due to bone erosions. The specific issues that must be assessed on imaging studies and that will affect the surgical treatment are bone erosion and the degree of extension. CT is sensitive for the detection of early bone erosions and detailed imaging of the soft tissue extent of middle ear cholesteatoma.[1-4]

Cholesteatoma can be accurately diagnosed by the HRCT in the vast majority of cases.[5] Mafee et al reported 96 % of the specificity in diagnosing cholesteatoma in pre-operative scans.[5,6] The hallmarks of the cholesteatoma are the presence of non-dependent soft tissue density in middle ear cavity, ossicular erosion, smooth erosions of the middle ear borders and adjacent structures. These changes when associated with bony expansion of the middle ear cavity and aditus ad antrum are highly suggestive of cholesteatoma.[1,5,7,8]

The present study showed excellent demonstration of above features in majority of the cases which are diagnostic for cholesteatoma. HRCT scans well delineate the extent and location of the disease.[1,5,7-12] HRCT scan can determine its extent by revealing a soft tissue mass and bone erosion, with 80% specificity.[1] The non-dependent soft tissue in middle ear cavity, widening of aditus ad antrum with loss of its "figure of 8" appearance and expansion of the mastoid antrum by soft tissue favours the diagnosis of cholesteatoma.[1,5,7,8,12] Erosion of the mastoid cortex may lead to extension of the cholesteatoma in extra-temporal region. The extension of the cholesteatoma in sinus tympani, facial recess, vestibule, cochlea; internal and external auditory canal are well evaluated with HRCT temporal bone scans. Present study is an excellent example of demonstrating the value of HRCT in evaluation of location and extent of the cholesteatoma.

However HRCT scans overestimate the extent of disease as it often cannot differentiate definitively between cholesteatoma and granulation tissue.[1,5,6,8] In present study many of cases showed soft tissue occupying the many spaces at the time of CT study. Many of the patients had both granulation tissue and cholesteatoma, which could not be distinguished on HRCT.

Erosion of the ossicles is commonly seen with cholesteatomas, as they enlarge and come in contact with contiguous structures in the middle ear. Total absence of the ossicle suggests its complete erosion. The HRCT scan gives a good to excellent radiosurgical correlation for the middle ear ossicles in our cases, and this is also the experience that others have reported.[1,5,6,10-15] Prior knowledge of the status of ossicles decides the likelihood of hearing preservation achieved after surgery. Patients with intact stapes tend to show better hearing preservation as compared to those where the superstructure is absent.[1,5,7,8,13,16]

Tympanic membrane evaluation is of not much importance as it is usually obscured by the soft tissue as in present study. Erosion or blunting of scutum is classically seen in attic cholesteatoma. It may be the earliest sign of attic cholesteatoma before significant ossicular erosion.[7-9] Few cases of early cholesteatoma were detected in present study in which scutum was proved to be an important landmark. Erosion or absence of the Koerner's septum is considered as a sign of antral cholesteatoma.[1,7,8] Gaurano et al

demonstrated 89 % incidence of absence of Koerner's septum in case of cholesteatoma. This was well correlated in our study.

Knowledge of the mastoid pneumatization aid in the planning of surgical approach e.g. whether to do canal wall down or up type of surgery. [5] In majority of the adult cholesteatoma patients mastoid air cells are very few in number and sclerotic.[1,5,7,8] Also at the same time trabeculations are lost in these patients. Present study findings well correlates with this statement. Tegmen tympani or sinus plate erosions warrants the radiologist to find intracranial complications if any. Venous sinus thrombosis and cerebral/ cerebellar abscess of otologic etiology are always associated with erosion of these structures.[7,8] In our study all the cases of cerebral and cerebellar abscess had erosion of tegmen tympani and sinus plate respectively.

Pre-operative demonstration of facial nerve canal involvement is often difficult because of its small size, oblique orientation in tympanic part and developmental dehiscence, particularly when abutted by soft tissue.[1,5,7,8] Facial nerve canal dehiscence is a fairly common finding in 55 % of temporal bones, and usually occurring in a focal area in the tympanic portion of the facial nerve canal.[5,17,18] So the facial nerve canal should be evaluated in both axial and coronal scans. The most common site of the facial nerve compression is the tympanic segment where it lies exactly below the lateral semicircular canal. When a complete bony canal is present, erosion of the canal wall is easily detected on imaging. However the bony canal in this segment may be congenitally thin when its erosion may become difficult to detect. Still gross invasion of the facial nerve canal in these region is quiet demon-strable.[8,19] This explains the low radiological sensitivity in detection facial nerve canal erosion as in present study.

Lateral semicircular canal is the most commonly affected canal by cholesteatoma as in this study. In all the patients with middle ear disease, this area should be carefully evaluated on both axial and coronal images for cortical thinning. The diagnosis of the fistula is made when the mass is seen in direct apposition to the lumen of labyrinth. HRCT clearly depicts bone erosion even in the absence of fistula which helps surgeon intra-operatively in careful resection of cholesteatoma to prevent labyrinthine fistula.

Conclusion

The pre-operative delineation of the cholesteatoma and the recognition of its manifestations and complications. HRCT provided useful information for cholesteatoma operating surgeon as degree of ventilation/opacification of middle ear cleft from the Eustachian tube to the mastoid tip, erosion of ossicular chain, access to the epitympanum as determined by the level of the dura laterally, development/cellularity/ sclerosis of the mastoid cortex, dehiscence of the tegmen, erosion of the labyrinth, especially the lateral semicircular canal and status of the facial nerve. HRCT is confirmed valuable in the diagnosis and in guiding the surgical management of cholesteatoma.

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