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Original Research Article

Correlation of HRCT mastoid with clinical presentation and operative findings in ear diseases

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ABSTRACT

Background: HRCT is found to be extremely useful for evaluating the ear diseases involving the external auditory canal, middle ear cavity, vertical segment of facial nerve canal, vestibular aqueduct, tegmen tympani, sigmoid sinus plate, sinodural angle, carotid canal, jugular fossa, infra and supralabrynthine air cells and temporomandibular joint. Our main objective was to correlate the clinical presentation and operative findings of ear diseases with HRCT mastoid.
Methods: This study is done in our institute otorhinolaryngology dept. from April 2014 to April 2016. This is prospective study involves 36 patient belonging to different age and sex groups with high suspicious of ear diseases. We have taken detail history of each patient with complete ear nose throat examination done and after that all patient were investigated with routine blood investigation, X-ray and HRCT mastoid to correlate clinical finding and subjected for operation to compare operative findings with HRCT finding.
Results: Determined using Pearson chi square test indicated a statistically significant correlation between HRCT temporal bone with clinical presentation and operative findings of ear diseases ($p<0.05$).
Conclusions: With the advent of modern high-resolution CT scanners, detailed demonstration of temporal bone anatomy is practically possible now. We have been able to identify many significant structures not demonstrated by any of the known imaging modalities. The improved contrast and soft tissue a definition possible with HRCT has resulted in production of excellent images of soft tissue lesions in air spaces. Hence HRCT appears to be the diagnostic modality of choice for cholesteatomas and other soft tissue lesions in middle ear.

Keywords: HRCT mastoid, Ear diseases, CSOM

INTRODUCTION

The human temporal bone has an extremely complex structure. Direct axial and coronal CT sections are quite satisfactory for imaging the anatomy of the temporal bone but most of the normal and pathological details of the temporal bone are better visualized with direct sagittal CT sections. The sagittal projection is of interest for surgeons, as it has the advantage of following the plane of surgical approach. HRCT is found to be extremely useful for evaluating the diseases involving the external auditory canal, middle ear cavity, vertical segment of facial nerve canal, vestibular aqueduct, tegmen tympani, sigmoid sinus plate, sinodural angle, carotid canal, jugular fossa, infra and supralabrynthine air cells and temporomandibular joint. HRCT has contributed greatly to an understanding of the complex anatomy and spatial relationship of the minute structures of hearing and balance organs, which are packed into a small pyramid-shaped petrous temporal bone. HRCT shows not only soft tissue extension but also gives a more sensitive demonstration of calcification. It has also become useful

for assessment of bony erosion, destruction by malignant or inflammatory lesions (acute and chronic). Accurate identification of nature, site, size, extension and invasion into adjacent structures and tissue planes including the intracranial extention has been made possible thereby affecting the course of management.[1]

METHODS

This study involved 36 patients belonging to different age and sex groups with complaints giving high suspicion of pathology in ear were examined clinically in OPD and then were investigated with the help of X rays mastoid and high resolution computerized tomography of temporal bone following which mastoid exploration was done in selected patients. The patients were selected from the patients reporting to otorhinolaryngology OPD [outpatient department] from period of April 2014 to April 2016. The initial evaluation included detail history of the chief complaints, past illness, personal and family history. General and systemic examination preceded ear, nose and throat examination. The essential pathological and biochemical investigations were carried out.

Radiological investigation consisted of both conventional plain radiography and computerized tomography. Conventional plain radiography in the form of X-ray mastoid (Schuller's view). In computerized tomography, high resolution CT using 1 mm thin sections were obtained in both axial and coronal planes. Axial images were obtained parallel to the orbitomeatal plane. Coronal sections were done in scanning angle that is parallel to vertical rami of the mandible. All Selected patients consent taken underwent mastoid exploration and the type of surgery was determined by the otological diagnosis and intra-operative findings. The type and extent of disease was studied during the surgery and the radiological findings (X-ray mastoid and HRCT mastoid) were confirmed. Pearson chi square test used as statistical tool to analyse the data. All patients were followed up in otorhinolaryngology OPD after 6 weeks and 12 weeks following surgery.

