Diagnosis of unsafe chronic suppurative otitis media using computed tomography through predictive value assessments

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Abstract

Background: Chronic Suppurative Otitis Media (CSOM) is a significant cause of preventable hearing loss. Global emergence of resistant strains is of great concern. The aim of the present study was to assess the accuracy and predictive value of computed tomography in diagnosis of unsafe chronic suppurative otitis media. **Methods:** Aprospective, analytical study was conducted among 90 patients with complaint of unsafe chronic suppurative otitis media which were randomly selected from outpatient Department of Otorhinolaryngology at Subharti Medical College, Dehradun, Uttarakhand. The patients comprised of both males as well as females and also of different age groups. **Results:** Out of 90 patients, 61(67.22%) were males followed by 29 (32.22%) females. The minimum age of patient in the study was of 8years and the maximum age of patient in study of 50 years. Maximum number of patients belonged to the age group of 11-20 (50%). The mean age in this study was 23 years. Among study subjects, 32 (35.55%) cases had conductive hearing loss, 11 (12.22%) cases had sensorineural type, 40 (44.44%) had mixed type and 7 (7.77%) had no response. In this study, sensitivity, specificity, positive predictive value, negative predictive value was calculated of computed tomography findings as compared to preoperative findings. The sensitivity of HRCT for mastoid was 100%, visualization malleus was 94.11%, incus was also 62.31%, stapes was 47.22% and facial N dehiscent and intact was 44.82%. Similarly, the specificity of CT scan for mastoid was 83.33%, malleus was 92.85%, incus was 61.90%, stapes erosion was 37.03% and facial N dehiscent was 96.72%. **Conclusion:** The present study was concluded that computed tomography can accurately image the findings in unsafe chronic suppurative otitis media and represents a major advance in the diagnostic imaging of this disease.

Keywords: Chronic suppurative otitis media, Predictive value, Computed tomography
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Introduction

Chronic suppurative otitis media is typically a persistent disease, insidious in onset, capable of causing severe destructions and irreversible sequelae. It clinically manifests as deafness and chronic intermittent aural discharge [1].

The widespread prevalence of chronic suppurative otitis media in third world countries can be attributed to the socioeconomic factors such as poor living conditions, overcrowding, poor hygiene and nutrition [2]. Chronic suppurative otitis media has been classified into two main group's Tubotympanic and atticoantral disease.

Atticoantral is considered a dangerous form of the disease in lieu of the risks of intracranial complications. The typical feature of atticoantral disease is the prevalence of cholesteatoma [3]. Aural cholesteatoma, a middle ear disease entity described first by Cruveilhier in 1829 as a pearly tumor is yet in many respects ill understood. This dangerous disease process has so much to reveal even after more than a century of its discovery [4]. The standard management of chronic suppurative otitis media is surgical. The management of chronic suppurative otitis media has witnessed a profound change over the last century; from early attempts at surgical exposure of the middle ear to the present day techniques of Tympanoplasty in persistent but inactive disease and the canal up and canal down

procedure in case of cholesteatomas [5]. Morgagni (1982-1771) was the first to recognize that suppuration in the brain was secondary to ear infection and he further emphasized the potentially serious nature of ear infection. Different view regarding this subject has been put forward by various authors.

When the German physiologist Johannes Mueller covered the term cholesteatoma in 1838 he was identifying "a layered pearly tumor of fat, which was distinguished from other fat tumors by the biliary fat (cholesterin) that is interspersed among the sheets of "polyhedral cells" [6].

Although Mueller coined the term, it was the French pathologist Cruveilhier who first described the pathologic features of this disease. The aim of this study is to assess the predictive value of computed tomography in the diagnosis of unsafe chronic suppurative otitis media.

Materials and Methods

A prospective, analytical study was conducted among 90 patients with unsafe chronic suppurative otitis media which were randomly selected from outpatient Department of Otorhinolaryngology at Subharti Medical College, Dehradun, Uttarakhand.

