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Impact Of Diffusion Weighted Imaging (Dwi) ,Asequence Of Magnetic Resonance Imaging (Mri) On Management Decision In Patients With Suspected Recurrent Atticoantral Disease Following Surgery For Cholesteatoma

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Abstract:

Aim:

- To assess the diagnostic accuracy of Diffusion weighted imaging sequence of MRI for the detection of residual or recurrent atticoantral disease.
- Explore the potential of DWI MRI in reducing unnecessary surgical interventions and optimising patient outcomes.

Materials and Methods: The patient population in this single centre, cross sectional study was a group of 33 participants with suspected recurrence of atticoantral disease from a period of 2 years, from June 2020 to June 2022.

Result: The sensitivity, specificity, and predictive values of MRI in diagnosing recurrence of atticoantral disease is 100%.

Conclusion: MRI, specifically diffusion-weighted MRI, is a reliable alternative to CT scanning and can prevent unnecessary second look surgeries in patients with doubtful recurrence ofatticoantral disease and cholesteatoma.

Keywords: diffusion weighted images, atticoantral, MRI, cholesteatoma, recurrence

INTRODUCTION

Chronic middle ear infection is a common problem in India and other developing countries. Chronic Suppurative Otitis Media is a major problem that requires a significant amount of clinical assessment and surgical time. [(1)]Unless life-threatening complications arise, most people tend to ignore their discharging ears. Tympanosclerosis, ossicular erosion, cholesteatoma, granulation, polyp, effusion, and many other pathological changes in the tympanic membrane and middle ear can be caused by it. When ossicular chain erosion and discontinuity are present, it can cause significant conductive hearing loss. Patients with Attico-Antral disease are particularly vulnerable

to ossicles being destroyed and life-threatening complications. [2,3]

Cholesteatoma is a cystic bag-like structure lined by stratified, squamous epithelium containing desquamated epithelial debris, which is found in the middle ear and is associated with bone eroding disease or atticoantral disease. Perforation of the pars flaccida may occur because ofatticoantral disease, which is marked by a blood-stained, purulent, scanty, foul-smelling discharge. [4]

There are many fascinating and challenging issues to deal with when it comes to

assessing and managing cholesteatoma. The fundamental principle of management is its surgical removal to prevent further extension of disease. Selection of surgical procedure is consequently dependent on the location and extent of disease [5]. Small cholesteatomas can be treated with atticotomy and tympanoplasty [5,6]. For extensive disease, a tympanomastoidectomy will be the treatment of choice for complete disease removal. Surgeons will elect to perform a combine approach or "canal wall-up" (CWU) tympanomastoidectomy in which the posterior wall of the external auditory canal is preserved. In cases of extensive erosive disease for better exposure for removal, a "canal wall-down" (CWD) mastoidectomy is necessary. This will create a mastoid cavity potentially requiring lifelong maintenance by an otolaryngologist. Given higher rates of recurrence, disease surveillance after CWU tympanopastoidectomy is accomplished through a surgical re-exploration and direct visualisation of the disease site[7,8,9]. This is often known as a "second look tympanotomy" procedure.

When it comes to detecting recurrent or residual disease, magnetic resonance imaging

(MRI) has several advantages over computed tomography (CT). Contrast-enhanced magnetic resonance imaging (MRI) can distinguish between cholesteatomas that do not enhance and other contrast-enhancing findings, such as inflammation, scarring, or granulation tissue. [10,11] DWI is more practical because it requires less examination time than delayed contrast material-enhanced imaging, and it does not require the use of contrast material. Brownian motion of water molecules is used in this technique, which is based on scientific principles. [12] Additionally, DWI MRI is extremely useful for the assessment of possible complications such as erosion of the semicircular canal or invasion of the membranous labyrinth or the middle cranial fossa, as well as for the assessment of abscess formations after a cranial surgery. [13] The DWI sequence is a valuable tool in preventing unnecessary second look surgeries in patients with atticoantral disease and cholesteatoma, and it is a reliable alternative to CT scanning in this situation.

The current study was conducted to assess the diagnostic accuracy of DWI sequence of magnetic resonance imaging in clinically suspected cases of recurrence of atticoantral disease and its role in avoiding second look surgeries.

