ORIGINAL RESEARCH ARTICLE

Role of CT in Evaluation of Diagnosis and Pathologies of Temporal Bone

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A B S T R A C T

Introduction: CT and MRI are currently the most widely used techniques and have largely replaced the other modalities. HRCT, a modification of routine CT provides a direct visual window into the temporal bone providing hitherto unavailable minute structural details. Therefore the present study was undertaken to find out role of CT in evaluation of diagnosis and detection of pathologies of the temporal bone

Material and methods: This study evaluating the efficacy of CT in the diagnosis of temporal bone pathologies was done on 40 cases. The main source of data for this study are patients attending/referred to the department of Radio diagnosis for High resolution computed Tomography of temporal bone at Navodaya Medical College Hospital, Raichur was included in the study. Patients who were clinically suspected of having symptoms related to the temporal bone were referred and subjected to HRCT of the temporal bone.

Result: In the present study, female (52.5%) was predominance than male. Most common lesion in our study was infection (70%) with male preponderance For infection, 28 (70%) cases were studied and out of which, majority was 11 (39.3%) cholesteatoma cases, 8 (28.6%) mastoiditis cases, 8 (28.6%) CSOM cases, and 1 (3.6%) was malignant otitis externa. Tumors is the second most common lesion in our study, 10 (25%). Out of 10 (25%) neoplastic lesions that were scanned 6 were diagnosed as acoustic neuromas (60%).

Conclusion: HRCT outweighs the conventional modalities of investigations and provides higher spatial resolution and better soft tissue contrast. HRCT provides essential information for planning the surgical approach.

Keywords: Temporal Bone, Computed Tomography, Cholesteatoma, Infections

INTRODUCTION

The ability to image the human central nervous system non-invasively has completely changed the diagnostic approach to pathology of the brain. Many imaging modalities are available for the evaluation of the temporal bone, including plain radiographs, angiography, cerebrospinal fluid (CSF) analysis, air and non-ionic contrast cisternography, computed tomography (CT), and magnetic resonance imaging (MRI). CT and MRI are currently the most widely used techniques and have largely replaced the other modalities.

Conventional radiography has been of value in screening the entire temporal bone. It produces a composite single plane image of a tridimensional temporal bone resulting in superimposition where larger and denser structures obscure smaller and less denser ones. CT scanning excels in the evaluation of bone and air space anatomy and disorders. Because CT scans are more accurate in identifying many soft tissue abnormalities and are much less prone to artifacts, they have largely replaced polytomography, there is also less radiation to the lens of the globe with CT scans than with polytomography. CT has the advantage of producing images with higher contrast and a better spatial resolution.

MRI has expanded the range of pathology that can be accurately evaluated because it can image many soft tissue entities not visible by other techniques. MRI studies can also be extremely useful in the evaluation of blood vessel related disorders of the temporal bone. Angiography is still the "gold standard" for vascular evaluation, and interventional angiography can be used in treatment of vascular lesions of the temporal bone.[1] Each technique has its own advantages and disadvantages, and often more than one examination is necessary for a complete temporal bone evaluation.

HRCT, a modification of routine CT provides a direct visual window into the temporal bone providing hitherto unavailable minute structural details.[2]

With the introduction of helical scanning methods, CT has become the imaging study of choice for conclusive preoperative temporal bone imaging[3]

The purpose of the study was role of CT in evaluation of diagnosis and detection of pathologies of the temporal bone.

MATERIAL AND METHODS

This study evaluating the efficacy of CT in the diagnosis

of temporal bone pathologies was done on 40 cases. This study was conducted in the department of Radio diagnosis in Navodaya Medical College for a period between January 2018 – July 2019.

Source of data

The main source of data for this study are patients attending/ referred to the department of Radio diagnosis for High resolution computed Tomography of temporal bone at Navodaya Medical College Hospital, Raichur was included in the study.

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.

Inclusion criteria

1. Patients presenting with ear discharge.

Exclusion criteria

1. Patients with electric devices at the skull base, such as cochlear implants, temporal bone trauma were excluded from the study.

