Original Article

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Is Computed Tomographic Scanning Alters the Management of Patients with Suspected Cholesteatoma?

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Abstract

Background: Cholesteatoma is an abnormal skin growth that can develop in middle section of your ear behind the eardrum; a cholesteatoma may also be caused by a poorly functioning eustachian tube, which is the tube that leads from the back of the nose to the middle of the ear. It causes mainly chorionic ear infection, sinus infection, cold and allergies. This may cause a section of eardrum to be pulled into middle ear, creating a cyst than can turn into cholesteatoma. **Subjects and Methods:** A prospective, analytical study was conducted among 90 patients with complaint of unsafe chronic suppurative otitis media which were randomly selected from outpatient Department of ENT at Shridev Suman 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. Out of 90 study subjects, 46 (51.11%) had cholesteatoma. **Conclusion:** The clinical and radiological findings showed a high level sensitivity with intra operative findings as regards to the presence of cholesteatoma, changes of the ossicular chain and erosion of the lateral semicircular canal. HRCT findings, in the treatment of any congenital abnormality of the ear were a good guide to the surgeon for planning and management.

Keywords: Cholesteatoma, unsafe chronic suppurative otitis media, computed tomography

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Introduction

Middle ear cholesteatoma, which is more often acquired than congenital, has been recognized clinically and radiologically for many years.[1-3] Acquired cholesteatoma is the main complication of chronic otitis, resulting from ingrowth of the keratinizing squamous epithelium, from the external acoustic meatus to the middle ear through the tympanic membrane. The hallmarks of cholesteatoma are a soft tissue mass-like opacity in the middle ear cavity and mastoid antrum associated with smooth bony erosion of the ossicles and expansion of adjacent structures. The radiographic appearance of the soft tissue itself does not differ, whether it is cholesteatoma or granulation tissue, but the association of bone erosion is highly suggestive of cholesteatoma.[4] The absence of abnormal soft tissue on CT essentially excludes cholesteatoma. To minimize the interpretative errors of mild bone erosions, particularly the tegmen, the lateral semicircular canals and horizontal portion of the facial nerve canal, familiarity with the radiographic variations and comparison with the normal side are valuable.[5] High resolution computerized tomography (HRCT) is most valuable for detection of early erosive changes in the ossicles, particularly in the smaller parts such 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. Aural cholesteatoma, middle ear disease entity described first by Cruveilhier in 1829 as a pearly tumor is yet in many respects ill understood1. This dangerous disease process has so much to reveal even after more than a century of its discovery.[6]

Middle ear cleft by virtue of its proximity to vital structures such as diameter of the middle and posterior fossae, sigmoid sinus and jugular bulb, is in a highly susceptible position to dangerous complications of cholesteatoma. It can lead to wide spectrum of complications ranging from disabling facial palsy at one end to the life threatening leptomeningitis and brain abscess at the other.[7,8]

Historically mastoid surgery has been undertaken with otoscopy, audiometry and possibly plain x-rays as the only preoperative investigations. The advent of high definition computed tomography scanning in 1980s has allowed superb preoperative imaging of the anatomy and familiarity with landmarks, with evidence of disease and a screen for asymptomatic complications.[9]

Computed tomographic scanning is a modality which can

accurately image the pathological anatomy in chronic suppurative ear disease and represents a major advance in the diagnostic imaging of this disease.

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".[10]

Although Mueller coined the term, it was the French pathologist Cruveilhier who first described the pathologic features of this disease. His grossly descriptive (and, within that limit, accurate) name was "tumeur perlee", referring to the nacreous pearly appearance of the mass. Virchow adopted his term, and in its German form ("Perlgreschwulst"), wrote extensively about the disease. Subsequently many authors have labeled choelsteatoma by various names: such as "Margaritome" (Virchow, 1855), "Molluscus tumor" (Toynbee, 1850), (Bezold, 1890) and "Epidermoide" (Bostroem, 1897), Eggston and Wolff (1947) suggested the term "Epidermoid cyst". Cystic nature of cholesteatoma was emphasized by Fowler (1948) and he named it as "inclusion cyst". Young in 1950 introduced the term "cholesteatosis" and negated the neoplastic nature of cholesteatoma. To differentiate cholesteatoma from cholesterol granuloma, Friedman (1959) termed it as "Epidermoid cholesteatoma". So the etymology of cholesteatoma is a trouble one, born with a misconception that has become enshrined through tradition and inertia.[11,12]

Historically diagnosis of cholesteatoma was based on history, otoscopy, microscopic ear examination and appropriate audiometric assessment. It was in 1928 that Lille found that cholesteatoma may present radiologically as sclerosis. Prior to 1975, an examination utilized namely plain films and multidirectional polytomography. Significant advances were made during this period of time and with the introduction of computed tomography as yet another diagnostic tool in 1971, a major step was taken in temporal bone imaging.[13]

The aim of this study is to find out whether computed tomographic scanning alters the management of patients with suspected cholesteatoma.

