HIGH RESOLUTION COMPUTED TOMOGRAPHY FINDINGS OF TEMPORAL BONE IN PATIENTS WITH UNSAFE CHRONIC SUPPURATIVE OTITIS MEDIA.

Radiology

Sakshi Shami	Senior Resident, Department of Radiology, ABVIMS & Dr. Ram Manohar Lohia Hospital, Delhi.
Raunaq	Post Graduate student, Department of Radiology, Indira Gandhi Medical College, Shimla, Himachal Pradesh.
Shishir Chumber	Research Associate, Department of Neurology, ABVIMS & Dr. Ram Manohar Lohia Hospital, Delhi.
Kavita Vani*	Consultant, Department of Radiology, ABVIMS & Dr. Ram Manohar Lohia Hospital, Delhi. *Corresponding Author
Akhilandeswari Prasad	Consultant, Department of Radiology, ABVIMS & Dr. Ram Manohar Lohia Hospital, Delhi.

ABSTRACT

CSOM is defined as chronic inflammation of mucoperiosteal lining of middle ear cleft, i.e. eustachian tube, middle ear and mastoid. Unsafe CSOM is associated with marginal/ attic perforations and cholesteatoma, which may produce multiple complications. It is a potentially serious condition as it can progressively enlarge and cause erosion into neighbouring structures, giving rise to serious complications. HRCT provides information regarding the extent of disease and depicts anatomical variations, which may lead to complications during surgery. The aim of this study was to assess the usefulness of HRCT imaging of temporal bone in cases of unsafe CSOM. In an IRB approved cross-sectional observational study of consecutive 50 patients with clinically diagnosed unsafe CSOM, HRCT of temporal bone was performed. Patients not fit for CT scan e.g., pregnant patients were excluded. HRCT was performed on Philips Brilliance 40 slice CT. Collimation was set at 190mm with scan time of 4.79 seconds with kVp of 140 and mAs of 350. HRCT findings of these patients were compared with the intraoperative findings of those patients who underwent surgery. Standardised statistical methods were used. It was found to be male predominant disease with a mean age of 25.5 years. The most common finding on HRCT was soft tissue density involving the middle ear cleft. Cholesteatoma caused ossicular erosion with the incus being most commonly affected. This study concludes that HRCT should be done in all patients of unsafe CSOM to know the extent of disease which guide in surgical approach and treatment plan.

KEYWORDS

Unsafe CSOM; mucoperiosteal; cholesteatoma; middle ear cleft

INTRODUCTION

Chronic suppurative otitis media (CSOM) has been a major cause of middle ear disease since ancient times. CSOM is a very common disease, especially in South East Asia and western pacific nations, which contribute to 85% of global burden of CSOM cases^[1]. India has the second highest prevalence (7.8%) in the world, next only to Tanzania (14%)^[1]. Occurrence of CSOM is highest in children and young adults of developing countries and it accounts for 91% of childhood hearing impairment among Indian population^[1].

Chronic Suppurative Otitis Media is defined as chronic inflammation of mucoperiosteal lining of middle ear cleft, i.e. eustachian tube, middle ear and mastoid^[2]. The commonly associated symptoms are discharge and deafness of variable severity. The diagnosis of chronic otitis media suggests permanent abnormality of tympanic membrane, most likely as a sequelae of earlier acute otitis media, negative middle ear pressure or otitis media with effusion^[3]. It often causes severe destruction of the tympanic membrane, middle ear ossicles and the temporal bone.

Chronic otitis media (COM) equates with the classical term chronic 'suppurative' otitis media, but that is not the recommended term, as COM is not necessarily a result of the 'gathering of pus'. However, the distinction remains between active COM, where there is inflammation and production of pus, and inactive COM, where this is not the case though there is the potential for the ear to become active at some time.

CLASSIFICATION OF CSOM

CSOM has been divided into two types : **Mucosal type** (safe or tubotympanic disease) is associated with central perforation and fewer complications and **squamous type** (unsafe or attic-antral CSOM) on the other hand is associated with marginal/ attic perforations and cholesteatoma, which may produce multiple complications.

