A STUDY OF RADIOLOGICAL CHANGES IN CSOM AND THEIR CO-RELATION WITH INTRA-OPERATIVE SURGICAL FINDING

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Abstract

Introduction: HRCT temporal bone is the currently widely used investigation for the chronic otitis media patient especially in unsafe disease.

Aim: This study was conducted to assess the condition of the middle ear in CSOM by HRCT temporal bone and compare them with intraoperative finding of the middle ear cleft.

Method: Study group includes patients of Attico-antral variety of CSOM presenting in ENT OPD in our institution over a period of 18 months who undergone Computed Tomography Temporal bone followed by Surgical Procedure.

Results: After study it was observed that CT scan can reliably detect bony & soft tissue changes in middle ear and intracranial complication. It can detect soft tissue in the middle ear but can not differentiate between soft tissue and cholesteatoma.

Conclusion: CT scan provides excellent anatomical details and pathological changes of the ear and mastoid. Scanning all the patients is not feasible and justified, so we need to select patients in whom diagnosis and extend of the diseases is in doubt.

Introduction:

Chronic suppurative otitis media is defined as chronic inflammation of middle ear and mastoid with permanent abnormality in the pars tensa or flaccida of tympanic membrane.

The disease manifests most commonly as hearing loss and otorrhea. CSOM has long been acknowledged as one of the most common diagnoses in primary care setting worldwide.⁽¹⁾

CSOM as per estimation affects 65 to 330 million individual globally.⁽²⁾ India has the second highest prevalence of chronic suppurative otitis media (7.8%) in the world, next to Tanzania (14%). The disease burden of chronic suppurative otitis media accounts for 91% of childhood and young adulthood hearing impairment in India.⁽²⁾

Clinical features of the CSOM

COM can usually diagnosed by the history taking and otoscopy. The majority of adults

(approx 80%) presenting with COM report a hearing impairment and approximately 70% an ear discharge (Table 1).⁽⁷⁾

Table 1: Symptoms of the active CSOM

Symptoms	Percentage	
	mucosal	Squamosal
Hearing loss	74	83
Otorrhoea	69	56
Otalgia	37	39
Childhood ear disease	26	43

Pathological finding of CSOM includes osteitis, mucosal oedema with submucosal gland formation, granulation tissue, tympanosclerosis, cholesterol granuloma, cholesteatoma, tympanic membrane perforation and retraction.⁽³⁾ It remains an international challenge because of its prevalence, associated morbidity and sequelae. If not diagnosed and treated on time can cause complications which are life threatening. In the past we have to rely on the clinical examination for the diagnosis. As the advent of radiology computed tomography changed the way of examination in otorhinolaryngology.

Computed Tomography

Today, computed tomography (CT) is the most frequently used tool to evaluate the temporal bone. It is used not only to detect pathology, but also as an evaluation tool

preoperatively and during operative procedures. Preoperatively, CT may be helpful in decisions about the most optimal surgical approach and may help minimize complications during surgery. (4)

HRCT temporal bone allows quick imaging of the temporal bone. This data is reconstructed in different imaging plane depending on anatomical area scrutinized. Typically temporal bone CT images are acquired at a thickness of the 0.5- 0.6 mm. This provides excellent bony details of external auditory canal, middle ear and mastoid, ossicular chain, inner ear, and facial nerve canal. HRCT temporal bone allows identification of the masses and opacification in the temporal bone but it fails to differentiate between different types of opacity.

Points to note in the computed tomography includes

1. Soft tissue mass
2. Aeration mastoid
3. Extent of disease
4. Tegmen tympani erosion
5. Sinus plate erosion
6. Facial canal dehiscence
7. Lateral semi-circular canal (LSC) dehiscence
8. Malleus
9. Incus
10. Stapes
11. Disease outside middle ear cleft

Finding on the HRCT temporal bone in different temporal pathology

Acute otitis media and mastoiditis

A mild degree of mastoiditis is generally present with the ASOM. Use of antibiotics has reduced the significant number of cases. Uncomplicated mastoiditis is seen as fluid in the mastoid air cells with preserved internal bony septations and peripheral bone margins.