OBJECTIVE

- To assess the diagnostic accuracy of Diffusion weighted imaging sequence of MRI for the detection of residual or recurrent atticoantral disease.
- Explore the potential of DWI MRI in reducing unnecessary surgical interventions and optimising patient outcomes.

METHODOLOGY

The study was conducted at a tertiary care hospital, focusing on the role of DWI sequence of magnetic resonance imaging in clinically suspected recurrence of atticoantral disease. The study was a single centric, observational, cross-sectional study conducted over a period of two years. The study population of 33 patients consisted of clinically suspected patients of recurrence of atticoantral disease referred to the hospital, and the sampling technique used was purposive sampling.

Ethical considerations were considered, with approval obtained from the institutional ethics committee and the department of Otorhinolaryngology, and written informed consent was obtained from the stable patients prior to their enrolment in the study. The inclusion criteria encompassed specific patient characteristics related to perforation at attic or posterosuperior, retraction pocket, post mastoid cavity exploration, purulent, scanty, foul-smelling, blood-stained discharge, and medically fit, while the exclusion criteria included factors such as unwillingness to consent for further investigations, perforation in pars tensa, profuse, mucoid, odourless discharge, and contraindications for MRI.

Statistical analysis

- Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median.
- Normality of data was tested by Kolmogorov-Smirnov test. If the normality is rejected then non-parametric tests were used.
- Descriptive statistics were analysed and presented in terms of mean with standard deviation.
- Qualitative variables were compared using Chi-Square test /Fisher's exact test.
- A p value of <0.05 was considered statistically significant.
- The data was entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

All the patients underwent a DWI sequence magnetic resonance imaging, prior to the established protocol of exploratory surgery to look for findings suggesting recurrence. The findings noted was tabulated and compared.

RESULT

The present study was an observational study conducted in the department of Ear, Nose, and Throat (ENT) after approval from the institutional ethics committee and the department of ENT. In this study, 33 patients with suspected diagnosis of atticoantral disease was evaluated.

The results of our study are as follows

a) Age wise distribution of patients

- The average age of patients enrolled in our study was 36 ± 14.40 years
- Majority of patients (39.39 %) were in the ages group of 21 and 35 followed by those between the age of 36-50 years

b) Gender wise distribution

- Male predominance was observed in our study population (66.66%)
- Male to female ratio of 2: 1.

c) Site of cholesteatoma

- Laterality of involvement showed right side was involved more as compared to left

d) Clinical manifestation

Clinical feature	**No of patients**	**Percentage**
Ear discharge	29	87.87
Ear ache	5	15.15
Hearing loss	29	87.87
Facial weakness	1	3.03
Giddiness/Vomiting	2	6.06

Table 4: Clinical manifestation

- Hearing loss and ear discharge were the two most common symptoms reported
- Other common complaints were ear pain, nausea and vomiting, and facial weakness.

e) MRI finding of cholesteatoma

MRI finding	**No of patients**	**Percentage**
Present	27	81.81
Absent	6	18.18
Total	**33**	**100**

Table 5: MRI finding of cholesteatoma

- MRI findings of cholesteatoma was present in 81.81% cases,
- In 18.18% patients, MRI characteristics were absent.