CT Machine

All the HRCT scans were performed at our institute on the Multidetector High Resolution Computed Tomography (GE 16 Sliced Computed Tomography) Patients were scanned in the axial and coronal (supine or prone) axes. Scout films were taken routinely in all patients before starting the scan. Slight extension of the head was given to avoid gantry tilt and thereby protect the lens from radiation. Axial acquisition is performed from top of petrous apex to inferior tip of mastoid and acquisition plane perpendicular to infraorbitomeatal line. Coronal reformation is done to include both the anterior tip of the petrous apex to the posterior margin of mastoid. Data is reconstructed into 0.6mm thickness overlapping sections in axial and coronal planes. A high spatial bone algorithm is used. Large window width (4,000 HU) and low window centering levels (0-200 HU) are used. 2mm thickness soft tissue window is also reconstructed.

Preparation of patients

Prior to performing the scan particularly in infants and children less than six years, sedation was usually required. The purpose of sedation was to avoid motion artifact and to ensure a CT scan of diagnostic quality.

HRCT Technique

CT excels in the evaluation of disorders that primarily affect air spaces or cortical bone. The optimal technique for HRCT was described in detail by Shaffer and Turski.[4] Gantry angulations for axial and coronal scans have been suggested for evaluating specific intratemporal structures.[5]

If the goal of a temporal bone CT study is to focus on the otic capsule, cortical plates, ossicles and the air spaces alone, then high resolution bone algorithm techniques may be adequate. However, if it is also important to evaluate the soft tissues, as in the case of a patient with cancer of external auditory canal, then it may be necessary to use intravenous contrast and techniques similar to those used for a brain or soft tissue neck study.

HRCT comprises the use of a thin collimation, a high spatial frequency algorithm, smallest practical FOV (15 to 20cm) and a large reconstruction matrix (512 x 512). With a 1cm collimation the volume averaging within the plane of scan reduces the ability of CT to resolve small structures significantly. Therefore, scanning with thin collimation is essential.

A high spatial frequency algorithm reduces image smoothening and increases spatial resolution, making structures appear sharper. This also increases the noise present in the image, which is reduced by increasing the KVp and MAs setting.

CT images are usually acquired or displayed in axial and coronal planes. For axial imaging, sections are made in a plane rotated 300 superior to the anthropologic base line. Scan produced in this plane display the temporal bone structures to good advantage. This plane allows separation of individual component of the temporal bone so that they are better visualized in their entirely, with less of overlap and fewer partial volume imaging artifacts. Direct coronal images are usually obtained at an angle of approximately 1200 from anthropologic baseline, while reconstruction coronal images are usually oriented 900 from anthropologic baseline.

The important patient factor influencing HRCT is motion. Therefore, patients were instructed to the motionless during the procedure.

For contrast enhancement, a bolus injection of Diatrizoate meglumine and Diatrizoate sodiuim were given in the dose of 300mg lodine/kg of body weight Trazograf or urograffin 60% was used in children and trazograf or urograffin 76% was used in adults. This was given just before the contrast enhancement CT was to be performed.

All the data were expressed in number and percentages.

RESULTS

In the present study, female (52.5%) was predominance than male. Most common lesion in our study was infection (70%) with male preponderance

The chief presenting symptoms were otorrhea, otalgia hearing loss and headache. 2 patients had ipsilateral facial nerve palsy. For infection, 28 (70%) cases were studied and out of which, majority was 11 (39.3%) cholesteatoma cases, 8 (28.6%) mastoiditis cases, 8 (28.6%) CSOM cases, and 1 (3.6%) was malignant otitis externa.

Tumors is the second most common lesion in our study, 10 (25%). Out of 10 (25%) neoplastic lesions that were scanned 6 were diagnosed as acoustic neuromas (60%). Acoustic neuroma is the commonest neoplasm. Left CP angle predominance was noted in our study

28 (70%) patients suspected of having middle ear infections were studied. Majority of patients belongs to age group 11-20 years (39.3%) followed by 21-30 years (21.4%).

10 (25%) patients suspected of having tumor were studied. Majority of patients belongs to age group 41-60 years (60%) followed by 21-40 (40%). Peak age incidence of tumours ranging from 21-30 and 41-50 years.

