High Resolution Computed Tomography Evaluation of Temporal Bone in Patients of Chronic Otitis Media; A Surgico-Radiological Correlation Study.

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ABSTRACT

Background: High-resolution CT (HRCT) of the temporal bone is the method of choice for making the diagnosis, knowing the extent of disease and planning the treatment. Early appreciation of the disease is important to implement a surgical procedure to save the patient from loss of hearing and to prevent critical intracranial complications. The present research has been undertaken to study the role of High Resolution Computed Tomography (HRCT) of temporal bone as a diagnostic modality in COM. **Methods:** This is a prospective study done in Teerthanker Mahaveer Medical College for duration of one year. The study was conducted on fifty patients who had positive history of chronic otitis media (COM). All the patients underwent HRCT scans in department of Radiology and then the surgical intervention was done. Both the radiological and surgical findings were tabulated and correlated with each other. False positive, false negative, sensitivity, specificity and P value were calculated. The level of significance was considered significant for P-value <0.05. **Results:** Certain findings like mesotympanum, epitympanum, hypotympanum, perilabyrinthine cells, mastoid air cells, tegmen tympani involvement and intra-cranial involvement showed 100% sensitivity. The perilabyrinthine cells, mastoid air cells involvement, stapes erosion, tegmen tympani erosion, mastoiditis and intracranial complication showed 100% specificity. **Conclusion:** HRCT of temporal bone is a reliable investigation in preoperative evaluation of chronic otitis media and its complications except for facial canal dehiscence.

Keywords: High resolution computer tomography, Chronic otitis media, Temporal bone.

INTRODUCTION

The factual meaning of Otitis media is inflammation of the middle ear. On the basis of duration of symptoms it is divided into two types- acute otitis media (AOM) and chronic otitis media (COM). AOM is an infection of sudden onset and most common symptom is ear pain. Another presentation is otitis media effusion (OME) which is typically not associated with symptoms. Sometimes the patient complains of a feeling of fullness in ear. It is defined as the existence of non-infectious fluid in the middle ear for at least more than three months. Otitis media is called as chronic suppurative otitis media (CSOM) when symptoms of ear fullness and discharge are present for more than two weeks. Sometimes, it may be a complication of acute otitis media. Pain is rarely present. All the three types of otitis media may be related with progressive loss of hearing.[1,2]

High-resolution CT (HRCT) of the temporal bone is the method of choice for making the diagnosis, knowing the extent of disease and planning the treatment. Since S- shaped external auditory canal does not permit visualization of tympanic membrane and other middle ear structures, imaging studies are compulsory.[3]

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Radiological outcomes are essential for exact classification of the grade of disease and surgical decision-making. On the basis of radiological findings various grading system of CSOM has been proposed. One of these is based on eight critical areas of temporal bone anatomy, each area receiving 1 rating scale point, with the exception of the presence of a stapes, which received 2 points. Patients with a pre-surgical rating of ≤5 points should not be considered surgical candidates. A pre-surgical rating of 8 points translates into an 80% chance of resorting hearing to normal or near-normal levels.[4]

The common radiological abnormalities observed in CSOM are hypoplastic middle ear cavity, deformed ossicles, oval window atresia, aberrant course of the facial nerve, absent or hypoplastic tympanic bone, sclerosis, erosions, aditus or antrum involvement, mastoiditis or mastoid abscess formation, involvement of mastoid or perilabyrynthine cells and intracranial involvement. But it has been found that inner ear remains normal.[5,6]

Hence, as we know that HRCT of temporal bone plays an important role in planning the management as well as prognosis of disease, it becomes very important to know the sensitivity and specificity of the radiological methods. Thus in this study we compared the pre-operative radiological findings with the intra-operative findings of the same person to judge the accuracy of the radiological examination of the temporal bone. It is also important to differentiate between the two types of COM: the chronic mucosal disease and the chronic otitis media with cholesteatoma because of

higher threat of complications linked with the cholesteatoma group which can lead to life threatening circumstances.[7-9]

Early appreciation of the disease is important to implement a surgical procedure to save the patient from loss of hearing and to prevent critical intracranial complications. The present research has been undertaken to study the role of High Resolution Computed Tomography (HRCT) of temporal bone as a diagnostic modality in COM.

MATERIALS AND METHODS

This is a prospective and observational study done in Teerthanker Mahaveer Medical College for duration of one year. The study was conducted on fifty patients fulfilling certain criteria.

