Role Of High Resolution Computed Tomogrpahy In Evaluation Of Temporal Bone In Middle And Innner Ear Pathology

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Abstract: Background: HRCT, a modification of routine CT, provides a direct visual window into the temporal bone providing minute structural details. Purpose of the present study is to evaluate the normal variations, pathological processes (infections, tumors and congenital anomalies) and their extent involving the temporal bone. Material And Methods: This study evaluating the efficacy of HRCT temporal bone finding among patients of middle and inner ear diseases in sir t. General hospital a cross sectional study. Result: Among the 70 cases which were studied, infection was found to be the most common pathology affecting the temporal bone with increasing preponderance in the younger age group. Temporal bone trauma is forming second largest group of trauma patients in which longitudinal fracture of temporal bone is most common. Neoplasms formed the third largest group of lesions with acoustic neuroma being the most common tumor. Conclusion: HRCT is a revolutionary imaging modality that helps in evaluating the distribution features, localization and assessing the extent of various pathologies affecting the temporal bone. [Parmar P Natl J Integr Res Med, 2023; 14(1): 01-05, Published on Dated: 20/01/2023]

Key Words: High Resolution Computed Tomography Of Temporal Bone, Acoustic Neuroma, Cholesteatoma; Middle Ear; Otitis Media With Suppuration; Mastoiditis; Meningioma; Cerebellopontine Angle Mass Lesion

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Introduction: Diagnostic imaging of the temporal bone underwent a revolution in the 1980s with the introduction of high-resolution computed tomography (CT) scanning. CT provides the best structural definition scanning of all the imaging techniques now in use[1,2]. For a very long time, imaging methods have supported research on the auditory system. To achieve accurate visualization, however it is necessary to apply specific, dedicated, and optimized protocols due to the structure of the auditory system and associated pathologies.

The most popular imaging techniques for examining the auditory system at any level are computerized tomography (CT) and magnetic resonance imaging (MRI). The intricate architecture and spatial relationships of the tiny structures that make up the hearing and balancing organs, which are crammed into a tiny pyramid-shaped petrous temporal bone, have been substantially improved by HRCT. Along with soft tissue expansion, HRCT also demonstrates calcification more clearly. The primary cause of sensorineural hearing loss (SNHL) is inner ear malformations (IEMs), which are brought on by the ear's interruption in development during the first trimester of fetal development[6]. Both hereditary and nonhereditary SNHL are associated with inner ear abnormalities. In fact, the cause of IEM may be genetically predisposed, idiopathic, or stem from exposure to a teratogen[7]. Even though IEMs might happen on their own, 30% of these cases are linked to a particular condition[8,9]. Diseases that only affect the middle ear cleft, which includes the mastoid and eustachian tube are referred to as middle ear diseases.

Three categories of chronic otitis media exist: mucosal disease (active/inactive), squamous disease (active/inactive), and chronic otitis media that has healed[10]. The population frequently has middle ear disorders. Symptoms of middle ear illness include otorrhea, hearing loss and ear pain[11]. The characteristics and severity of the symptoms differ from person to person. If left untreated, certain middle ear conditions (such as inflammation and neoplastic disease) which can affect the inner ear, the brain, and other systems, might develop into major medical issues[12]. A thorough examination of the patient's medical history, an otoscopic examination, pure-tone audiometry, and a review of their x-rays are the best ways to determine if they have this condition. Currently, the method of choice for evaluating congenital inner ear abnormalities and middle ear disorders is high-resolution computed

tomography (HRCT). Helical multi-detector scanners can reconstruct the inner and middle ear structures in any 2D plane or 3D image in addition to offering a quick imaging method.

HRCT images of the inner and middle ear's bony structures can be used to examine them, but magnetic resonance imaging is required to view the internal auditory canal's (IAC), membrane labyrinth and nerves (MRI).

Temporal bone disease imaging, as well as middle ear and inner ear disease imaging is difficult and requires a thorough understanding of anatomy, particularly in relation to High Resolution Computed Tomography (HRCT) imaging.

Cross-sectional imaging has evolved rapidly and has surpassed plain film tomography. That's why we want to prospectively study HRCT of the temporal bone among individuals with middle ear and inner ear disorders[13,14].

