

Original Research Article

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Middle ear cholesteatoma: a study of correlation between HRCT temporal bone and intraoperative surgical findings

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ABSTRACT

Background: Cholesteatoma is a long-standing infection of the middle ear cleft having erosive properties. Chronic ear discharge and decreased hearing are most common clinical presentation. Multi-directional tomography of high quality can provide a detailed understanding of the interpretation of anatomical structures visualized by HRCT. Knowledge of the anatomical variations and changes induced by pathology in the temporal bone are the guiding marbles for surgery.

Methods: This is a prospective study consisted of 100 cases of chronic suppurative otitis media of unsafe type requiring ear surgery admitted in the E.N.T. department of P.D.U. Civil Hospital Rajkot in 2 years from December 2015 to December 2017. A total no. of 100 patients of both gender between 5 to 80 years has been included in the study.

Results: In this study, 58% patients were females while males were 42%. Left ear (46%) was involved more as compared to right ear (40%). Most of the patients belonged to 11-20 (25%) years of age group. Mean age is 24.5 years. Most common symptoms were ear discharge (98%) and decreased hearing (83%).

Conclusions: HRCT guides the surgeon on the possible surgical hazards before the surgery and helps in earlier management and operative complications. The use of CT in the case of chronic suppurative otitis media does provide valuable information. HRCT scanning is a unique method of detection of early cholesteatoma as well as detection of cholesteatoma in hidden areas. In addition, HRCT scanning serves as a road map to assist the surgeon during cholesteatoma surgery.

Keywords: Cholesteatoma, HRCT temporal bone

INTRODUCTION

Cholesteatoma is a long-standing infection of the middle ear cleft. It is a three-dimensional stratified squamous epithelial sac confirming to the middle ear cleft, containing keratin debris and having the capacity for progressive and independent growth at the expense of the underlying bone, displacing or replacing the middle ear mucosa, and has a tendency to recur after removal.¹ It has a destructive nature that erodes the bone and causes rapid bone destruction. Cholesteatoma have characteristics of

growth, migration and osseous erosion and are thus locally destructive, the only treatment is their full surgical removal since there is no effective clinical treatment for eradication of the disease so far.²

Chronic ear discharge and decreased hearing are most common clinical presentation in cholesteatoma disease. Other symptoms are tinnitus, earache, ear bleeding. Other warning symptoms are headache, high grade fever, vomiting, giddiness and facial asymmetry suggestive of intratemporal and intracranial complications.

Otoscopic and microscopic examinations are gold standard techniques for diagnosis of cholesteatoma. High resolution computed tomography of temporal bone (HRCT) axial and coronal scan required to know the anatomy of mastoid, position of tegmen tympani and sinus plate, degree of pneumatization of mastoid, bony erosion, complications such as labyrinthine fistula, facial nerve dehiscence, stenosis of external auditory canal and congenital abnormalities.

HRCT offers excellent spatial density resolution using special algorithms. It provides information not only about bony outline but also soft tissue changes making it possible to demonstrate the location and extent of disease as well as its complications. Furthermore, coronal and axial CT scanning together has dramatically improved the imaging of temporal bone. HRCT accurately depicts the boundaries between the external, middle and inner ear cavities thereby localized the disease precisely and also greatly demarcate thin boundary between temporal bone and intracranial compartment with exact details of intracranial spread of primary temporal bone disease.³ Contrast media help to evaluate the vascularity and contrast enhancing characteristics particularly in soft tissue lesions of temporal bone giving clues to the histopathology.

Preoperatively precise knowledge of the complex anatomy of the deepest structures of the temporal bone is must for this advancing otology surgery. Knowledge of the anatomical variations and changes induced by pathology in the temporal bone are the guiding marbles for surgery and previous surgery.

Keeping pace with technology, multi-directional tomography of high quality, carried out by qualified, trained technicians and reported by a radiologist can provide a detailed understanding of the interpretation of anatomical structures visualized by HRCT.⁴

METHODS

This study consisted of 100 cases of chronic suppurative otitis media of unsafe type requiring ear surgery admitted in the Otorhinolaryngology department of P.D.U. Civil Hospital Rajkot in 2 years from December 2015 to December 2017.

Sample size

A total no of 100 patients has been included in the study.

Type of study: Prospective study.

Inclusion criteria

- Atticoantral type of disease.
- Any age with unsafe type of disease, both adults and children.
- Both males and females.

- Patients with CSOM complications both intra and extracranial complications.
- Patients giving consent to undergo CT scan and surgery.

Exclusion criteria

- Patient with the history of trauma to the temporal bone.
- Patients with electric devices at the skull base, such as cochlear implants.
- Known cases of temporal bone neoplastic diseases and cases unsuitable for surgery or scanning (pregnancy).

A clinical proforma was filled up for each patient incorporating details regarding particulars of the patient, history, clinical examination and investigations. All patients were examined carefully under microscope for confirmation of diagnosis. Hearing status was assessed by pure tone audiometric examination according to the age and compliance of the patient.