Cholesteatoma is a sac of keratinising squamous epithelium in the middle ear cleft. The lesion is classically recognized by the presence of attic squamous on otoscopic examination. The suspicion of cholesteatoma must be made beneath the polyps protruding from the

pars flaccida or when there is a marginal tympanic membrane perforation or granulation. It is a potentially serious condition as it can progressively enlarge and cause erosion into neighbouring structures, giving rise to life threatening intracranial and extracranial complications.

Symptoms of CSOM- Otorrhoea, hearing loss, pain, headache, tinnitus, vertigo chills, sweat and rigors.

Complications of CSOM - It can be intratemporal or extratemporal. Intratemporal complications can be extracranial e.g., ossicular erosion, labyrinthine fistula, facial nerve paralysis, post inflammatory ossicular fixation, mastoiditis, petrous apicitis or it can be intracranial e.g., meningitis, brain abscess, lateral sinus erosion, epidural abscess, otitic hydrocephalus, meningo/encephalocele. Extratemporal (extracranial) complications include subperiosteal abscess and bezold's abscess.

MATERIALS AND METHODS

In this Institutional Ethics Committee approved, cross sectional observational study of sequential 50 patients who were clinically diagnosed with unsafe CSOM underwent HRCT of temporal bone on Philips Brilliance 40slice CT. Pregnant patients were excluded. Collimation was set at 190mm with scan time of 4.79sec with kVp of 140 and mAs of 350. HRCT findings of these patients were compared with the intraoperative findings of patients who were operated.

Automated coronal & sagittal reformatted images were acquired & presence of soft tissue density in middle ear & erosion of middle ear ossicles was evaluated.

RESULTS

The cases encountered in our study were in the age range of 10- 60 years. The mean age for the group was 25.5 years. The male to female ratio was 1.4 :1. External auditory was found to be involved in 6 patients and tympanic membrane was involved in 12 patients. Erosion of the carotid canal, sigmoid sinus plate and cochlea were not found in our study. Out of the 50 patients, follow up of 44 patients was possible.

On surgery, 36 patients had cholesteatoma. In 6 cases granulation tissue was found and 2 had polyp formation.

Table: Demographic data, clinical symptoms and imaging findings

Age (years)		0-10	11-20	21-30	31-40	41-50	51-60	Total
	Male	2	8	9	6	2	2	29
	Female	2	6	9	3	1	0	21
Sidedness	Right	Left	Bilateral					
	19	11	20					
Symptoms	Hearing loss	Otorrhea	Earache	Fever	Vertigo	Facial palsy		
	40	50	8	5	3	2		
Soft tissue density	Epi-tympanum	Meso-tympanum	Hypo-Tympanum	Aditus	Mastoid antrum			
	48	45	42	40	46			
Malleus	Head erosion	Handle erosion	Intact					
	23	19	24					
Incus	Body erosion	Long process erosion	Intact					
	26	29	19					
Stapes	Footplate erosion	Intact						
	25	25						
Bony erosions	Scutum	Semicircular canals	Facial nerve canal	Tegmen tympani				
	41	9	16	19

Fig 1: HRCT axial image showing (a) soft tissue density in bilateral middle ear with erosion of short process of incus on the right side, (b) thinning of bone overlying the right semicircular canal, (c) soft tissue density in bilateral middle ear cleft with erosion of facial nerve canal and a defect in mastoid anterior wall showing communication with external ear on right side.

Fig2: HRCT image showing (d) coronal: blunting of scutum, (e) axial: soft tissue density in middle ear with erosion of cochlear promontory, (f) coronal: erosion of tegmen tympani on right side, (g) coronal: thickened tympanic membrane on right side.

DISCUSSION

The diagnosis of cholesteatoma is usually made by otological examination in cases where diagnosis is not obvious. HRCT of temporal bone may show a soft tissue mass with bony erosions and displacement of middle ear ossicles. Cholesteatoma may be revealed by radiological examination even if it is not detected clinically.