In coalescent mastoiditis destruction of the internal bony septation occurs. In more aggressive mastoiditis infection can spread through to form a subperiosteal abscess and extend into upper neck forming beczold abscess.

Chronic otitis media

In HRCT temporal chronic otitis media usually presents with middle ear and mastoid effusion, with increased sclerosis of the adjacent bony structures. Further complications from chronic otitis media include ossicular erosions (without cholesteatoma) due to chronic surrounding hyperaemia, and ossicular chain fixation. Fixation of the ossicles secondary to COM may be fibrous or calcific, the latter being termed tympanosclerosis.

Necrotising (malignant) otitis externa

Necrotising otitis externa (NOE) usually presents in elderly patients with ear discharge and severe otalgia, generally with an underlying history of diabetes or chronic immune suppression. *Pseudomonas aeruginosa* are the most common causative organisms.

Imaging has a role to play in diagnosing presence and extent of disease, identifying complications, and in the long-term management and follow-up of this complicated and often difficult to manage condition. CT is normally the first imaging technique.

Cholesteatoma

This is a collection of the keratinizing squamous cells in the middle ear cleft, which are associated with the erosion of the adjacent bony structure. In HRCT it shows as middle ear opacification and bone erosions of the scutum and adjacent ossicals. A normal HRCT temporal has extremely high NPV for absence of cholesteatoma. The limitation of CT is that it cannot differentiate mucosal or inflammatory middle ear disease from the soft tissue mass of a cholesteatoma, cholesterol granuloma, granulation tissue or malignancy.⁽⁵⁾ It is best modality to detect bone erosion in both pars flaccida and pars tensa cholesteatoma.

Acquired cholesteatomas arise from invaginations of the tympanic membrane, or grow into the middle ear via perforations. The former type is derived from an apparently intact membrane; are more common, and typically arise from the pars flaccida region. Keratin accumulates in the lateral epitympanic (Prussak) space, and causes scutum erosion, medial displacement of the ossicular chain, and ossicular erosion. Cholesteatoma growing into the middle ear via a perforation usually arises from the pars tensa. These 'secondary acquired' cholesteatomas are often located medial to the ossicular chain, and cause early erosion of the long process of incus and tend to more erosion of the inner ear structures.

Superior semicircular canal dehiscence

Superior semicircular canal dehiscence (SSCD) has been increasingly recognized as a cause of a variety of vestibular and auditory symptoms. SSCD is thought to be due to a bony defect affecting the arcuate eminence of the superior canal, resulting in a mobile third window into the labyrinth. Absent bone over the SSC, however, is described in up to 13% of asymptomatic individuals.⁽⁶⁾ Thin section CT scans can demonstrate bone thinning and bone defects. Images should be reconstructed in planes parallel (plane of Pöschl) and perpendicular (plane of Stenver) with respect to the superior canal to allow accurate demonstration of defects, the angle they subtend, and to help plan surgery if symptomatic. Labyrinthine fistula due to lateral semicircular canal erosion can result in vertigo, imbalance and sensorineural hearing loss. Less commonly, cochlear promontory erosion may occur.

AIM

To study the correlation between the radiological findings and intra operative findings in the ear in patients of the CSOM.

Material and method

Inclusion criteria

1. Patients of the age group between 7 to 70 years with diagnosed CSOM.

Exclusion criteria

1. Pregnant woman
2. Children below 7 years of age
3. Patients above 70 years of age

After complete demographic details, detailed history through clinical ENT examination was conducted which included otoscopy, examination under microscope, tuning fork tests, pure tone audiometry, and impedance audiometry. Patients with the chronic or recurrent discharge and on clinical examination found to have discharging ear with perforation of the tympanic membrane were selected for the study.