RESULTS

The present study includes 36 patients. In in study most common age group affected is 21-30 (36.33%) whereas the least common age group affected in between 41-50 (2.77) and 51-60 (2.77%) (Table 1). Present study include 36 cases of which 21 (58.33%) are males and 15 (41.66%) are females (Table 2). Present study includes total 36 cases of which 20 (55.55%) belong to infective etiology are the most common category whereas second is trauma 8 (22.22%) and least common etiology is metabolic (e.g. otosclerosis) 2 (5.55%) (Table 3). The present study shows that majority of the cases came with complaints of ear discharge 22 (61.11%) next common being decreased hearing 21 (58.33%) whereas least common symptom was tinnitus 2 (5.55%) (Table 4). The present study shows that most common sign elicited is mastoid tenderness 14 (38.89%) whereas second most common sign elicited is swelling over mastoid region 9 (25%) and signs of meningeal irritation, cerebellar signs, nystagmus and tragal tenderness are amongst the least common signs elicited 2 (5.55%) (Table 5).

Table 1: Tabular distribution of patient according to age.

Sr no.	Age (years)	No. of patients	Percentage
1	0-10	7	19.44
2	11-20	7	19.44
3	21-30	12	36.33
5	31-40	4	11.11
6	41-50	1	2.77
7	51-60	1	2.77
8	>61	4	11.11
	Total	36	100

Table 2: Tabular distribution of patient according sex.

Sr no.	Sex	No. of cases	Percentage
1	Male	21	58.33
2	Female	15	41.66
	Total	36	99.99

Table 3: Tabular distribution of symptoms of the 36 patient.

Sr No.	Symptoms	No. of cases	Percentage
1	Ear discharge	22	61.11
2	Decreased hearing	21	58.33
3	Ear bleed	8	22.22
4	Swelling behind pinna	9	25
5	Facial asymmetry	12	33.33
6	Giddiness	6	16.66
7	Tinnitus	2	5.55
8	Fever	8	22.22
9	Pain	4	11.11
10	Headache	4	11.11
11	Vomitting	8	22.22
12	Unconsciousness	4	11.11

Table 4: Tabular distribution according to sign of 36 patient.

Sr No.	Signs	No. of cases	Percentage
1	Mastoid tenderness	14	38.89
2	Mastoid swelling	9	25
3	Mass in EAC	5	13.89
4	Post auricular fistula	3	8.33
5	Signs of meningitis	2	5.55
6	Cerebellar signs	2	5.55
7	Nystagmus	2	5.55
8	Tragal tenderness	2	5.55

Table 5: Tabular distribution according to aetiology.

Sr No.	Etiology	No. of cases	Percentage
1	Infective	20	55.55
2	Traumatic	8	22.22
3	Neoplastic	3	8.33
4	Congenital	3	8.33
5	Metabolic(otosclerosis)	2	5.55
	Total	36	100

Table 6: Table showing HRCT cholesteatoma.

Study	No. of cases	Soft tissue density (%)	Erosion of ossicles (%)	Eroded facial canal (%)	Tegmen erosion (%)
Gaurano et al[3]	64	64 (100)	59 (92.18)	55 (85.93)	48 (75)
Present study	18	18 (100)	15 (83.33)	2 (11.11)	5 (27.77)

Table 7: Table showing correlation of hrct findings with operative findings in cholesteatoma.