In computerized tomography, high resolution serial 1 mm thick 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 ramus of the mandible.

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. After the scan was taken, radiologist gave the detailed reporting of the temporal bone.⁴

All the patients went through ear surgery and all the findings seen intra-operatively were noted. Both the radiological and surgical findings were tabulated and correlated with each other. All patients underwent mastoid exploration and the type of surgery was determined by the intra operative findings. The type and extent of disease, ossicular erosion and complications were studied during surgery.

RESULTS

In this study, 58% of patients were female and 42% were male patients (Table 1).

As shown in Table 2, most of the patients- 25% are belonging to 11-20 years of age followed by 23% in 21-30 years of age. 17% were in 0-10 years while 12% are in 31-40 years. 9% and 7% patients are in 41-50 and 61-70 years.

Table 1: Sex distribution.

Sex	No. of patients	% of patients
Male	42	42
Female	58	58
Total	100	100

Table 2: Age distribution.

Age group (in years)	No. of patients	% of patients
0-10	17	17.00
11-20	25	25.00
21-30	23	23
31-40	12	12.00
41-50	9	9
51-60	5	5.00
61-70	7	7
71-80	2	2.00

Table 3: Ear with cholesteotoma.

Ear with cholesteotoma	No. of patients	% of patients
Right	40	40
Left	46	46
Both	14	14.00

Table 5: CT and surgical findings for cholesteatoma.

CT findings					
Surgical	Cholesteotoma	No cholesteotoma	Total	Sensitivity	98.7
Cholesteotoma	76	6	82	Specificity	73.91
No cholesteotoma	1	17	18	PPV	92.68
Total	77	23	100	NPV	94.44

Table 6: CT and surgical findings for ossicular chain.

Ct findings					
Surgical	Ossicles eroded	Intact	Total	Sensitivity	100
Ossicles eroded	89	0	89	Specificity	100
Intact	0	11	11	PPV	100
Total	89	11	100	NPV	100

Table 7: CT and surgical findings for lateral semicircular canal.

CT findings					
Surgical	Fistula	No fistula	Total	Sensitivity	78.94
Fistula	15	10	25	Specificity	87.65
No fistula	4	71	75	PPV	60
Total	19	81	100	NPV	94.66

46% of patients in this study had left ear with cholesteatoma and 40% were having right ear diseased. 14% patients were having cholesteatoma in both ears.

Table 4: Symptoms.

Symptoms	No. of patients	% of patients
Ear discharge	98	98.00
Decreased hearing	83	83
Earache	52	52.00
Giddiness	29	29
Facial asymmetry	9	9.00
Nasal blockage	11	11.00

Most of patients were having ear discharge (98%) and reduced hearing (83%) as chief complaints. 52% were having ear ache and 29% were having giddiness. 9% had facial asymmetry and 11% had associated nasal blockage.

At surgery, cholesteatoma was present in 82 out of 100 patients (82%). There were 76 patients (73.91%) in whom the cholesteatoma was predicted correctly by the CT scan and 17 patients (98.70%) where it was excluded correctly. In one patient (2%) it was excluded by CT scan but was present at surgery. From the above data, the sensitivity of the scan in detecting cholesteatoma is 98.70%, specificity is 73.91%, positive predictive value is 92.68% and negative predictive value is 94.44%.

Ossicular chain erosion was present in 89 out of 100 patients. Erosion was also reported on 89 of the 100 CT scans. There were 11 patients in whom the ossicular chain was intact in both CT as well as during surgery.

From the above data, the sensitivity of the scan in detecting ossicular chain erosion is 100%, specificity is 100%, positive predictive value is 100% and negative predictive value is 100%.

During surgery, semicircular canal dehiscence was seen to be present in 25 of 100 patients. Semicircular canal dehiscence was reported on 15 of the 100 CT scans. There were 15 patients in whom the semicircular canal dehiscence was predicted correctly by the CT scan, 71 patients where it was excluded correctly, 10 patients

where it was predicted incorrectly and in the remaining 4 patients it was excluded by CT scan but was present at surgery. From the above data, the sensitivity of the scan in detecting semicircular canal dehiscence is 78.94%, specificity is 87.65%, positive predictive value is 60% and negative predictive value is 94.66%.

Table 8: CT and surgical findings for tegmen.

CT findings					
Surgical	Dehiscent tegmen	Intact	Total	Sensitivity	82.35
Dehiscent tegmen	14	5	19	Specificity	93.97
Intact	3	78	81	PPV	73.68
Total	17	83	100	NPV	96.29

Table 9: CT and surgical findings for sigmoid sinus plate.

CT findings					
Surgical	Sinus plate eroded	Intact	Total	Sensitivity	86.36
Sinus plate eroded	19	8	27	Specificity	89.74
Intact	3	70	73	PPV	70.37
Total	22	78	100	NPV	95.89

Tegmen dehiscence was seen to be present in 19 of 100 patients. It was reported in 17 of the 100 CT scans. There were 14 patients in whom the dehiscence was predicted correctly by the CT scan, 78 patients where it was excluded correctly, 3 patients where it was predicted incorrectly by CT scan but was present at surgery. From the above data, the sensitivity of the scan in detecting tegmen dehiscence is 82.35%, specificity is 93.97%, positive predictive value is 73.68% and negative predictive value is 96.29%.

