
HRCT with oblique reconstructions in diagnosis and detection of pathologies of the temporal bone in CSOM

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Abstract

Background: HRCT with oblique reconstructions, a modification of routine CT provides minute structural details. The purpose of the study is primarily to understand the capability of HRCT with oblique reconstructions in diagnosis and detection of pathologies of the temporal bone in middle ear infection.

Method: study is carried out in the Department of Radio-diagnosis, Kasturba Medical College, Mangalore, from July 2013 to October 2014. A total of 23 referred cases of CSOM were subjected HRCT and oblique reconstructions performed for diagnosis and management.

Results: Infection was 3rd most common cause of temporal bone lesion, 1st and 2nd were tumor and temporal bone trauma respectively, incus long process being the most common ossicle involved in erosion. The common presenting symptoms were otorrhea and otalgia. Most patients presented with chronic ear discharge.

Conclusions: From the present study we conclude that HRCT with oblique reconstructions in CSOM helps in accurate assessment of pathology prior to surgical exploration regarding location, extent and complication of the disease.

Keywords: Computerized Tomography (CT), High Resolution computerized Tomography (HRCT), Chronic Suppurative Otitis Media (CSOM), Magnetic Resonance Imaging (MRI), Multiple Detector Computed Tomography (MDCT).

1. Introduction

Many imaging modalities are available for the evaluation of the temporal bone, including plain radiographs, angiography, air and non-ionic contrast cisternography, computed tomography (CT), and magnetic resonance imaging (MRI). [1] CT and MRI are currently the most widely used techniques and have largely replaced the other modalities. [2]

HRCT with oblique reconstructions, a modification of routine CT provides a direct visual window into the temporal bone providing hitherto unavailable minute structural details. [3]

The purpose of the study is primarily to understand the capability of HRCT with oblique reconstructions in diagnosis and detection of pathologies of the temporal bone in middle ear infection.

Ordinarily, the temporal bone anatomy is difficult to comprehend. The advent of MDCT, with high resolution scanning and multiplanar reconstruction capability, has greatly simplified the evaluation of the various anatomical components of the middle and inner ear. However, the physical limitations of gantry angle and patient positioning are still restrictive with the earlier 1 and 4 detector CT scanners. The plane of imaging is restricted to standard axial and coronal orientation. Most anatomic structures of middle and inner ear are, therefore, not optimally detected.

As the CT technology has improved and the MDCT has attained a 64 slice stage, it has further improved the anatomical evaluation by enabling

exquisite mutliplanar reconstruction of these structures.[4]

diagnosis, Kasturba Medical College, Mangalore, from July 2013 to October 2014.

2. Material and Methods

This study evaluating the efficacy of CT in the diagnosis of temporal bone pathologies in CSOM was done on 23 cases in the Department of Radio

2.1 Selection of Patients

Patients who were clinically suspected of having symptoms related to the temporal bone were referred and subjected to HRCT of the temporal bone.

3. Result and Observation

Table 1: Distribution of Disease

CSOM	No of patients	Percentage
Soft tissue in tympanic cavity	23	100%
Soft tissue in aditus/tympanic isthmus	10	43%
With bony erosion	13	57%
Without erosion	10	43%
Mod-Severe sclerosed mastoid	6	30%
Erosion of malleus: Head	3	13%
Long process	5	21%
Erosion of Incus: Head	6	26%
Long process	10	43%
Erosion of Stapes: Partial	3	13%
Complete	3	13%
Displaced	1	4%
Scutum erosion	8	34%
Widened aditus	4	17%
Lateral SSC erosion with fistula	1	4%
Labyrinthitis ossificans	2	8%
Erosion of bony labrynth	1	4%
Automastoidectomy	1	4%
Tegmen tympani erosion	1	4%

Table 2: Table for multiplanar reformation

Area of interest	Plane of reconstruction	Approximate primary reference plane	Secondary reference plane
Malleus	Double oblique coronal	Axial 150°	Sagittal 85°
Incus	Double oblique coronal	Axial 150°	Sagittal 60°
Malleus and Incus-Molar	Double oblique sagittal	Axial 60°	Coronal 120°
Stapes oval window complex			
Long axis	Double oblique axial	Coronal 30°	Sagittal 150°
Short axis	Double oblique sagittal	Axial 65°	Coronal 120°
Round window	Single oblique sagittal	Axial 60°	
Cochlea			
Short axis	Double oblique coronal	Axial 30°	Sagittal 75°
Long axis	Single oblique sagittal	Axial 120°	
Superior semicircular canal	Single oblique sagittal	Axial 135°	
Vestibular aqueduct	Single oblique sagittal	Axial 90°	
Facial nerve canal	Double Oblique Sagittal	Axial 60°	Coronal 95°

4. Discussion

In the present study, 23 cases were studied and out of which 13 had erosion and 10 did not. Study by Lloyd *et al*[5] in 30 patients with CT IJBR (2015) 6 (05)

showed infection as the 3rd most common cause of temporal bone lesion. 1st and 2nd were tumor and temporal bone trauma respectively. This variation could be due to the increasing number of

complications associated with the infections because of the late presentation of the disease in our study, which could be attributed to the low socio economic strata and illiteracy of the patients.