Results

A total number of 90 cases of unsafe type of chronic suppurative otitis media were selected for present study.

The patients comprised of both males as well as females and also of different age groups. A detailed history with regard to otorrhoea, deafness, tinnitus, otalgia and vertigo was taken and recorded in a systemic manner. A complete general physical examination was carried out followed by otorhinolaryngological examination which included otoscopic examination and examination under microscope. Unsafe CSOM involves cholesteatoma. Cholesteatoma is a non-malignant but destructive lesion of the skull base [7].

Assessment of hearing was done by tuning fork tests and pure tone audiometry. Routine haematological and urine investigations were carried out in each case along with X-ray chest PA view and ECG wherever indicated. Patients with malignancy of the ear, patients unfit for surgery or anesthesia and patients who were pregnant were excluded from the study.

Written informed consent were taken from study subjects and approval for the study was obtained from Institutional Research and Ethical Committee. Associated symptomatology suggestive of impending or already established complications of unsafe chronic suppurative otitis media was enquired into and noted. All cases were investigated and subsequently operated with an aim to correlate the radiological and operative findings.

Table-1: Demographic distribution of patients

Age (yrs)	Number of patients	Percentage
0-10	4	4.44%
11-20	45	50%
21-30	30	33.33
31-40	2	2.22%
41-50	9	10%
Sex	**Number of patients**	**Percentage**
Male	61	67.77%
Female	29	32.22%
Type of hearing loss	**Number of patients**	**Percentage**
Conductive	32	35.55%
Sensorineural	11	12.22%
Mixed	40	44.44%
No response	7	7.77%

The above table illustrates that the patients belonged to age groups varying from first decade to fifth decade. The youngest patient was of 8years and the eldest of 50 years. Maximum number of patients belonged to the age group of 11-20 (50%). The mean age in this study was 23 years. There was marked male preponderance in this study.

Out of a total number of 90 patients, total of males were 61 (67.77%) and number of females were 29 (32.22%). Out of total number of 90 patients, 32 (35.55%) cases had conductive hearing loss, 11(12.22%) cases had sensorineural type, 40(44.44%) had mixed type and 7(7.77%) had no response.

Table-2: Sensitivity, Specificity, Positive predictive value and Negative predictive value of findings in computed tomography among study subjects.

Variable Name	Per op disease present	Per op disease absent	Sensitivity	Specificity	PPV	NPV
CT : disease present	80	0	91.95%	100%	100%	30%
CT: disease absent	7	3				
CT : sclerosed mastoid	72	3	100%	83.33%	96%	100%
CT: cellular mastoid	0	15				
CT : disease present	78	2	97.5%	80%	97.5%	80%
CT: disease absent	2	8				
CT : Tegmen tympani eroded	17	11	60.71%	82.25%	60.71%	82.25%
CT : Tegmen tympani intact	11	51				
CT : Sinus plate eroded	6	3	75%	96%	75%	97.53%
CT : Sinus plate intact	2	79				
CT : Facial N. dehiscent	13	2	44.82%	96.72%	86.66%	78.66%
CT : Facial N. intact	16	59				
CT : Lat SSC Fistula	12	8	85.71%	97.14%	60%	97.14%
CT : Lat SSC Intact	2	68				
CT : Malleus eroded	32	4	94.11%	92.85%	88.88%	96.29%
CT : Malleus Intact	2	52				
CT : Incus eroded	43	8	62.31%	61.90%	84.31%	33.33%
CT : Incus Intact	26	13				
CT : Stapes suprastructure eroded	17	34	47.22%	37.03%	33.33%	51.28%
CT : Stapes suprastructure Intact	19	20				
CT : Disease outside middle ear cleft present	16	0	94.11%	100%	100%	98.61%
CT : Disease outside middle ear cleft Absent	1	73				

In each above mentioned areas sensitivity, specificity, positive predictive value, negative predictive value was calculated of computed tomography findings as compared to preoperative findings. In identifying soft tissue mass in a case of unsafe chronic suppurative otitis media, computed tomography was found to be extremely effective in those without the mass, but not so much in those with the mass. On the basis of statistical analysis, there was good radio-surgical correlation between CT and operative findings. It's accuracy as a diagnostic test in this regard was thus acceptable.

