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EVALUATION OF TEMPORAL BONE PATHOLOGIES USING HIGH RESOLUTION COMPUTED TOMOGRAPHY: A PROSPECTIVE STUDY WITH SURGICAL AND HISTOLOGICAL CORRELATION

Radiodiagnosis

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ABSTRACT

Background: Conventional techniques like X-ray of mastoids have limited ability to determine the temporal bone and cochlea-vestibular anatomy and associated pathology. High resolution computed tomography (HRCT) is a modified CT technique which is extremely helpful in evaluating the anatomy and pathology type and extent of disease.

Objective: To evaluate role of HRCT in detecting and diagnosing the pathologies of the temporal bone.

Materials and Methods: Fifty patients with suspected temporal bone pathologies formed the material of study. Detailed history and findings of clinical examination were recorded in detail. All the patients were subjected to HRCT of temporal bone using standard protocols. Imaging findings were recorded and results were reported as proportions and rates. Imaging findings were correlated with histopathological and surgical findings wherever possible.

Results: Majority of the patients were males (64%) with maximum number of cases in 3rd decade of life. Most common temporal bone pathologies was infection (60%) followed by trauma (16%). Tumors and Congenital anomalies were seen in 12% cases each. In patients with infection, ossicular chain erosions were seen in 36.7% cases while cholesteatoma was seen in 56.7 % cases. Sensitivity of HRCT in diagnosing cholesteatoma and ossicular erosion was 94.1% and 93.3% respectively.

Conclusion: HRCT is an important pre-operative imaging tool in evaluating the various pathologies affecting the temporal bone. It helps in evaluating the distribution, features, localization and extent of various pathologies and lays down an anatomical roadmap for the surgeon preoperatively.

KEYWORDS

HRCT; Temporal bone; Cholesteatoma; Middle Ear; Infection

INTRODUCTION:

The temporal bone is a complex anatomical structure containing the middle and inner ear and contained structures such as ossicles. Ear pathology is the third most common reason of visiting an otorhinolaryngologist and inflammatory conditions of the middle ear are a frequent reason to prescribe antibiotics and perform surgery in children and teenagers [1]. Many imaging modalities are available for the evaluation of the temporal bone, including conventional radiographs, angiography, computed tomography, and magnetic resonance imaging. Significant advances in diagnostic imaging has occurred with the introduction of High Resolution computed Tomography (HRCT). HRCT provides a direct visual window into the temporal bone and provides minute structural details of both anatomy and pathology of temporal bone [2]. As HRCT can assess temporal bone area with unprecedented accuracy, it has allowed better understanding of the etiology, pathology, disease course, earlier detection of complications and treatment modality and has considerably reduced the morbidity and mortality pertaining to lesions of this region [3]. HRCT is widely used in the diagnosis of inflammatory middle ear diseases, such as chronic otitis media or cholesteatoma and in evaluation of middle ear following mastoidectomy or tympanoplasty [4,5]. The purpose of the study is to evaluate the capability of HRCT in diagnosis and detection of temporal bone pathologies and congenital anomalies of the temporal bone.

MATERIALS AND METHODS:

Fifty clinically suspected patients with temporal bone pathologies, who presented to the department of Otorhinolaryngology at ASCOMS Hospital, Sidhra Jammu were included in the study. Detailed history and findings of clinical examination were recorded in detail. All the patients underwent HRCT of the temporal bone using GE Bright Speed Elite, 16 Slice MDCT machine. Scans were acquired in the helical mode to reduce motion artifacts. Scanning parameters of 130 kV, 150 mAs, 1-2 mm section thickness and 0.5 mm collimation were taken. With the patient in supine position, axial projections of the temporal bone were obtained with the line joining the infra-orbital rim and external auditory meatus perpendicular to the table. The images were reconstructed with a bone algorithm. Coronal and sagittal reformatting was done to a slice thickness of 0.63 mm. For contrast enhanced scans, bolus injection of non-ionic agent iohexol (omnipaque) containing 350 mg of iodine per ml was given in the dose of 1.5 ml/kg of body weight. Imaging findings were recorded in detail and reviewed on workstation by experienced radiologists. Imaging findings were correlated with histopathological and surgical findings wherever applicable.

RESULTS:

Majority of the patients were males (64%) with male to female ratio of approx. 1.8:1. Maximum number of cases was seen in 3rd decade of life followed by 2nd decade. The most common presenting symptom was hearing loss followed by ear ache and ear discharge.