Ossicular involvement was commonest of the incus bone followed by malleous Intracranial complications were observed in high frequency in patients with a break in

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Distribution of diseases	Number	Percentage
Infection		
Cholesteatoma	11	39.3
Mastoiditis	8	28.6
CSOM	8	28.6
Malignant otitis external	1	3.6
Tumor		
Acoustic neuroma	6	60
Glomus jugulare	2	20
CP angle meningioma	1	10
Adenoid cystic carcinoma of external ear	1	10

Table–1 : Distribution of Diseases

Distribution of diseases	Number	Percentage
Infection		
0-10	1	3.6
11-20	11	39.3
21-30	6	21.4
31-40	4	14.3
41-50	3	10.7
51-60	3	10.7
61-70	0	0.0
Tumor		
0-10	0	0.0
11-20	0	0.0
21-30	2	20.0
31-40	2	20.0
41-50	3	30.0
51-60	3	30.0
61-70	0	0.0

Table–2: Distribution of age according to disease distribution

CT appearance of studied patients	Number	Percentage
Opacification of external ear	1	1
Cholesteatoma	11	11
Opacification of mastoid air cells	13	10
Ossicular erosion	12	11
Intra cranial extension	2	2

Table-3: Comparison between CT and operative finding in infections

tegmen or dural plate. Excellent correlation between CT and operative findings in cholesteatoma. CT is ideal for evaluation of Temporal Bone lesion.

Peak incidence of acoustic tumours in age group of 41-6 years. These patients chiefly presented with deafness, tinnitus, ear discharge or with 7th nerve palsy. After plain CT scan a contrast enhanced scan was performed. Soft tissue windows were used to show soft tissue enhancement.

DISCUSSION

HRCT temporal bone plays a crucial role in addressing the challenge of delineating the details of temporal bone anatomy and pathology, thus aiding in more accurate diagnosis, assessment of extent of disease.[6]

The air in the tympanic cavity surrounded by the dense temporal bone and the mastoid air cells provide an inherent natural contrast to the HRCT imaging of temporal bone and provides excellent delineation of bony land marks within the temporal bone.[7]

It has the advantage of providing outstanding topographic observations, devoid of superimposition from structures. It enables an accurate evaluation of pathology before surgical exploration.[8]

HRCT outweighs the conventional modalities of investigations and provides higher spatial resolution and better soft tissue contrast. HRCT is far advantageous in assessing the complications of infection

Infection

Patient with infection form the largest proportion of cases studied. The age range was from 15 months to 60 years, 28 cases were studied and out of which, cholesteatoma were 11 cases, mastoiditis were 8 cases, CSOM were 8 cases, and 1 was malignant otitis externa.

Jyothi. A.C. et al in 50 cases, infection was the most common pathology affecting the temporal bone. Neoplasms formed the second largest group of lesions. Of the 50 temporal bone HRCT studies, 41 scans were having infections of the temporal bone (82%), 5 were having tumours (10%).[9]

In otitis media and mastoiditis, HRCT shows non-specific debris within middle ear and mastoid, possibly with several fluid levels.

The CT appearance of cholesteatoma is a non-dependent, homogenous, soft tissue mass in an appropriate location.

Tumours	No. of patients	CT Features	Operation findings and biopsy
Acoustic neuroma	6	Left – 3 Right –2 Bilateral - 1 Hypodense to slightly hyperdense angle mass enhancement with erosion of IAC.	4 patients were operated and CT findings were corrrelated with operative findings. other patients was unwilling for operation biopsy schwannoma
Glomus jugulare	2	Erosions of middle ear and widening of jugular fossa, and erosion of petrous apex.	
Adenoid cystic carcinoma external ear	1	Erosions of bony external auditory canal.	

Table-4: Comparison of CT findings with operative/biopsy finding in cases of tumour

Acquired cholesteatomas are either present in pars tensa or pars flaccida.

In infections, cholesteatoma (39.3%) is most common infection in our study, similar findings were reported study done by Thukral et al, from a total of 50 cases, 83.33% had cholesteatoma. The surgical and radiological findings showed a high level of sensitivity (89.29%) in the identification of cholesteatoma.[10]

Age group most commonly involved in our study is 11-20 years, and males are more common than females, similar findings were also reported study done by Thukral et al. [10] In our study maximum cases are seen in the 2nd decade. 39.3 % of the cases in this were in the age group of 11-20.

Prakash.S.Handi et al evaluating HRCT temporal bone, infections of middle ear cleft (with cholesteatoma) was the most common pathology observed. Also, the CT scan accurately delineated ossicular erosion, scutum erosion, fallopian canal, tegmen tympani and lateral semicircular canal erosions in the cases with cholesteatoma.[8]

Out of 11 patients in the present study 7 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.