In a case of unsafe chronic suppurative otitis media, computed tomography was found to be extremely effective in identifying those with sclerosis of mastoid but less effective in those with cellular mastoid. In our study, computed tomography proved to be helpful in correctly picking out the extent of the disease. Its role in spotting areas free from the disease was found to be less satisfactory. As is evident from the table above, our study demonstrated that computed tomography cannot be used as a diagnostic method for detecting erosion of the Tegmen tympani in unsafe chronic suppurative otitis media. In our study, we demonstrated that, in pinpointing patients with sinus plate erosion in unsafe chronic suppurative otitis media, computed tomography was highly effective. However, it's utility in spotting out those with a normal sinus plate was limited. In identifying facial nerve dehiscence, computed tomography was established as a poor test in our study. However it's importance in singling out those with an intact nerve was significant.

In our series of patients with unsafe chronic suppurative otitis media, the status of using computed tomography as a diagnostic investigation for lateral semicircular canal integrity of fistulization was shown to be below acceptable standards. In recognizing malleus erosion or intactness, computed tomography in our study was demonstrated to be within satisfactory norms. On behalf of the statistical analysis Kappa (K) value shows thatradiosurgical agreement was excellent for the malleus. In singling out incus erosion, computed tomography was found to be a poor investigation, as well as in patients with an intact incus. For stapes erosion demonstration, computed tomography shown to have no role at all, in view of its inability in correctly picking out those with or without erosion. Computed tomography proved to be an excellent investigation in our study in spotting patients without disease outside middle ear cleft with no false positives.

Its efficacy in identifying those with disease outside middle ear cleft was however borderline. For this purpose cases of unsafe chronic suppurative otitis media were evaluated clinically and through computerized tomography in order to get an idea about the middle ear and mastoid status. Subsequently surgery was undertaken in the above selected cases and an attempt was made to correlate computerized tomography with per operative findings.

Discussion

The present study was conducted to assess the predictive values of computed tomography in diagnosis of unsafe chronic suppurative otitis media and correlating it with preoperative findings so that attempts can be made to restore or conserve hearing and promote healing, after the excision of disease from the middle ear and mastoid.

The diagnosis of unsafe chronic suppurative otitis media has been relied in the past mainly on history, clinical examination, otoscopy, pure tone audiometry, and plain x-rays. There is no doubt that clinical examination has been, by far, the principle means of diagnosis and radiology has been the least important. At present, the type of surgery available, is very varied, elaborate, lengthy and often staged. It is of help to the surgeon and to the patient to know as much as possible what is involved, so as to turn as 'exploration' in to a planned procedure. It is in view of this, unsafe chronic suppurative otitis media should be reassessed. A total of 90 cases were selected and each of the selected cases of unsafe chronic suppurative otitis media were subjected to computed tomography of temporal bone. In every patient both axial and coronal sections were taken, taking high resolution section of 1-2 mm thickness.

These cases were undertaken for surgical exploration and finally an attempt was made to correlate the preoperative findings with preoperative computed tomography findings [8]. In this study, incus was most commonly affected ossicle followed by malleus and stapes. The sensitivity of HRCT for mastoid was 100%, visualization malleus was 94.11%, incus was also 62.31%, stapes was 47.22% and facial N dehiscent and intact was 44.82%. Similarly, the specificity of CT scan for mastoid was 83.33%, malleus was 92.85%, incus was 61.90%, stapes erosion was 37.03% and facial N dehiscent was 96.72%.