Similarly, sensitivity of CT for sinus plate erosion is 86.36% while specificity was 89.74%. Negative predictive value is 95.89% and positive predictive value is 70.37%. For dural plate dehiscence sensitivity was 82.35% and specificity was 93.97%.

DISCUSSION

CSOM is a common ear disease that may have serious, life threatening complications. As such early diagnosis and treatment is of importance for a good patient prognosis. HRCT of temporal bone is of great value in the diagnosis and preoperative assessment of a case of CSOM.

The purpose of the study is primarily to understand the capability of CT in diagnosis and detection of various pathological changes occurring in the temporal bone in a case of chronic suppurative otitis media.

Chronic suppurative otitis media and resultant hearing loss remains a significant health problem in terms of prevalence, economics and sequelae. Short and long-term sequelae of otitis media may be devastating. It can be avoided if recognized early and properly treated. Early

surgical intervention is needed to limit the disease. The presence, location and extent of disease along with the presence of any complications determine the surgical approach to be followed. As such imaging plays an important role in providing crucial information to the surgeon in this regard.

Cholesteatoma is more common amongst females. In this study, 58% patients were females while males were 42%. The study done by Dutta et al, 44% were found males and 56% were females.⁵

In this study, left ear (46%) was involved more as compared to right ear (40%). Some (14%) were having disease in both ears. In study done by Rohit et al, right side (38%) was commoner as compared to left (36%) and 26% were having bilateral disease.

Most of the patients in my study belonged to 11-20(25%) years of age group, after which next was 21-30 having 23% of patients. 17% patients were in 0-10 years. In study done by Nanraj et al, most common age group was 21-30 having 40% patients followed by 11-20 having 26% and 18% were in 31-40. Their mean age was 26.9 years while it was 24.5 years in my study.⁶

In this study most, common symptoms were ear discharge (98%) and decreased hearing (83%). Ear ache was also present in 52% of patients. Similarly, in study done by Gyanu et al also most common symptom was ear discharge (100%) and hearing loss (96%) were as ear ache constituted about 16.6%.⁷

The purpose of this study is to evaluate CT's role in chronic suppurative otitis media and its surgical management. The major role of CT scans in the context

of chronic suppurative otitis media is to provide more information regarding the condition of middle ear structures as well as the extent of disease.

The condition of the ossicles (and more specifically the malleus and incus) is generally well depicted by CT scans. Erosion of the stapes is not very well demonstrated by CT, especially in the presence of soft tissue. The soft tissue covers the stapes due to the partial volume averaging phenomenon present in CT images.⁸

Most authors agree that CT can detect the presence and extension of soft tissue in the middle ear, and there is a consensus that CT cannot distinguish the type of tissue (i.e. granulation tissue vs. cholesteatoma).⁹

Certainly, having prior knowledge of potential hazards does reduce the risk of complications. Being able to see the extension of soft tissue can allow the surgeon to plan accordingly and reduce the risk of recurrent disease.

Assessing the access by examining the tegmen tympani and dural height can also alter an otologist surgical method and plan. The surgeon may opt for a canal wall up or canal wall down mastoidectomy depending on that information. Therefore, it seems always useful to have that information on hand before surgery whether it directly influences management by altering the treatment plan or improve the quality of the surgeon's work.

Patients with cholesteatoma should be scanned in both axial and coronal planes as many relevant structures are best seen in only one of these planes. The use of single plane may lead to mistakes because the structures parallel to the plane of section are not visualized.¹⁰

With the more prevalent use of HRCT scanning, considerable morbidity may be avoided. Because of the ability to see middle ear structures with great clarity, more limited and more directed procedures can be done to eradicate disease while preserving function.

HRCT guides the surgeon on the possible surgical hazards before the surgery. So that the surgeon is prepared to face the same. The surgeon must however not depend completely on the findings of the scan and rely more on his surgical expertise and clinical judgement in treating the patient.

HRCT 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.¹¹ 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.¹²

In summary, the use CT in the case of chronic suppurative otitis media and before the determination of any complications does provide valuable information. HRCT scanning is a unique method of detection of early cholesteatoma as well as detection of cholesteatoma in hidden areas. In addition, HRCT scanning serves as a road map to assist the surgeon during cholesteatoma surgery.

CONCLUSION

HRCT is useful for the anatomy and variations in the temporal bone. It helps to know the changes induced by the disease in the temporal bone. HRCT helps us to assess the extent of pathology before surgery. It helps us to predict the possible complications prior and manage it properly. Because of earlier detection, it can be treated safely. HRCT guides the surgeon on the possible surgical hazards before the surgery and helps in earlier management and operative complications. It makes runway for the surgeon to fly in the operative field. HRCT definitely has a role in management of chronic suppurative otitis media but it should be used in addition to the skill of the ENT surgeon.

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