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.

Limitations of the use of CT in evaluation of chronic middle ear disease

1) 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.
2) Tympanic membrane thickening and perforations were difficult to assess on HRCT and better seen on otoscopy.

Neoplasm

They constitute 25% of our study which is not correlated with the study of GAS Lloyd et al which claimed neoplasms to be the most frequent lesions. Age group of these patients in our study varied from 5years to 45 years with female preponderance.[11]

Acoustic neuroma

Out of 10 (25%) neoplastic lesions that were scanned 6 (60%) were diagnosed as acoustic neuromas. Left CP angle predominance was noted in our study.

Taylor S, in his study had reported bony erosion on CT is upto 87% of the cases.[12] 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 GAS Lloyd.[11]

Similar to study done by Prakash.S.handi et al, HRCT scan can be very helpful in differentiation of only external auditory atresia from EAC atresia associated with anomalous middle ear structures, thus identifying the patients best suited for reconstructive surgery.[8] HRCT is commonly utilised in the diagnosis of inflammatory middle ear illnesses such as chronic otitis media or cholesteatoma, as well as in the assessment of the middle ear after mastoidectomy or tympanoplasty.[13,14]

CONCLUSION

HRCT outweighs the conventional modalities of investigations and provides higher spatial resolution and better soft tissue contrast. For the assessment of middle-ear infections, a close clinical correlation is essential to evaluate the nature of middle-ear soft tissue masses as cholesteatoma is mimicked by many other middle-ear pathologies. HRCT provides essential information for planning the surgical approach.

REFERENCE

1. Haaga JR, Boll D. Computed Tomography & Magnetic Resonance Imaging of the Whole Body E-Book. Elsevier Health Sciences; 2016 Jun 6.
2. Swartz JD, Goodman RS, Russell KB, Marlowe FI, Wolfson RJ. High-resolution computed tomography of the middle ear and mastoid. Part II: Tubotympanic disease. Radiology. 1983;148(2):455-9.
3. Alexander AE, Caldemeyer KS, Rigby P. Clinical and surgical application of reformatted high resolution CT of the temporal bone. Neuroimaging Clin N Am. 1998;8(3):631-50
4. Turski P, Norman D, DeGroot J, Capra R. High-resolution CT of the petrous bone: direct vs. Reformatted images. AJNR: American Journal of Neuroradiology. 1982;3(4):391.
5. Zonneveld FW, van Waes PF, Damsma H, Rabischong P, Vignaud J. Direct multiplanar computed tomography of the petrous bone. Radiographics. 1983;3(3):400-49.
6. Bast TH. The temporal bone and the ear. Courtesy of Charles C Thomas. 1949.
7. Chakeres DW, LaMasters DL. Paragangliomas of the temporal bone: high-resolution CT studies. Radiology. 1984;150(3):749-53.
8. Handi PS, Patil MN, Nisha P. High resolution computed tomography of temporal bone in the evaluation of otologic diseases. International Journal of Otorhinolaryngology and Head and Neck Surgery. 2018;4(1):87-92.
9. JyothiA,ShrikrishnaB,Role of high resolution computed tomography in the evaluation of temporal bone lesion :our experience.int J otorhinolaryngol head neck surg 2016;2:135-9
10. Thukral CL, Singh A, Singh S, Sood AS, Singh K. Role of high resolution computed tomography in evaluation

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of pathologies of temporal bone. Journal of clinical and diagnostic research: JCDR. 2015;9(9):TC07.
11. Lloyd GA, Phelps PD, Du Boulay GH. High-resolution computerized tomography of the petrous bone. The British journal of radiology. 1980;53(631):631-41.
12. Taylor S. The petrous temporal bone (including the cerebellopontine angle). Radiologic Clinics of North America. 1982;20(1):67-86.
13. Tono T, Miyanaga S, Morimitsu T, Matsumoto I. Computed tomographic evaluation of middle ear aeration following intact canal wall tympanoplasty. Auris Nasus Larynx.1987;14(3):123-30.
14. Jackler RK, Dillon WP, Schindler RA. Computed tomography in suppurative ear disease: a correlation of surgical and radiographic findings. Laryngoscope. 1984;94(6):746-52.

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