Study		Surgically detected (%)	HRCT finding (%)
	Semicircular canal erosion		
Chee et al[4]	6	6 (100)	5 (83.33)
Present study	4	4 (100)	2 (50)
	Ossicle involvement		
Chee et al[4]	Malleus 15	15 (100)	14 (93.33)
	Incus 31	31 (100)	30 (96.77)
	Stapes suprastructure 11	11 (100)	11 (100)
Present study	31(100%)	15 (100)	15 (100)
	Tegmen tympani Involvement		
Chee et al[4]	1	1 (100)	1 (100)
Present study	7	7 (100)	5 (71.42)
	Facial canal involvement		
Chee et al[4]	9	9 (100)	3 (33.33)
Present study	3	3 (100)	2 (66.66)

Table 8: Table showing HRCT findings of fracture temporal bone.

Study	No of cases	No. of #	Longitudinal#	Transverse #	Mixed #	Others
Ulug et al[6]	10	11	7 (63.64%)	-	4 (36.36%)	-

Table 9: Showing HRCT finding in otosclerosis.

Study	No. of cases	HRCT finding positive (%)
Mafee et al[7]	32	24 (75)
Present study	2	2 (100)

Table 10: Showing HRCT findings in congenital ear diseases.

Study	No. of cases	Ossicle dysplasia (%)	Facial canal displacement (%)
Meyer et al[8]	184	180 (98)	138 (75)
Present study	3	1 (33.33)	2 (66.66)

DISCUSSION

The present study includes 36 cases of ear diseases HRCT was performed in all of them and in most of these cases findings of HRCT were well correlated clinically and intra-operatively. The present study includes 18 cases of cholesteatoma and correlation with operative findings was found in most of them. The results were consistent with those of Johnsons et al study They studied 44 cases of cholesteatomas and found high degree of correlation

between HRCT image based findings and operative findings. Typical complications of cholesteatoma such as destruction of ossicles, bony labyrinth, facial nerve canal, lateral wall of attic and superior and inferior wall of tympanic cavity were clearly demonstrated.[2] Gaurano et al studied 64 patients of cholesteatoma whose HRCT was evaluated for the presence of soft tissue density, extent of middle ear involvement, bone expansion, thinning and erosions involving the ossicles and adjacent structures.[3] Present study includes 18 patients of cholesteatoma evaluated with HRCT finding correlated with above study (Table 6).

Chee et al studied surgical findings of 36 cholesteatoma cases which were operated and compared with HRCT findings. They analyzed diagnostic feature of cholesteatoma on HRCT, status of middle ear structure, ossicles, facial nerve canal, semicircular canal and tegmen tympani. They found radiosurgical agreement was excellent for malleus, stapes and semicircular canal; good for incus and tegmen; poor for facial nerve cana.[4] The present study HRCT and surgical findings of cholesteatoma patients are co-related to above study (Table 7).

The present study includes 18 cases of cholesteatoma present with (ear discharge, decreased hearing etc.) HRCT is done in all cases in which 5 (27.7%) cases have intracranial complications (venous sinus thrombosis, meningitis, subdural empyema and brain abscess) and in 7 (38.8%) cases extracranial complications (mastoid abscess, fistula, facial palsy) in present study extracranial complications are more than intracranial complication (Table 7).

Present study include 18 cases of cholesteatoma of which 5 (27.7%) cases present with complaint of giddiness but HRCT findings of lateral SCC erosion is found in only 2 (11.11%) cases this study findings are related to the findings of Gaurano et al they studied 64 cases of cholesteatoma in which 10 (15.6%) cases were present with giddiness but HRCT show lateral SCC fistula in 4 (6.2%) cases and partial erosion of lateral SCC in 5 (7.8%) cases.

The present study includes 8 cases of temporal bone trauma out of these 4 (50%) have longitudinal fracture, 3 (37.5%) have mixed fracture and 1 (12.5%) have transverse fracture. They present with hearing loss, facial asymmetry, post auricular swelling. HRCT findings of present study are in agreement with findings of Johnson et al study. They studied 12 cases of temporal bone trauma and found that HRCT findings are well correlated with clinical signs and symptoms.[5] Ulug et al they studied 10 patients with 11 temporal bone fracture resulting in facial paralysis (Table 8).[6]