Study by Mahmood *et al*[6] showed advantages of CT scanning over complex motion tomography, namely superior soft tissue contrast resolution and improved spatial detail. In his study many patients with cholesteatoma had both granulation tissue and cholesteatoma, which could not be radiographically distinguished. A useful sign was bulging of the tympanic membrane, usually signifying cholesteatoma. In contrast, retraction of the tympanic membrane suggested fluid, granulation, or scar tissue in the middle ear. An irregular weblike density was always due to granulation and scar tissue. Erosion of the incus was a common finding in the ear with cholesteatoma. Erosion of the distal portion of the long process of the incus was frequently seen in patients with chronic otitis media. Erosion of the lateral wall of the attic, anterior tympanic spine, facial nerve canal, and superior wall of the external canal, along with displacement of the ossicles, was often seen in cholesteatoma. Increased thickening of the ossicles (osteitis), intratympanic calcification, and bone formation at the level of the aditus ad antrum were frequently seen in patients with tympanosclerosis.

Present study correlated with the study by Mahmood *et al*[6]; with incus long process being the most common ossicle involved as it has the least ligamentous support: seen in 10 patients (43%) ; Other bony structures involved being incus body 6 patients (26%), scutum in 8 patients (34%) malleus long process in 5 patients (21%), malleus head and short process 3 patients (13%), partial and complete erosion of stapes in 3 patients (13%) each, lateral semicircular canal dehiscence in 1 patient (4%).

Out of 23 patients in the present study 10 patients (43%) belonged to low socio economic groups. This is accordance with studies and a well acknowledged fact, Poor nutrition and poor hygiene coupled with illiteracy perhaps plays a major role as most patients were found to be illiterate and ignorant about ear disease. Most patients sought medical advice very late.

The common presenting symptoms were otorrhea and otalgia. The discharge was scanty, foul smelling and purulent. Most patients presented with chronic ear discharge.

Increased ear discharge, persistent ear ache, fever, post auricular swelling and facial weakness heralded complications of cholesteatoma. The presence of vomiting, headache, drowsiness and altered sensorium indicated a more sinister threat of a

lurking intracranial complication. Bilateral cholesteatoma are rare.

Cholesteatoma in children and adolescent is said to be more aggressive. This is validated by the high incidence of complication in the first two decades of life and further substantiated by the fact that very extensive disease at the time surgery is more frequent in children than in adults and also by higher rates of recidivism in children.

Jackler and Schindler[7] studied forty-two patients with chronic otitis media who underwent preoperative CT scanning followed by surgical exploration of the middle ear and mastoid. The CT finding of abnormal soft tissue density associated with bone erosion was highly correlated with the surgical finding of cholesteatoma. By contrast, the total absence of abnormal soft tissue on CT essentially excluded cholesteatoma. However, 50% of all patients had abnormal soft tissue on CT scan not accompanied by bone erosion. In this largest group of patients it was not possible to diagnose or exclude cholesteatoma on the basis of CT findings alone.

In present study 10 patients (35%) had soft tissue without bone erosion which was categorized as nonerosive chronic otitis media, 1 patient (4%) had soft tissue with bulging tympanic membrane without erosion which according to Mafee *et al*[8] signifies cholesteatoma.

Ferlito[9] studied the pathologic alterations of the mucous membrane in the course of chronic otitis media. The inflammatory process affects the periosteum, mesosteum, endosteum. The osteogenic process causes increased thickening of the trabeculae and finally obliteration of the mastoid air cells.

In present study cases out of 23 patients with CSOM, 8 patients (34%) had moderate to severe mastoid air cell sclerosis.

Tumarkin[10] study revealed that tympanic isthmus obstruction is the most frequent cause of blockage of air communication between the middle ear and the mastoid in chronic otomastoiditis, with consequent loss of air reservoir to prevent rapid pressure changes in the middle ear. So the middle ear is placed under the constant strain of negative pressure across the tympanic diaphragm. In present study soft tissue at the tympanic isthmus and aditus was seen in 11 patients (43%).

5. Summary

This study was undertaken to develop a systemic method for evaluation of temporal bone as there are a variety of other imaging modalities. The lowest radiation dose to the lens, visualization of small bony structures, technical factors, interpretation

of the images and economical factors were all considered.

To get diagnostic quality images in two different planes in single-detector row CT, a second coronal acquisition must be performed in addition to the transverse acquisition, which is highly dependent on the patient's mobility. But the multi-detector row CT, a major advance in CT technology, offers the potential to overcome this obstacle because coronal reformatted images can be obtained without loss of resolution. The high image quality is a result of the thinner section thickness (0.6 mm instead of 1 mm in single-detector row CT) and the smaller reconstruction increment of 0.4mm. This new type of CT with isotropic imaging has a submillimeter spatial resolution in the z-axis by which MPR images can be created in any plane with the same spatial resolution as the original sections resulting in longitudinal resolution nearly identical to the inplane resolution. It helps in accurate assessment of pathology prior to surgical exploration regarding location, extent and complication of the disease, such as in patients

6. Conclusion

In the present study multiplanar reformation of the data set, acquired by spiral CT helped in terms of improved diagnostic accuracy and better demonstration of pathological anatomy in CSOM. Multiplanar views are therefore clinically relevant for the ear surgeon in the planning of restoration surgeries.

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