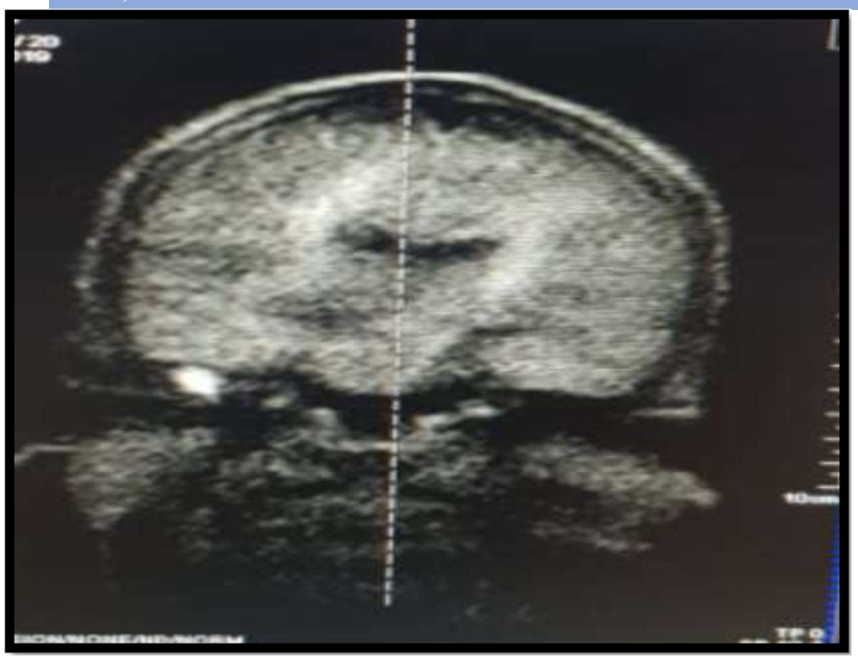

FIG:CHOLESTEATOMA NOTEDIN THE RIGHT EAR IN DWI MRI

f) Surgical findings of cholesteatoma

Surgical finding	No of patients	Percentage
Present	27	81.81
Absent	6	18.18
Total	**33**	**100**

Table 6: Surgical findings of cholesteatoma

- Surgical findings of cholesteatoma was present in 81.81% cases,
- In 18.18% patients, Surgical findings were absent.

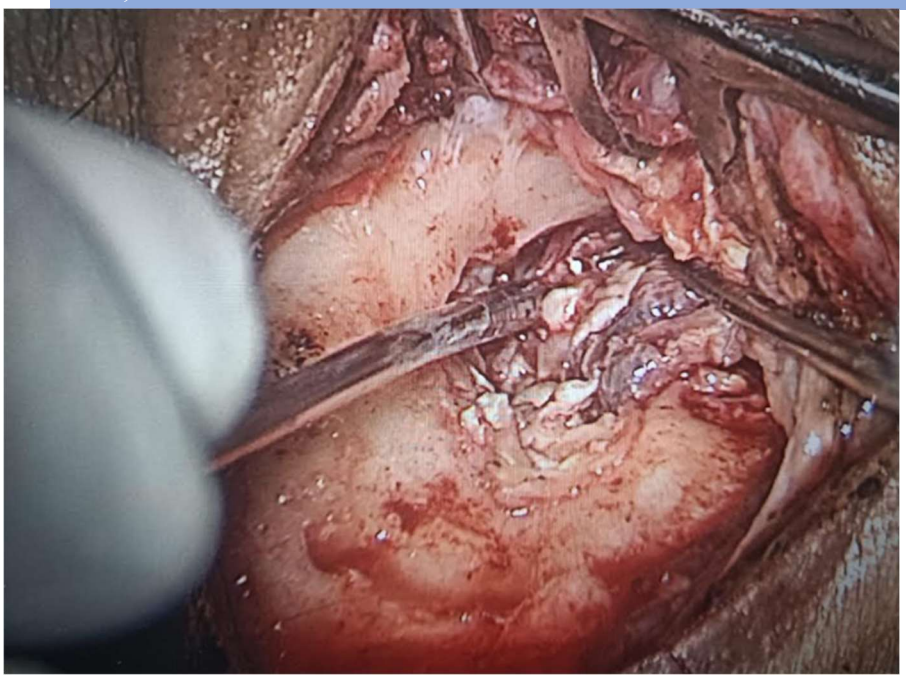

FIG: ON TABLE EVIDENCE OF CHOLESTEATOMA NOTED

g) Sensitivity and Specificity of cholesteatoma

Variable	Value (%)	95% Confidence Interval
Sensitivity	100	87.24 to 100
Specificity	100	54.09 to 100
Positive Predictive Value	100	87.24 to 100
Negative Predictive Value	100	54.09 to 100

Table 7: Sensitivity and Specificity of cholesteatoma

- Sensitivity, Specificity of MRI in the diagnosis of attico antral disease was 100%
- Positive Predictive Value was 100%
- Negative Predictive Value was 100%

DISCUSSION

Cholesteatoma can recur after a seemingly complete surgical resection and may be complicated by necrosis of facial nerve, inner ear, and intracranial components. The ossicles are also eroded, resulting in hearing loss. As a result, early detection of the disease is critical to its proper management. [14] The frequency of recurrence ranges from 5 to 15% but can be as high as 61%, particularly following canal wall up techniques. [15]CT is the standard modality because it can detect bone changes. It has ahigh sensitivity but a low specificity in mass lesions because it cannot distinguishgranulation tissue, cholesterol granulomas, or other soft tissue growths fromcholesteatomas. Diffusion-weighted Magnetic Resonance Imaging (DW-MRI) is avaluable tool in the study of cholesteatoma because it does not require contrastinjection. By virtue of its keratin content, cholesteatoma returns high signal intensity compared to brain tissue on the diffusion weighted images. Non-cholesteatomatous soft tissue such as granulation tissue, inflammation, and fluid return lower or no signal.