The study findings are consistent similar with the findings of Chee et al. and in context to study by Tatlipinar et al. who observed sensitivity of 62.8% and specificity of 85.7% for the same [9,10].

The findings of the study in which computed tomography had a sensitivity of 60.71% and specificity of 82.25% with regards to detection of erosion of tegmen tympani plate, which is comparable to study [11].

In past studies [12,13,14,15], computed tomography was found up to 100% sensitive in detecting a soft tissue mass preoperative. Our data showed a slightly lower sensitivity of 91.95 %. This discrepancy could be because of greater sample size in our study. However the specificity and Positive predictive value in this regard were both 100%. However, we could not distinguish cholesteatoma from other soft tissue disease, and this again was the experience of most authors. The differential diagnosis of soft tissue mass is often quite difficult with computed tomography. We have been unsuccessful most of the times in differentiating pathologic processes on the basis of computed tomography number. Acquired cholesteatoma, granulation tissue (in the absence of haemorrhage) and middle ear effusion all share computed tomography numbers ranging from 40 to 65. We therefore must rely on secondary findings to help in differential diagnosis.

Thus after clinical examination, otoscopy and diagnosis of cholesteatoma, computed tomography can determine its extent by revealing the combination of a soft tissue mass and bone erosion with 80% specificity. In studies on efficiency of computed tomography in defining the extent of disease preoperatively, O'Donoghue et al and MacAfee et al independently found computed tomography to be highly accurate [16,17].

O'Reilly et al, in his study, corroborated the above studies with a 100% sensitivity of computed tomography in defining the extent of disease. In our study, the sensitivity and Positive Predictive Value were both 97.5% which is in agreement with the aforementioned studies [18].

O' Donoghue et al, reported a sensitivity of 50% in identifying Tegmen tympani erosion but did not report his false positives [16]. O' Reilly et al showed sensitivity of 46% and specifity of 84% [18]. Macfee et al, showed a sensitivity of 50% and a positive predictive value of 100% for detecting tegmen erosion [19]. Pandey et al, reported a sensitivity of 100% but a PPV of 33.33% in this regard [20].

In our study, the sensitivity and positive predictive value were both 60.71%. These non-correlating values can be explained partly by the very small number of patients with tegmen erosion in these studies, and also on the fact stated [21]. He commented that it is not possible to demonstrate reliably a dehiscence in the tegmen on axial scan alone but even using coronal cuts they found that the effect of partial volume averaging with adjacent soft tissue could give a false impression of tegmen tympani erosion. In detecting sinus plate erosion on computed tomography our study showed sensitivity of 75%, specificity of 96%, positive Predictive Value of 75% and negative Predictive Value of 97.53%. Hence in our study, we demonstrated that, in pinpointing patients with sinus plate erosion in unsafe chronic suppurative otitis media, computed tomography was highly effective. However, it's utility in spotting out those with a normal sinus plate was limited. In previous studies, the sensitivity of computed tomography in detecting facial canal dehiscence varied widely with values of 0%, 25%, 44%, and 100% [18,22,23].

The specificity has been reported only by O'Reilly as 85%. In our study, the sensitivity was 44.82% and specificity was 96.72%, which was comparable to the O.' Reilly study [18]. These non-compliant results can be explained on the fact that the visualization on thin bony structures like facial nerve canal may be misleading due to errors in scanning eroded portions due to the fact that the computer averages their density with adjacent soft tissue and air.

Limitations: The present study have some limitations. The limited sample size of the study could have affected the interpretation of the obtained result. Clearly, more studies involving a larger sample size are warranted in future.

Conclusion

In conclusion, the present study pointed that high resolution computed tomography scanning is a modality which can accurately image the pathological anatomy in unsafe chronic suppurative otitis media and represents a major advance in the diagnostic imaging of this disease. Its use by otologists is encouraged, especially in patients who have or are suspected of having complex problems and in whom the maximum information is desirable for preoperative assessment.

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