Subjects 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. 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. 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 was 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.

Results

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

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: Classification of Surgical findings according to study subjects

Surgery done	No. of cases	Percentage
Modified Radical mastoidectomy	13	13.33%
Modified Radical Mastoidectomy with Tympanoplasty	38	42.22%
Intact Canal Wall Mastoidectomy	4	4.44%
Intact Canal Wall Mastoidectomy with Tympanoplasty	14	15.55%
Cortical Mastoidectomy	2	2.22%
Abscess drainage followed by Modified Radical mastoidectomy	10	11.11%
Abscess drainage followed by Cortical Mastoidectomy	5	5.55%
Atticotomy with type 1 Tympanoplasty	4	4.44%

All the patients included in present study had undergone mastoid exploration. 13 cases (14.44%) underwent Modified Radical Mastoidectomy while in 38 patients (42.22%) Modified Radical Mastoidectomy with Tympanoplasty was performed. 4 patients (4.44) was subjected to Intact Canal Wall Mastoidectomy and in 14 patients (15.55%) Intact Canal Wall Mastoidectomy with Tympanoplasty was done. 2 patients (2.22%) underwent Cortical Mastoidectomy while in 10 patient (11.11%) Atticotomy with type 1 Tympanoplasty was done as no significant disease was found in computed tomography as well as per operatively. In patients who had complications in form of brain abscess as diagnosed on computed tomography, 10 patients (11.11%) had undergone Abscess drainage followed by Modified Radical Mastoidectomy and in 4 patients (4.44%) Abscess drainage followed by Cortical Mastoidectomy was done.

Table 3: Classification of Operative findings according to study subjects.

Operative findings	Number of patients	Percentage
Cholesteatoma	46	51.11%
Granulation	26	28.88%
Cholesteatoma & Granulation	16	17.77%
No disease seen	2	2.22%

The above table illustrates that on mastoid exploration out of 90 patients, in 46 patients (51.11%) cholesteatoma was found. 26 cases (28.88%) had granulation on exploration without an evidence of cholesteatoma. In 16 cases (17.77%) cholesteatoma along with granulations were seen. In 2 cases (2.22%) no disease was seen.

Discussion

Cholesteatoma can be accurately diagnosed by the HRCT scan in the vast majority of cases. Mafee et al reported in his series of 48 patients with cholesteatoma that 46 of them (96%) were diagnosed correctly with the pre-operative CT scan. All our cases exhibited at least 1 of the radiological features that we associate with cholesteatoma, i.e. tissue mass, typical location and bone erosion, and 30 cases (83.3%) had all the 3 features. When we base our diagnosis of cholesteatoma on the scan having at least 2 of the 3 features, 34 cases (94.4%) would be correctly diagnosed with cholesteatoma.[14] However further study comparing the scan findings of cholesteatoma to other middle ear pathologies would be needed to determine the specificity of these radiological criteria. Also, one should be careful of the limitation of CT to pick out early or limited diseases, since it is difficult to diagnose cholesteatoma on the scan if the soft tissue mass is not associated with bone erosion. While a definitive diagnosis of cholesteatoma can only be made at the time of surgery, the scan picture may at times influence the decision and timing of surgical exploration. Scan evidence of cholesteatoma with significant bony destruction or other complications could prompt the surgeon to operate earlier, particularly if polyps or a tortuous bony canal obscures visualization of the tympanic membrane and hinders clinical diagnosis. On the other hand, the threshold to explore the ear may be higher when the scan is non-confirmatory,

particularly if the patient has medical risks for surgery. The HRCT scan gives a good to excellent radiosurgical correlation for the middle ear ossicles in our cases, and this is also the experience that others have reported.[15] While prior knowledge of the state of the ossicles is probably not critical insofar as the operative risk is concerned, it has bearing on the likelihood of hearing preservation that can be achieved after surgery. For example, the hearing outcomes in patients with an intact stapes tend to be better than those where the stapes suprastructure is absent. Pre-surgical knowledge of the status of the ossicular chain would allow the surgeon to better advise the patient on the degree of hearing attainable after surgery.