All the patients underwent high resolution computed tomography temporal bone.

Depending upon the extend of the disease multiple surgeries were performed, which includes

1. Myringoplasty
2. Tympanoplasty
3. Atticotomy
4. Mastoidectomy
 - a. Cortical/ simple
 - b. Canal wall up
 - c. Canal wall down
 - d. Modified radical mastoidectomy
5. Combined approach tympanoplasty: canal wall up mastoidectomy with tympanoplasty.

Observation

Table 2: Distribution of the patients according to age

Age group	Number	Percentage
11-20	29	36.3
21-30	24	30.0
31-40	18	22.5
41-50	06	7.5
51-60	02	2.5
61-70	01	1.3
Total	80	100.00

Table 3: Distribution of the patients according to gender

Gender	Number	Percentage
Male	49	61.3
Female	31	38.7
Total	80	100.0

Table 4 Distribution of the patients according to the erosion of the ossicular chain on surgery

Erosion of the ossicular chain	Number	Percentage
Ossicular chain intact	46	57.5
Complete ossicular destruction	05	6.3
Handle of malleus erosion	14	17.5
Incus absent, eroded incus	13	16.3
Supra structure of stapes	07	8.8

Table 5: Distribution of the patients according to the erosion of the ossicular chain on HRCT temporal

Erosion of the ossicular chain	Number	Percentage
Ossicular chain intact	46	57.5
Complete ossicular destruction	05	6.3
Handle of malleus erosion	14	17.5
Incus absent, eroded incus	13	16.3
Supra structure of stapes	04	5.0

Figure 1: Comparison of the ossicular chain status on computed tomography and surgical finding

Table 6: Distribution of finding on surgery

Surgical finding	Number	Percentage
Middle ear mass	53	66.3
Mastoid mass	34	42.5
Bone erosion	33	41.3
Dura exposure	07	8.8
Ossicular disruption	33	31.3
Canal fistula	03	3.8
Facial dehiscence	02	2.5
Brain abscess	01	1.3

Table 7: Distribution of finding on HRCT temporal

CT finding	Number	Percentage
Middle ear mass	53	66.3
Mastoid mass	32	40.0
Bone erosion	31	38.8
Dura exposure	06	7.5
Ossicular disruption	23	28.7
Canal fistula	02	2.6
Facial dehiscence	03	3.8
Brain abscess	01	1.3

Figure 2: Comparison of the intra op and CT finding of the patients

Discussion

This study constituted 80 subjects who undergone computed tomography for the pathology of temporal bone with extend of the disease and these were compared with the surgical finding.

Age & Gender distribution

Maximum cases were present in the age group of 11-20 years in this study. Age distribution for the CSOM with cholesteatoma was given different by different authors. Sweeny et al found that incidence was highest in the age group 10 – 20 years. Malik AK found highest incidence in the age group 1-10 years. Nene et al (1979)⁽¹⁷⁾ reported that the highest incidence in the age group 10-15 years.

In gender distribution this study shows 38.8% were male patients and 61.3 % were female. Rao and reddy (1994)⁽¹⁶⁾ reported an incidence of 58 % in males and 42 % in female. B. C. Okafor reported incidence of the 61.1 % in males and 38.9 % in female.

Surgical finding correlated with the radiological finding

Cholesteatoma

On computed tomography cholesteatoma could not be distinguished from other soft tissue disease; this is same as reported by the most authors as Jackler et al, 1984⁽¹¹⁾; Phelps and Wright, (1990) although Mafee et al (1983) believed it was possible to identify cholesteatoma by its characteristic low attenuation value. This study established the accuracy at 95% to identify middle ear mass (soft tissue) with a sensitivity of 97%. Many patients had both granulation tissue and cholesteatoma, which could not be radiographically distinguished. A useful sign was bulging of the tympanic membrane signifying cholesteatoma or retraction of tympanic membrane which suggest fluid scar tissue or granulation in middle ear. Jackler et al (1984)⁽¹¹⁾ and O'donogh et al (1987)⁽¹²⁾ found cholesteatoma in 80 % of the cases explored in whom, CT there was bone erosions in association with soft tissue mass. Using the same criteria B. J. O. Reilly et al (1991)⁽¹³⁾ reported 79 % cases accurately with false negative rate of 21%.