Yates et al^[4] concluded that HRCT imaging is necessary for anatomic determination of chronic otitis media, suspicion of congenital anomalies and to detect any changes in the surgical landmarks caused due to prior surgical intervention.

HRCT is less expensive and provides useful information about surgical trend and thus if co-ordination can be made between the otologist and radiologist with an appropriate familiarity of the surgeon with HRCT scans, pre-operative imaging is essential and very helpful in evaluation of pathology prior to surgical exploration regarding the location, extent of involvement and complication of the disease.

This study has been done to develop a systematic method for evaluation of temporal bone as there are a variety of other imaging modalities. The lowest possible radiation dose to the lens, technical factors, visualization of small bony structures, interpretation of the images and economical factors were all taken into consideration.

CLINICAL SPECTRUM

Age: Sharma et al^[5] studied 50 patients of unsafe CSOM with most common age group being 21-30 years. In our study too, we have found majority of the patients were aged less than 30 years which is similar to the findings by Datta et al^[6]. Thus, most of the studies on temporal bone have reported the mean age of patients between 25 to 30 years.

Gender: Out of 50 patients included in our study 29 (58%) were males and 21 (42%) were females. The male to female ratio was 1.4 :1. Gerami et al^[7] showed high male predominance with male to female ratio of 2.48:1 and Sharma et al^[5] also showed male predominance.

Associated symptomatology: In the present study, all (100%) of the patients had active ear discharge. Majority had hearing loss (80% cases) followed by pain in ear (16% cases) similar to the study conducted by Gomaa et al^[8]. This probably indicates that the patients come to hospital relatively late and are not willing for initial treatment. **Side of affection:** In our study, majority patients 40 % cases had bilateral ear involvement.

This was in contrast to the study conducted by Gomaa et al^[8] who observed bilateral ear disease only in 3.57% cases.

RADIOLOGICAL SPECTRUM

Soft tissue density: In this study, there were 36 cases (72%) of cholesteatoma. There was considerable variation in the location and extent of involvement of cholesteatoma in the study population. Epitympanum was the most common location found in 98% of the cases in our study, followed by mesotympanum, hypotympanum and aditus ad antrum similar to the observation made by Gaurano JL et al^[9].

Ossicular chain erosion: Ossicular erosion was found in the majority of cases of CSOM associated with cholesteatoma. Mafee et al^[10] stated that using HRCT, he was able to diagnose ossicular erosion in 89% cases.

In our study, the most common ossicle eroded was of the incus, followed by malleus and stapes. Though there was some variation in the incidence of erosion of each ossicle in different studies, it was observed that incus was the most commonly involved ossicle in all the studies.

Scutum erosion: In our study, scutum erosion was seen in 82% cases with cholesteatoma which is in accordance with that seen by Gaurano JL et al^[9]. This is slightly higher than the values observed by Rogha et al^[11].

Mastoid pneumatization: Chee NW et al^[12] stated that knowledge of the mastoid pneumatization aids in the planning of the surgical approach e.g. whether to do canal wall down or up type of surgery. In our study, pneumatization of mastoid air cells was affected in 92% (46) cases of CSOM.

Semicircular canal erosion: O'Reilly BJ et al^[13] stated that axial scans are more satisfactory as they depict the lateral semicircular canal in its entirety but nevertheless both axial and coronal sections should be obtained. Semicircular canal erosion was identified only in one case in our study which is in accordance with the study conducted by him.

Facial nerve canal erosion: Erosion of the facial nerve canal was found in 32% cases in our study with the tympanic part being more commonly affected which is more than as observed by Baviskar S et al^[14] in his descriptive study of 50 patients of unsafe CSOM. The variable results can be explained by the small number of cases of facial nerve canal dehiscence and statement made by Mafee et al^[10]. They had stated that visualisation of thin bony structures like facial nerve canal may be misleading due to error in computer reconstruction of their images. The fact that computer averages their density with adjacent soft tissue and air makes these structures appear eroded.