The principal value of computed tomography is its inherent ability to delineate disease which is not clinically apparent. Potentially the most wide based use of temporal bone computed tomography is in the evaluation of patients chronic suppurative otitis media. High resolution computerized tomography represents significant advances in computerized tomography and has the ability to depict the status of the structures of the temporal pathology, prior to surgical exploration of middle ear with cholesteatoma.[12]

T Fuse, Y Tada, M Aoyagi et al studied the CT detection of facial canal dehiscence and semicircular canal fistula with surgical correlation in 1996. The purpose of this study was to determine the accuracy of high resolution CT in the detection of facial canal dehiscence and semicircular canal fistula, the pre-operative evaluation of both of which is clinically very important for ear surgery in 46 (75%) of the 61 patients. The data for the facial canal revealed sensitivity of 66% and specificity of 84%. For semicircular canal fistula, in 59 (97%) of the 61 patients, the HRCT image based assessment and the surgical findings coincided. In our study HRCT has a sensitivity of 55% and 100% specificity of 100% and 100% in the assessment of facial canal and semicircular canals respectively.[16]

It has been suggested that computed tomography should be employed to evaluate all suspected cases of cholesteatoma or few selected cases such as closed mastoid cavities and congenital cholesteatoma. High resolution computerized tomography is proposed as a mode of diagnosing cholesteatoma, demonstrating ossicular chain, detecting labyrinthine fistulae and bony defects in facial canal.[17] In most instances cholesteatoma is visible otoscopically but computed tomography could be valuable in diagnosing cholesteatoma behind an intact tympanic membrane (as in congenital cholesteatoma or after combined approach tympanoplasty in residual disease in the sinus tympani and facial recess).

Knowledge of the mastoid pneumatization aid in the planning of surgical approach e.g. whether to do canal wall down or up type of surgery. In majority of the adult cholesteatoma patients mastoid air cells are very few in number and sclerotic. Also at the same time trabeculations are lost in these patients. Present study findings well correlates with this statement. Tegmen tympani or sinus plate erosions warrants the radiologist to find intracranial

complications if any. Venous sinus thrombosis and cerebral/ cerebellar abscess of otologic etiology are always associated with erosion of these structures. In our study all the cases of cerebral and cerebellar abscess had erosion of tegmen tympani and sinus plate respectively.[13,18]

Pre-operative demonstration of facial nerve canal involvement is often difficult because of its small size, oblique orientation in tympanic part and developmental dehiscence, particularly when abutted by soft tissue. Facial nerve canal dehiscence is a fairly common finding in 55 % of temporal bones, and usually occurring in a focal area in the tympanic portion of the facial nerve canal. So the facial nerve canal should be evaluated in both axial and coronal scans. The most common site of the facial nerve compression is the tympanic segment where it lies exactly below the lateral semicircular canal.[4,10] When a complete bony canal is present, erosion of the canal wall is easily detected on imaging. However the bony canal in this segment may be congenitally thin when its erosion may become difficult to detect. Still gross invasion of the facial nerve canal in these region is quiet demonstrable.[19] This explains the low radiological sensitivity in detection facial nerve canal erosion as in present study.

Lateral semicircular canal is the most commonly affected canal by cholesteatoma as in this study. In all the patients with middle ear disease, this area should be carefully evaluated on both axial and coronal images for cortical thinning.[20] The diagnosis of the fistula is made when the mass is seen in direct apposition to the lumen of labyrinth21. HRCT clearly depicts bone erosion even in the absence of fistula which helps surgeon intra-operatively in careful resection of cholesteatoma to prevent labyrinthine fistula.

Limitation

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. 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. Evaluation of postoperative mastoid is yet difficult as the altered anatomy pose difficulty in diagnosing recurrent cholesteatoma from granulation tissue. Enhancing tumors like paraganglioma may be missed in the plain films.

Conclusion

The advent of HRCT scans of the temporal bone has significantly enhanced the pre-operative evaluation of cholesteatoma. This study has shown that CT imaging for cholesteatoma accurately depicts the status of the middle ear structures, with the exception of the facial canal.

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