Mafee et al studied 32 cases of mixed and sensorineural hearing loss where HRCT proved valuable in detecting otosclerosis, foci of demineralization, and change in bony structure.[7] Present study includes 2 cases of mixed hearing loss in which HRCT shows radiolucent foci involving anterior margin of oval window and spreading to oval window (Table 9). The present study included 3 cases of congenital ear disease present with (anotia, decreased hearing, deformed pinna, facial palsy) out of which 3 have auricular dysplasia 1 (33.33%) has ossicular fusion and 2 (66.66%) have aberrant course of facial nerve, these HRCT findings are in agreement with findings of Meyer et al.[8] It was also found that the extent of auricular anomalies corresponds to the severity of change in the external auditory canal, excessive inclination of the external and internal auditory canals, dysplasia of the middle ear cavity and ossicles. This is in accordance with the study by Meyer et al they examined HRCT of 184 cases of congenital auricular dysplasia and had similar indings (Table 10). Present study also included one case of acoustic neuroma present with (giddiness, tinnitus) in which HRCT shows widening of internal auditory canal. On contrast administration adjacent enhancing cerebellopontine angle mass lesions were noted. These findings were in accordance with those of Curtin.[9] Our study is also in accordance with Valvani et al they proved HRCT is superior to evaluation of internal auditory canal.[10] The present study include 2 cases of malignant otitis externa clinically present with swelling in EAC, pain, tragal tenderness) in which HRCT findings shows soft tissue density involving EAC, middle ear cavity, aditus, antrum, bony destruction this HRCT study findings are accordance with study done by Gold et al. They found that CT scanning is the current modality of choice for defining the anatomical extent of the disease in malignant otitis externa.[11] The present study included three cases of neoplasms of ear. These included 2 cases of squamous cell carcinoma, 1 case of acoustic neuroma. 3 of these were operated and HRCT image based findings were confirmed. HRCT was found to be highly accurate in establishing the presence, extent and spread of tumor. This is in accordance with the study by Bird et al who studied 10 cases of primary malignant tumors of ear and temporal bone.[12] Our results were also in accordance with a study of squamous cell carcinomas of the temporal bone by Oslen et al they found that the HRCT findings characteristic of squamous cell carcinoma of the EAC include presence of a large, destructive, soft-tissue mass, obliteration of adjacent normal-tissue fat planes and invasion of the adjacent structures.[13]

CONCLUSION

With the advent of modern high-resolution CT scanners, detailed demonstration of temporal bone anatomy is practically possible now. We have been able to identify many significant structures not demonstrated by any of the known imaging modalities. The improved contrast and soft tissue a definition possible with HRCT has resulted in production of excellent images of soft tissue lesions in air spaces. Hence HRCT appears to be the diagnostic modality of choice for cholesteatomas and other soft tissue lesions in middle ear. HRCT also clearly

demonstrates various complications of cholesteatomas and provides a detailed preview of the temporal bone prior to surgery thus enabling the surgeon to operate without any surprises. HRCT is also ideal for demonstrating residual or recurrent disease in surgically altered middle ear and mastoid. It provides attractive alternative to second look or staging operation. In patients with temporal bone trauma, HRCT accurately evaluates the fracture lines, ossicular disruptions and facial nerve canal injury. Hence it determines the management of trauma patients. In patients with congenital malformations of ear, HRCT depicts the ossicular and inner ear abnormality and aids in reconstructive surgery. In patients with neoplastic lesions involving the temporal bone, HRCT characterizes the lesion, delineates the extent and shows structural alterations in temporal bone thus aiding substantially in preoperative planning. HRCT is useful for detecting otosclerosis in clinically suspected patient of decreased hearing with normal tympanic membrane.

In a nutshell, HRCT of the temporal bone is a highly efficacious modality for accurate delineation of the anatomy and various pathologies (infective, traumatic, congenital, neoplastic and otosclerotic) of the temporal bone and it has revolutionalized the role of radiology in diagnosis and management of temporal bone diseases.

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