Material & Methods: This study evaluating the efficacy of HRCT temporal bone finding among patients of middle and inner ear diseases in sir t. General hospital a cross sectional study. The number of patients included in this study: 70.

Type Of Study: cross-sectional observation Study.

Source of Data: Department of Radio Diagnosis, Govt. Medical College, Sir T. General Hospital Bhavnagar.

Selection Of Patients: Patients who were clinically suspected of having symptoms related to middle and inner ear pathologies were referred from ENT Department, and subjected to HRCT of the temporal bone in Department of Radio-diagnosis, Sir T. General Hospital Bhavnagar.

Inclusion Criteria: Patient who has pain in ear, hearing loss, ear discharge. Patient with vomiting, fever, and headache associated with tinnitus/vertigo. Patient with facial weakness.

Patient with increase intra cranial tension with history of ear discharge. Patient with history of head trauma. Exclusion Criteria: Patient with cochlear implant hindering diagnostic availability. Patients with pregnancy status. All the data were expressed in percentages in chart & table form.

Results: Total number of patients included in this study is 70.

Table 1: Showing Distribution Of Disease

Diseases	No. Of Patients	Percentage
Infections	40	57.14%
Trauma	15	21.43%
Tumors	13	18.57%
Congenital Anomaly	2	2.86%
Total	70	100%

Table 2: Distribution Of Gender

Sex	No. Of Patients	Percentage
Male	40	57.14 %
Female	30	42.86 %

Table 3: Showing Distribution Of Infection

Distribution Of Infection	No. Of Patients	Percentage
Cholesteatoma	20	50 %
Mastoiditis	18	45%
Malignant Otitis Externa	2	5%

Table 4: Showing Age And Sex Distribution Of Infection

Age In Years	Male	Female
0-10	4	1
11-20	5	2
21-30	6	5
31-40	3	2
41-50	2	3
51-60	2	2
61-70	1	2

Table 5: Comparison Between CT And Operative Finding In Infection

CT Appearance Of Studied Patients	No. Of Patients	No. Of Patients With Similar Operative Findings
Opacification Of External Ear	2	2
Cholesteatoma	20	18
Opacification Of Mastoid Air Cells	18	17

Table 6: Distributions Of Trauma

Type Of Temporal Bone Fracture	No Of Patient	Percentage
Longitudinal Fracture	12	80%
Transverse Fracture	3	20%

Table 7: Showing Age Incidence Of Tumours

Age	No. Of The Patient	Percentage
0-10	0	0
11-20	1	7.69
21-30	6	46.15
31-40	1	7.69
41-50	2	15.38
51-60	3	23.09
61-70	0	0

Table 8: Showing Distribution Of Neoplasm

Distribution Of Neoplasm	No. Of Patients	Percentage
Acoustic Neuroma	5	38.46%
Meningioma	2	15.38%
Epidermoid Tumor	2	15.38%
Temporal Bone Osteoma	1	7.69%
Para Ganglioma	1	7.69%
Arachnoid Cyst	2	15.38%

Discussion: HRCT has the advantage of excellent topographic visualization, devoid of artifacts from superimposition of structures. It helps in accurate assessment of pathology prior to surgical exploration regarding location, extent and complication of the disease. It gives a clear anatomical detail prior to surgery which helps the surgeon for proper preoperative planning. In our study, infection was the most common temporal bone lesion.

According to one of the study infections was the 3rd most common cause of temporal bone lesion, 1st and 2nd being the temporal bone tumor and 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 socioeconomic strata and illiteracy of the patient.

Temporal bone has complicated anatomical structure including complex middle and inner ear structures. High Resolution Commuted Tomography is acquiring an increasingly important role in radiographic assessment of temporal bone.

Infections: Major bulk of the cases of study was formed by patients with temporal bone infection.

Age range was between 5 years to 67 years, total 40 cases were examined from which 2 cases were malignant otitis externa, where 20 cases of cholesteatoma and 18 mastoiditis.

In our study maximum cases are seen in age group 21 – 30 year,27.5% out of total 40 patients with infection; however maximum cases were seen in 21 – 30 age group in Gupta et al 1998 Study[15]. Mean age in our study was 26.4 year.

Male to female sex ratio in present study is 2: 1 which correlates with study of Paparella and Kim[16].

The common presenting symptoms were otorrhea and otalgia.