In our study, on using above criteria soft tissue mass was in 53 cases and bone erosion was in 31 cases. We were able to point out 23 (28.7%) cases of cholesteatoma and 30 (37.5%) cases on granulation accurately from the surgically positive 53 (66.3%) patients and sensitivity 83%, hence it is 81.2 % of cases could be diagnosed accurately and the association of CT scan and surgical finding was significant.

G.E. Valvassiorind M.F. Mafee (1988)⁽⁸⁾ reported that computerized tomography produce excellent soft tissue resolution it is unable to distinguish definitely between qualitative and granulation tissue or other pathological soft tissue with similar radiographic density. The CT or complex motion tomographic diagnosis of cholesteatoma mass is based on indirect sign such as the finding of the bone erosion.

Mafee et al and David et al described the criteria indicating cholesteatoma as “blunting of the scutum's normally sharp tip is often the earliest sign of attic cholesteatoma.

Joselitol et al stated that signs indicating cholesteatoma in the attic include erosion or destruction of scutum and widening of the aditus and antrum with loss of the “Figure 8” appearance.

Signs including cholesteatoma in the attic are blunting of the scutum's normally sharp tip. Bone destruction of the lateral attic wall causing widening of the aditus. Loss of figure of eight pattern formed by the narrow isthmus of the aditus, the epitympanum and antrum this usually signify that the cholesteatoma have extended into the antrum, destruction of the ossicles, erosion of the middle attic wall, smooth cavity that is usually longer. When air cells appear cloudy but maintained their regular trabecular pattern or whenever there is obliteration of mastoid antrum and periantral air cells by increasing reactive bone formation, chronic mastoiditis without cholesteatoma is indicated.

in our study 53/80 (66.2%) of cases CT scan indicated the presence of abnormal soft tissue masses or definite sign of bone erosion of bone erosion or both involving the mastoid air cells, antrum, scutum and/or the wall of the middle ear. Surgical exploration revealed soft tissue mass in hundred percent 53 out of 53 of these cases.

Jacqueline et al (1984)⁽⁸⁾ in a study show 33.3 (14/42) of cases CT scan indicated the presence of both abnormal soft tissue masses and definite signs of bone destruction involving the mastoid air cells and antrum and /or the walls of the middle ear. Surgical exploration revealed cholesteatoma in 78.6 % (11/14) of these cases. In 50% (21/42) of cases abnormal soft tissue density was found in the absence of osseous erosion. In only 33.3% (7/20) of these cholesteatomas was found. The remainder (14/21) of the soft tissue masses consisted of a wide variety of the benign inflammatory processes. If a non bone eroding soft tissue mass involve the epitympanum the probability of cholesteatoma was still only 35%.

The long processes of the malleus and incus and the stapes superstructure are the component most at risk in chronic suppurative otitis media but are also the most difficult to demonstrate on computer tomography. In this study intact ossicular chain was seen in 46 patients (57.5%) and in 33 patients (41.25%) a ossicular erosion was found during surgery out of which 23 patients (28.7 %) was found ossicular erosion in CT scan. While in 5 patients (6.3%) total erosion of the ossicular chain could be identified on CT scan with 100% accuracy. Erosion of handle of malleus was found in 14 patients (17.5%) during operative procedure while only 14 patients showed (17.5%) erosion of handle of malleus in CT scan with 100% accuracy.

While erosion of incus during surgery was seen in 13 patients (16.3 %) while in CT scan we found 13 patients (16.3%) with 100% accuracy. Superstructure of stapes

during surgery 7 patients (8.8%) while in CT scan found in 4 persons (5.0 %).