Tegmen tympani erosion: For tegmen tympani erosion, thinner HRCT scan slices on coronal sections are required. Tegmen tympani erosion was seen in 38% cases in our study. In the study conducted by Baviskar et al^[14] showed erosion of tegmen tympani only in 20% cases.

Sigmoid sinus plate erosion: Sigmoid sinus plate erosion was not found in none of the 50 cases studied.

However, Khavasi et al^[15] in their study found the erosion of sigmoid sinus plate in 40% cases, but intra-operatively only 20% cases had sinus plate erosion with sensitivity 66% and specificity was 83%.

Carotid canal erosion: In our study of 50 patients, there was no erosion of the bony wall separating the carotid canal from the middle ear on HRCT imaging. Similar findings were observed by Datta et al^[6] in their prospective study.

Surgical correlation: HRCT scan can accurately diagnose cholesteatoma in the majority of cases. Mafee et al^[10] reported in his study of 48 patients with cholesteatoma that 46(96%) of them were diagnosed correctly with the pre-operative HRCT scanning done. According to him, the characteristic feature of cholesteatoma on HRCT is a soft tissue mass in attic and mastoid antrum associated with bony expansion, scalloping of mastoid, erosion of lateral wall of attic i.e. scutum and erosion of ossicles. However, we could not distinguish cholesteatoma from other soft tissue diseases like granulation tissue and polyp.

Cholesteatoma characteristically causes bone erosion and when this feature was present in association with a soft tissue mass on HRCT. Using the same criteria, we detected 36 cases of cholesteatoma out of 44 cases on surgical exploration done at our hospital.

One of the main drawbacks in our study is that soft tissue changes like labyrinthitis could not be evaluated on HRCT. MRI has got better soft tissue resolution in identification of labyrinthitis. Similarly differentiation between cholesteatoma, granulation tissue and effusion is difficult on HRCT. However, on MRI this is possible specially on diffusion-weighted imaging where cholesteatoma restricts but

granulation tissue does not restrict. As such HRCT apart from diagnosis, is mainly useful in preoperative evaluation of the type, location and extent of disease process to help the surgeon in planning further management.

CONCLUSION

Chronic suppurative otitis media commonly occur in the age group of 21-30 years with slight male predominance. Most commonly, it affects both ears with the presenting complaints being otorrhea and hearing impairment. The radiological findings of temporal bone in patients with chronic suppurative otitis media were presence of non-dependent soft tissue mass in most cases, followed by ossicle erosion, scutum erosion, sigmoid sinus plate erosion, tegmen tympani erosion and mastoid cortex erosion and mastoiditis. In ossicular erosion, incus was most commonly involved followed by malleus and stapes. The extent of involvement of the middle ear and mastoid in cholesteatoma in decreasing order of frequency are highest involvement of epitympanum followed by mastoid antrum, mesotympanum, hypotympanum and aditus. Facial nerve canal and tegmen tympani were eroded in 30-40% cases while cochlea, semicircular canals, jugular fossa and carotid canal were unaffected in majority of the cases of CSOM. Chronic suppurative otitis media can be, at times life threatening and warrants that all ENT surgeons be familiar with the standard approach to these patients. Advent of HRCT and improvements in radiological techniques had definitely improved the study of temporal bone in patients with chronic suppurative otitis media which includes evaluation of extent and sites of involvement and inter-relationships of the tympano-mastoid compartment with the adjacent neurovascular structures. Therefore, this study concludes that HRCT should be recommended not only in cases suspected with the potential complications but also in cases of CSOM to know the extent of disease which should guide in surgical approach and treatment plan. It is a useful modality through which pre-operative assessment of temporal bone pathologies can be done efficiently with reasonable accuracy and precision for taking surgical decisions. Although, the present study has a limitation of sample size and showed that despite disagreement over some entities, the broad diagnosis of HRCT had a good agreement with the surgical findings, thus indicating that prudent use of HRCT with a good clinical judgement provided a basis for preparation of a broad diagnosis that steered the surgical decisions in the right directions.

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