Our present study was an observational study conducted in the department of Ear, Nose, and Throat (ENT) after approval from the institutional ethics committee and the department of ENT. In this study, 33 patients with suspected recurrence of atticoantral disease wasevaluated. The average age of patients enrolled in our study was 36 ± 14.40 years, with most patients (39.39 %) being between the ages of 21 and 35, and nearly 80%being below the age of 50 years. Male predominance was observed in our study population, with a male to female ratio of 2: 1. In a study on chronic suppurative otitis media, atticoantral type, Jothiramalingam[16] found that the majority of patients (40%) were in the age group 16–25 years, followed by 16% in the age groups 5–15 years and 26–35 years, with a nearly equal distribution of male and female patients. In contrast, the average age in Abbass Ayyaril's[17] study was 33 ± 16.8 years, but female predominance was observed (Male: Female: 14:16).

The two most common symptoms reported among the study population were hearing loss and ear discharge. A few patients also complained of ear pain, nausea and vomiting, and facial weakness. According to Jothiramalingam[16], 44 % in his study presented with complaints of ear discharge alone. Thirty-two percent of patients complained of both ear discharge and hard of hearing, twenty percent of patients complained of both ear discharge and ear pain, and one patient complained of both ear discharge and giddiness (4 %). Three patients (12%) presented with chronic suppurative otitis media complications, one with labyrinthitis and two with mastoid abscess. Wadhwa et al [18], on the other hand, reported hearing impairment and ear discharge in more than 80% of his patients in his study.

Among the suspected cases of recurrence, DWI MRI findings of cholesteatoma was present in 81.81% cases, where in 18.18% patients, MRI characteristics were absent. Surgical findings of cholesteatoma were reported in all 81.81% cases suspected on MRI. Thus, the sensitivity, specificity, Positive Predictive Value and Negative Predictive Value was 100% with MRI in the diagnosis of atticoantral disease. Due to the tendency of cholesteatomatous lesions to produce diffusion restriction, diffusion-weighted MRI is extremely useful in accurately diagnosing

cholesteatoma.
In a study conducted by Abbass Ayyaril's[17], MR-DWI was found to be accurate in diagnosing cholesteatoma in more than 90 % with a high sensitivity (100 %) and specificity (100 %) in more than 90 % cases. There were two cases of mastoid abscess with diffusion restriction that were misdiagnosed as such. The DWI's sensitivity and specificity in our study were comparable to those reported by Vercruysse and his colleagues (81 percent and 100 percent respectively). [11]Specifically, Mateos-Fernández M [18] in his study highlighted that diffusion-weighted magnetic resonance imaging technique is extremely helpful in the differential diagnosis of cholesteatoma, particularly after canal wall-up tympanoplasty surgery, and that this technique should be used to avoid routine second-look surgery in these patients with cholesteatoma It had 92.85 % sensitivity, 92.30 % specificity, and positive and negative predictive values of 92.85 % and 92.30 % negative predictive values.In the study by Stasolla, Alessandro, and colleagues, [19] postoperative casessuspected of having relapsing/residual cholesteatoma are subjected to DWI. EPI-DWI revealed diffusion restriction in 5 of 6 cholesteatoma patients. Diffusion restriction does not exist in noncholesteatomatous lesions. In diagnosing relapsing/residual cholesteatomas, the study has a sensitivity of 86%, a specificity of 100%, a positive predictive value of 100%, and a negative predictive value of 92%.
Thus, the result of our study and similar other study clearly highlights MRI is very useful in the diagnosis of suspected cases of atticoantral disease with high sensitivity and specificity. Our study had a few limitations, including the fact that it was a single-centric study conducted on a small number of patients, which may not represent observations seen on a larger scale in society. As a result, a large-scale, multicentric study will provide ideal data for research.

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