Mafee et al (1988)⁽⁸⁾ were able to define the state of the ossicular chain in 89% of cases scanned and O' Donoghue et al (1987)⁽¹²⁾ reported that they had detected erosion of long process of incus in 67% and absence of a stapes superstructure in its 6% of cases. On the other hand Jackles et al (1984)⁽¹¹⁾ were able to predict the state of the ossicular chain in only 7% of their cases and Phelps and Wright (1990) doubted that CT scan could demonstrate the ossicular chain reliably because of the combination of partial volume averaging and tissue silhouetting. In this study for ossicular chain disruption the accuracy was 75% and sensitivity 54.3% and bone erosion sensitivity was 60 % and accuracy was 70 %.

Facial canal dehiscence

Two plane scanning are required to demonstrate both the second and third part of the facial canal (Jackler et al 1984)⁽¹¹⁾. In our study facial canal dehiscence during surgery 3 cases proved positive and in CT scan 2 cases proved positive that shows city scan has a 100% sensitivity level coma with an accuracy of 66.7%. BJO' Reilly (1991)⁽¹³⁾ detected 4 out of 9 cases. Mafee et al (1988)⁽⁸⁾ none in six cases. O' donoghue et al (1987)⁽¹²⁾ appear to have detector all nine of their facial dehiscence but also had 6 false positive.

Pneumatization of mastoid

The mastoid is almost universally involved in chronic suppurative otitis media. CT scan was able to provide excellent view of mastoid air cells, antrum and aditus ad antrum in either coronal or axial planes. The most common finding was sclerosis which was present in (63/80) 78.8% of patients. Of which partial sclerosis (15/18) 18.8% was present. Pneumatization was present only in 1 patient (1.5 %) the next most common mastoid abnormalities seen were involvement of the air cells or antrum by soft tissue in 66.3% (53 / 80) and bone erosion in (31/80) 38.8 %. Sade J and Fuchs C did a comparison study in 1994 and reported that two main types of cholesteatomas were found in both adult and children, most of them (82.3%) associated with scratches or diploid mastoid and the rest (17.3%) with pneumatized mastoid. The format type was found more often in adult (96.3%) than in children (57.8%), while the latter was more frequent in children (42.2% in comparison to 3.7% in adult). In both adult and children cholesteatoma associated with pneumatized mastoid showed mainly an attic and mastoid distribution communicating with a pars tensa or pars placida retraction or marginal perforation.

Intracranial complication

In our study this complication was delineated by computed tomography with great accuracy. One subdural abscess was detected pre-operative CT scan. On surgery the same values

were seen hence these complications can be detected with 100% accuracy. Three post auricular fistula detected on pre-operative CT scan when compared to operator finding it was 100% accurate. Virtually all complication of cholesteatoma is related to osseous destruction. This ability to destroy bone may lead to the more serious and potentially fatal intracranial complication. All these complications may produce obvious sign and symptoms but they may be subtle and unrecognised without computed tomography. M F Mafee et al (1988)⁽⁸⁾ reported in their study three cases of intracranial complication with epidural abscess although one patient was quite ill; the other abscesses were not clinically obvious until CT scan were obtained.

The diagnosis of the cholesteatoma is usually made on otological examination. In cases in which diagnosis is not obvious, CT scan may demonstrate soft tissue mass with characteristic ossicular displacement and erosion of bone. Cholesteatoma in hidden areas such as the posterior tympanic recess may be revealed by a CT scan even if it is not detected by otologic examination. In order to maximum benefit from a CT scan in the chronic suppurative otitis media certain guidelines should be followed. In most circumstances it is advisable to obtain two planes of view; the two planes of CT scan routinely employed are axial and coronal projections. Coronal scans are more valuable in the evaluation of scutum, prussak's space, the tegman tympani, the ossicular heads and the horizontal portion of the facial nerve. In evaluation of the cholesteatoma this is the most important view. Axially oriented scans however are essential for the proper evaluation of sinus tympani, facial recess, lateral semicircular canal, stapes, and the vertical portion of facial canal. It is also important to get views of both the temporal bone so that anatomical peculiarities may be better analysed. CT scan also provides information about congenital and anatomic variation that may be encountered during surgery and also the various complications of cholesteatoma.