The discharge was scanty, foul smelling and purulent. Most patients presented with chronic ear discharge.

Increase ear discharge, persistent earache, fever, post auricular swelling and facial weakness heralded complications of cholesteatoma.

The presence of vomiting, headache, drowsiness and altered sensorium indicated to more sinister threat of lurking intracranial complications. Bilateral cholesteatoma are rare.

Table 9: Distribution of Infection Age Wise

Age In Years	Gupta et al (1998)(45)	Present Study (2022)
0-10	11.46%	12.5%
11-20	30.57%	17.5%
21-30	33.12%	27.5%
31-40	16.56%	12.5%
41-50	8.28%	12.5%
51-60	-	10%
61-70	-	7.5

Cholesteatoma in children and adolescent is 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 of the surgery is more frequent in children than in adults and also by higher rates of recidivism in children.

Limitations Of The Use Of HRCT In Evaluation Of Chronic Middle Ear Disease: CT scans of 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. Infrequently the soft tissue masses were proved to be granulation tissue or mucosal hypertrophy. Of greater predictive value in the diagnosis of cholesteatoma was the presence of abnormal soft tissue densities with bony erosion.

Tympanic membrane thickening and perforations were difficult to assess on HRCT and better seen on otoscopy.

Trauma[17]: Trauma of temporal bone is divided into longitudinal and transverse fracture. We had 12 longitudinal fractures and 3 transverse fractures. One of authors in their study of temporal bone fracture showed that the longitudinal fracture comprised of 70-90 % of all temporal bone fracture[18].

The longitudinal fracture runs parallel to the long axis of petrous bone. Longitudinal fractures typically traversed the middle ear cavity with frequent disruption of ossicles and resultant conductive hearing loss. The transverse fracture runs perpendicular to the long axis of the petrous bone. There are two subtypes of transverse fractures: medial and lateral relative to the arcuate eminence, both subtypes frequently result in SNHL.

We had 12 cases of longitudinal fracture ossicular disruption, ear ossicles joint dislocation/ subluxation and facial nerve canal injury.

We had 3 cases of transverse fracture, in which we found that fracture line extending to involve anterior wall of external ear cavity and up to genu of facial canal and disruption in ossicular chain.

Neoplasm: In our study neoplasm constitutes 18 %, which is not correlated with the study of G.A.S. Lloyd et al (1980)[19] which claimed neoplasms to be the most common lesions. Age group of these patients in our series varied from 17 years to 56 years with female preponderance.

Acoustic Neuroma: Out of 13 neoplastic lesions (15 %) that were scanned, 5 were diagnosed as acoustic neuroma. A well-defined cone shaped extra-axial heterogeneous lesion seen extending from internal auditory canal to cerebello-pontine angle cistern. Lesion shows heterogenicity and internal cystic area. Lesion causes compression of brain stem and cerebellar peduncle.

Acoustic neuroma was the most common internal auditory canal and/or CP angle lesion in a study by P Wolf (cerebellopontine angle compressing superior and middle cerebellar peduncle with mild secondary hydrocephalus. Taylor S (1982)[13], in his study had reported bony erosion on CT in up to 87% of the cases. This difference can be because we encountered all large size acoustic neuromas. Acoustic neuroma was the most common internal auditory canal and/or CP angle lesion in a study by P Wolf (1987)[13] and G.A.S. Lloyd (1980) als.

Conclusion: HRCT temporal bone is an efficacious modality for accurate delineation of anatomy and pathological involvement of temporal bone. HRCT is useful for diagnosis, surgical planning and management of temporal bone pathologies. We

described the most frequently encountered pathological conditions in various locations of temporal bone with a focus on inflammatory and neoplastic process. CT offers excellent delineation of soft tissue abnormalities against a background of air (middle ear cavity, external auditory canal, mastoid air cells).

In these cases, HRCT: Delineation of normal variants of surgical significance preoperatively. Lays down an anatomical roadmap for the surgeon preoperatively. Its ability to demonstrate fine bony details. Identifies the hidden areas of the middle-ear, namely the posterior recesses.

Is far advantageous in assessing the complications of infection. A previously operated ear has an altered anatomy. The disease of such an ear has a different morphological pattern of involvement. By precisely defining intra-canalicular extension of CP angle tumors. CT scan plays an important role.

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