Temporal bone infection was commonest pathology seen in 60% cases (Table 1). In these cases, right side was involved in 46.7 % cases and left in 33.3 % cases with bilateral involvement in 20% cases. HRCT findings were suggestive of cholesteatoma in 60.0 % cases, chronic otitis media without features of cholesteatoma in 23.3% cases and mastoditis alone in 16.7% cases (Table 2). All cases with HRCT findings of cholesteatoma were operated. On surgical exploration, evidence of cholesteatoma was seen in 16 of 18 cases while remaining two cases had chronic otitis media without any evidence of cholesteatoma. Seven cases of chronic otitis media were also operated. In one case, erosion of stapes was seen in addition to features of otitis media and was diagnosed as cholesteatoma on intraoperative findings. Traumatic involvement of temporal bone was seen in 16% cases. Squamous Temporal Bone was commonly involved (50.0%) followed by petrous and mastoid parts (25% each) Mixed/Oblique fractures were the commonest type seen in 62.5% % cases followed by longitudinal fractures (25%) and transverse fractures (12.5%).

Six cases of tumours were seen. Two cases of acoustic neuroma and solitary case each of meningioma, metastasis and glomus juglare were seen. Single soft tissue lesion was also seen in 8 year old child and proved as rhabdomyosarcoma on histopathology. Congenital anomalies were seen in 6 cases. They included two cases of microtia, two cases of external auditory atresia and single case each of ossicular anomaly and mondini dysplasia. All the Patients refused surgical correction of deformity. Overall sensitivity of HRCT in diagnosing cholesteataoma and ossicular erosion was 94.1 % and 93.3% respectively.

DISCUSSION:

HRCT of the temporal bone plays a significant role in delineating the temporal bone anatomy and pathology, provides accurate diagnosis, assessment of extent of disease, earlier detection of complications and

thus helps in planning the management strategy in temporal bone disease [6]. HRCT has considerably reduced the morbidity and mortality pertaining to lesions of this area [6]. Air in the tympanic cavity is surrounded by the dense temporal bone and the mastoid air cells and thus provides an inherent natural contrast to the temporal bone imaging and provides excellent delineation of bony land marks within the temporal bone [6].

In our study, majority of cases were seen in 3rd decade with male to female ratio of 1.8:1. The results were similar to study by Vivek R et al [3]. The commonest symptoms in our study were hearing loss, earache and ear discharge similar to previously published studies [3]. Temporal bone infection was the commonest pathology in our study similar to previously published studies [3,7,8]. In our study, right side was more commonly involved than left side similar to results of Thukral CL et al [9]. In patients with temporal bone infections, findings suggestive of cholesteatoma were seen in 60% cases. Hallmark of cholesteatoma on HRCT is presence of soft tissue mass in attic and mastoid antrum along with smooth bony expansion, scalloping of mastoid, erosion of scutum and middle ear ossicles [5]. Cholesteatoma characteristically causes bone erosion and when this feature is present in association with a soft tissue mass on HRCT, cholesteatoma was seen in 80% of explored cases as mentioned in previous studies [10,11]. Though a definitive diagnosis of cholesteatoma can only be made during surgery, CT evaluation may influence the decision and timing of surgical exploration with evidence of bony erosion, complications like acute mastoiditis, brain abscess prompting earlier surgical intervention [12]. Chronic Otitis media was the second commonest infection followed by mastoiditis. In otitis media and mastoiditis, HRCT findings consist of non-specific debris within middle ear and mastoid air cells respectively. In coalescent mastoiditis, HRCT shows erosion of the mastoid septations and associated development of intramastoid empyema [2]. Chole et al. [13] stated that mastoiditis is a common finding in cases with suspected temporal bone pathology and chronic ottitis media.

Traumatic involvement of temporal bone was seen in 16% cases in our study. Squamous Temporal Bone was commonly involved (50%) followed by petrous and mastoid parts (25% each). Mixed fractures were the commonest fracture in our study followed by longitudinal fractures. However previous studies [2,14] have demonstrated longitudinal fractures to be the commonest type in temporal bone trauma. This may be attributed to smaller sample size in our study. Facial nerve paresis, conductive hearing loss, cochlear and vestibular dysfunction, and leakage of cerebrospinal fluid are an important group of delayed sequelae of head injury [14]. HRCT is the most sensitive modality in radiological assessment of cases with temporal bone trauma [2,15]. HRCT accurately depicts the site of fractures with fine bony details including small fracture lines in the region of the genu of the facial nerve.