Inclusion criteria: a) Patient belongs to Indian race, b) Had positive history of chronic otitis media (COM), c) Age group between 21 – 60 years.

Exclusion criteria: a) Age < 21 or > 60 years, b) Patients with electric devices at the skull base, such as cochlear implants, c) Patients who have undergone previous temporal bone surgeries. d) Patient with the history of trauma to the temporal bone.

Written informed consent was taken from every patient. Both inpatients and outpatients were included and all the information available from the clinical records of the emergency department, pre-hospitalisation records, inpatient records with discharge summary and any surgical records were used. The study was approved by institutional ethical board. Detailed history of the patients was recorded and clinical examination was done.

All the HRCT scans were done in department of Radiology at Teerthanker Mahaveer Medical College. Initial lateral topogram was followed by helical acquisition in axial and coronal planes. Scanning range of coverage is from the inferior border of the mastoid process to the arcuate eminence on Norma lateralise topogram. Scanning angle of 30º to anthropological baseline parallel to lateral semi-circular canal was used. Coronal images were obtained perpendicular to the axial plane. Scanning parameters: 120 kV, 140 mA, 1 mm section thickness, 2 mm interval, 2-mm beam collimation, 0.562:1 pitch.

The diseased side was compared with the contralateral normal temporal bone. Intravenous contrast was given to evaluate the intracranial extension of disease when required. All the patients went through post-aural mastoidectomy and all the findings seen intra-operatively were noted. Both the radiological and surgical findings were tabulated and correlated with each other.

Statistical methods were carried out using SPSS for Windows (Version 16.0) and Minitab (Version 11.0) for windows. False positive, false negative, sensitivity, specificity and P value were calculated. The level of significance was considered significant for P-value <0.05.

RESULTS

The demographic profile of the patients recorded during history taking are tabulated and compared in Table 1, Figure 1. In this study, it was found that majority (52%) of patients were aged between 31-40 years. Only 6% patients belonged to the age group of 41-50 years. The male is to female ratio in the study is 3:2. The disease is most commonly found in low socio-economic status people (66%), followed by middle (28%) and low (6%) socio-economic conditions [Table 2]. Thus, this can be concluded that the incidence of otitis media is directly proportional to low socio-economic status and level of hygiene.

Table 1: Age distribution of the patients in the study.

Age range (years)	No. of patients (n)	Percent (%)
21-30	11	22
31-40	26	52
41-50	3	6
51-60	10	20

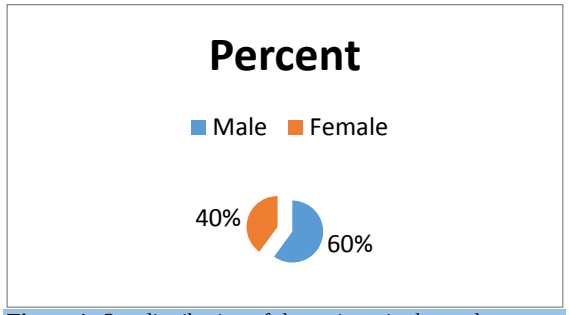

Figure 1: Sex distribution of the patients in the study.

Table 2: Distribution of the patients on the basis of socio-economic status.

Socio-economic status	Percent (%)
High	6
Middle	28
Low	66

Table 3: Distribution of patients on the basis of type of CSOM and surgery.

Type of disease	No. of patients (n)	Percent (%)	Type of surgery
Tubotympanic	15	30	Canal Wall Up
Atticoantral	35	70	Canal Wall Down

Approximately two-thirds patients had atticoantral disease (70%) and they were treated by canal wall down mastoidectomy. 36% of patients with tubotympanic disease were treated by canal wall up mastoidectomy [Table 3].

Table 4 describes type of mastoid pneumatisation and anatomical variations. In this table the HRCT and intraoperative findings were compared which were comparable and showed no statistical significance (p>0.05).

Table 4: Comparison of the Mastoid Pneumatisation findings of HRCT and during surgery.

Findings	HRCT	Intraoperative
Sclerosis	19	19
Well pneumatised	29	28
Facial canal dehiscence	7	9
Diploic	11	11

In table 5, different parameters and findings were compared by radiological (HRCT) method and intraoperatively. The sensitivity and specificity was calculated. Certain findings like mesotympanum, epitympanum, hypotympanum, perilabyrinthine cells, mastoid air cells, tegmen tympani involvement and intra-cranial involvement showed 100% sensitivity. The perilabyrinthine cells, mastoid air cells involvement, stapes erosion, tegmen tympani erosion, mastoiditis and intracranial complication showed 100% specificity [Table 5].