Conclusion

Computed tomography is highly sensitive in evaluation to the presence of soft tissue and bone erosion. However CT is lack sensitivity to the more subtle feature of dura exposure, ossicular disruption and facial canal dehiscence. Proper assessment of the normal otological anatomy and to know extend of diseases both Axial and coronal projections of the CT scan are required. Diagnosis of the cholesteatoma is usually made on otological examination, in cases where diagnosis is not obvious CT scan with characteristic bone erosion and ossicular displacement can be seen. In short CT scan provide excellent details of the ear and mastoid region.

References

1. Buzi A, Gluth MB, Black B. Chronic ear disease in the modern era: evolution of treatment, epidemiology, and classification. In: Dornhoffer JL, Gluth MB,

- editors. The chronic ear. New York: Thieme; 2016. p. 2–7.
2. World Health Organization. Chronic suppurative otitis media: burden of illness and management options. Geneva (Switzerland): WHO; 2004.
3. Schuknecht H. Pathology of the ear, 1st edition Cambridge, MA: Harvard university press; 1974.
4. Erwin A dunnebie Imaging for otolaryngologist 2nd edition, Thieme publisher; 2007.
5. Barath K, Huber AM, Stampfli P, et al. Neuroradiology of cholesteatomas. Am J Neuroradiol 2011; 32: 221–9.
6. Branstetter BF, Harrigal C, Escott EJ, Hirsch BE. Superior semicircular canal dehiscence: Oblique reformatted CT images for diagnosis. Radiology 2006; 238(3): 938–42.
7. Sheahan P, Donnelly M, Kane R. Clinical features of newly presented case of COM. J Laryngol Otol 2001; 115: 962–6
8. Maffe M., Levin C., Applebourn I., Campos F.. Cholesteatoma of the middle ear and mastoid. Otolaryngol Clin North Am. 1988; 21: 265–8.
9. David C., Lia D., Thomas R., Bergeron M.. Contemporary radiologic imaging in the evaluation of middle ear-attic-antral complex cholesteatoma. Otolaryngol Clin North Am. 1989; 22: 897–909.
10. Gurano J.L., Joharjy I.A.. Middle ear cholesteatoma: characteristic CT findings in 64 patients. Ann Saudi Med. 2004; 24(6): 442–7.
11. Jackler R, Briggs RJ, Luxford WM. Chronic ear surgery : a historical review ..Otolaryngology & Neurology .1994 jul 1;15(4) :558-67..
12. Bates GJ O:Donoghue GM, Anslow P, Houlding T, Can CT detect labyrinthine fistulae preoperative Acta otolaryngology, 106-40, 1988.
13. O'reilly BJ, Chevretton EB, Wylie I, Thakkar C, Butler P, Sathanathan N, Morrison GA, Kenyos GS, The value of CT scanning in chronic suppurative otitis media . The Journal of Laryngology & Otolaryngology .1991 Dec 1; 105(12); 990-994..
14. Cody DRT The definition of cholesteatoma .cholesteatoma first International conference Birmingham, Alabama, Aesculapius publishing Co pp.6-9 1 1997'
15. Robert Y et al congenital cholesteatoma of temporal bone MR finding and comparison with CT ,AJNR Am J Neuroradiol 16 (4), 755-761, April 1995
16. Rao BN, Reddy MS .chronic suppurative otitis media – A prospective study .Indian journal of otolaryngology and Head and neck surgery .1994 Apr 1; 46(2) ;72-77.
17. Nunes DA, Browning GG .Risks of developing otogenic intracranial abscess ,J Laryngol Otol 1990; 104; 468-72.