Six cases of tumours were also seen in the study. Two cases of acoustic neuroma and solitary case each of meningioma, metastasis and glomus juglare were seen. Single case of rhabdomyosarcoma was also seen in 8 year old child. Llyods G et al [8] also observed acoustic neuroma as the commonest temporal bone tumour in their study. Temporal bone Tumours appear isodense to slightly hypodense lesions on HRCT images [2]. Acoustic neuroma may be associated with secondary changes such as widening of ipsilateral cerebellopontine angle and quadrigeminal cistern, narrowing of contralateral cisterna and displacement and compression of 4th ventricle [2]. Enhancement is seen in the tumours after administration of Iodinated Contrast Materials. Meningiomas appear as sharply circumscribed mass on HRCT abutting the dural surface and forming an obtuse angle. Most of these are hyperdense and show strong and uniform enhancement with calcification is seen in 20 to 25% cases [2]. HRCT is a very significant diagnostic tool to diagnose and stage glomus tumours of the temporal bone [16,17].

Congenital anomalies were seen in 6 cases in our study including two cases of microtia, two cases of external auditory atresia and single case each of ossicular anomaly and mondini dysplasia.

There are some limitations in the use of HRCT in evaluation of middle ear disease. HRCT scan in chronically draining ears demonstrated abnormal soft tissue densities in the middle ear or mastoid. However, if this soft tissue mass was not associated with bone erosion, it was not possible to discern whether or not cholesteatoma was present. Tympanic membrane thickening and perforations were difficult to assess on HRCT and better seen on otoscopy [2].

CONCLUSIONS:

HRCT of Temporal Bone depicts complex bony details and associated soft tissue pathologies accurately. HRCT outweighs the conventional modalities and provides higher spatial resolution and better soft tissue contrast for evaluation of Temporal Bone lesions. It is extremely useful in assessing the complications of infection, lays down an anatomical roadmap for the surgeon, predicts certain normal variants of surgical significance preoperatively , identifies the hidden areas of the middle-ear, namely the posterior recesses and depicts the facial nerve anatomy clearly. Also in cases of External Auditory Canal Atresia, presence or absence of middle ear anomaly is significant diagnostic information which is provided by HRCT and thus helps the surgeon in planning effective surgical strategy and reducing morbidity during the surgery.

Conflicts of Interest: Nil
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Table1: Findings on HRCT (n=50)

Diagnosis on HRCT		No.
Infections	1. Cholesteatoma	18
	2. Chronic Otitis Media without cholesteatoma	7
	3. Mastoiditis	5
	Total:	30
Fractures	1. Mixed/Oblique	5
	2. Longitudinal	2
	3. Transverse	1
	Total:	8
Tumours	1. Acoustic Neuroma	2
	2. Meningioma	1
	3. Metastasis	1
	4. Glomus Juglare	1
	5. Rhabdomyosarcoma	1
Congenital Anomalies	1. Microtia	2
	2. EAC Atresia	2
	3. Ossicular Chain Anomaly	1
	4. Mondini Dysplasia	1

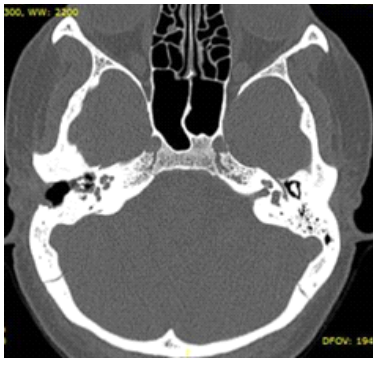

Figure 1: Axial HRCT image showing Right Sided Cholesteatoma with ossicular erosion.

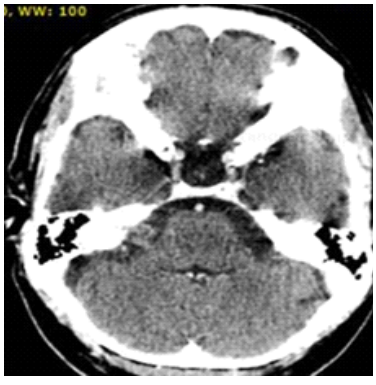

Figure 2: Axial CECT image showing heterogeneously enhancing Right CP angle mass.

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