Table 5: The sensitivity and specificity of HRCT findings compared with intraoperative (IO) findings.

Findings	HRCT	IO	FP	FN	Sensitivity	Specificity
Mesotympanum involved	11	7	4	0	100	90
Epitympanum involved	14	6	8	0	100	81.8
Hypotympanum involved	16	11	5	0	100	87.1
Perilabyrinthine cells involved	23	23	0	0	100	100
Mastoid air cells involved	15	15	0	0	100	100
Malleus erosion	26	26	2	2	92.3	91.6
Incus erosion	28	28	2	2	92.8	90.9
Stapes erosion	24	28	0	4	85.71	100
Tegmen tympani erosion	4	4	0	0	100	100
Mastoiditis and mastoid abscess	6	8	0	2	75	100
Intracranial complication	1	1	0	0	100	100

FP- False positive, FN- False negative

DISCUSSION

In this study, fifty patients having positive history of CSOM were randomly selected and their HRCT was done which was compared with the findings intra-operatively. The demographic profile of the patients was compared. The incidence of disease was found to be more common (52%) in age group between 31-40 years. The male is to female ratio in the study is 3:2. This demographic profile was similar to study by Gerami et al[1], Paperella & Kim.[2] Male: female ratio was 0.923:1 in accordance with the study by Petros V.[3] In a study by O'Donoghue GM[10], 96% belonged to the low socioeconomic status, which reflects that the disease is rampant among low socioeconomic class people. In our study also the incidence of disease is most commonly found in low socio-economic status people (66%), followed by middle (28%) and low (6%) socio-economic conditions. It suggests that lack of hygiene, poor nutritional status and reduced resistance to infection are the probable causative factors.

The HRCT was found to be 100% sensitive in identifying the involvement of mesotympanum, hypotympanum and epitympanum. The specificity were 90, 87.1 and 81.8 respectively. This is similar to findings by Ranga Reddy Sirgiri[4] which showed 92% sensitivity. The specificity of HRCT was 84% and 88.8% for hypo and epitympanum respectively. Some researchers like Mafee et al[5] and O'Reilly et al[6] found that HRCT was less sensitive and specific in identifying the involvement of ear ossicles like maleus, incus and stapes. But in this study we found that sensitivity range from 85-93% whereas specificity ranges from 90-100%, which is quite high. Bony erosion correctly predicted presence of cholesteatoma in 78% cases. This value is close to data by O'Donoghue et al[10] and Firas Q. Alzoubi et al[11] who found in 80% cases. Mafee et al[5] found bone destruction in 100% cases of acquired cholesteatoma.

Gerami et al[1] in his study suggested that HRCT sensitivity was 88.8% and specificity was 100% in identifying the involvement of mastoid air cells. In the perilabyrinthine cells, HRCT sensitivity was 100%, while specificity was 93.4%.in a study by Ranga Reddy Sirigiri et al.[4] In the present study, the sensitivity and specificity to identify the association of mastoid air cells and perilabyrinthine cells were 100%.

HRCT was found to be very sensitive (100%) and specific (100%) to detect Tegmen Tympani erosion which agrees with results by Jackler RK[7], Gerami et al[1].,Gaurano JL[12] also found it 100% sensitive. These researchers also found that HRCT is 100% sensitive and specific in detecting cochlear promontory fistula involvement.

Mastoiditis complicated with subperiosteal abscess was found in 6 patients in HRCT whereas intraoperatively 8 patients showed the presence of above mentioned sign. This is similar to findings by Leskinen et al[13] (7%). HRCT was found to be an excellent tool to detect the other complications of mastoiditis like mastoid abscess with 100%

sensitivity and specificity. In our study the sensitivity and specificity were 75% and 100% respectively.

So, overall HRCT has got a P value <0.05 for all the parameters mentioned above except for facial canal dehiscence. A further population based study for a longer duration and for large population is needed to make a more reliable comparison with the standard studies.

CONCLUSION

HRCT is the imaging modality of choice for temporal bone and middle ear pathologies. This study proves HRCT temporal bone is a reliable investigation in preoperative evaluation of chronic otitis media and its complications except for facial canal dehiscence.

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