

# Role of HRCT Temporal Bone in Cholesteatoma Patients Undergoing Surgery

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## ABSTRACT

**Introduction:** Cholesteatoma is an expanding middle ear ailment which is relatively common and is known to have serious consequences. It is caused by keratinization of squamous epithelium into a sac like structure in the middle ear cleft. It is a noncancerous cystic lesion occurring due to an abnormal growth of keratinizing squamous epithelium in the temporal bone. It is often referred to as “skin in the wrong place. Aim and Objectives: To compare the accuracy of computed tomography findings on patients undergoing surgery for Cholesteatoma with the surgical findings and to establish the importance of HRCT Temporal Bone in a patient with cholesteatoma.

**Material and methods:** Cross-sectional Study was done on a Patients with complaints of ear pain, discharge and hearing loss attending the OPD of ENT department, Aarupadai Veedu Medical College and Hospital, Pondicherry for a period of 2 years from November 2019 to October, 2021 (2 years) for 40 patients in Department of Radiology, AVMC&H. CT scan study was done for suspected cholesteatoma patients and correlated with intra-operative findings.

**Results:** Majority of patients were aged between 21 and 40 years (57.5%) with male preponderance. Ear discharge (57.5%) was the most common presenting complaint. On HRCT, mastoid sclerosis was the most common finding seen in all the 40 (100%) cases followed by Aditus ad antrum widening (87.5%). There was a strong agreement ( $p < 0.001$ ) between intraoperative and HRCT findings in mastoid sclerosis, aditus ad antrum widening, scutum erosions, ossicular erosions, facial canal erosions and tegmen erosions. There was an absolute agreement ( $k = 1$ ) between intraoperative and HRCT findings in lateral semi-circular canal fistula and lateral ossicular displacement.

**Conclusion:** The findings of the study showed a high level of accuracy of HRCT when compared with intraoperative findings. These findings thus suggest that HRCT is a useful preoperative assessment method in cases of cholesteatoma. Thus, HRCT could be successfully employed for a better visualization and surgical planning in cholesteatoma cases.

**Keywords:** Cholesteatoma, Scutum Erosions

## INTRODUCTION:

Cholesteatoma is an expanding middle ear ailment which is relatively common and is known to have serious consequences<sup>1</sup>. It is caused by keratinization of squamous epithelium into a sac like structure in the middle ear cleft<sup>2</sup>. It is often referred to as “skin in the wrong place<sup>3,4</sup>. It remains a cause of high pediatric morbidity and death in low-resource settings with low availability of advanced healthcare facilities<sup>5</sup>.

Chronic Suppurative otitis media (CSOM) is one of the most common risk factors for development of cholesteatoma. In India, its prevalence has been reported to be as high as 64% in cases of CSOM<sup>6</sup>. It may be congenital or acquired. Congenital cholesteatoma of temporal bone is due to epithelial rests of embryonic origin. It is specific to the childhood. An acquired middle ear cholesteatoma, which is the most common type of cholesteatoma, can affect both children and adults<sup>7</sup>.

Generally, diagnosis of cholesteatoma is made through the

Otoscopic examination<sup>8</sup>. HRCT is a confirmatory diagnosis for cholesteatoma of temporal bone and complements the clinical examination. Cholesteatoma causes ossicular erosion leading to hearing loss<sup>9</sup>. In the presence of cholesteatoma, operative intervention is the most common management strategy in all the patients except the elderly<sup>10</sup>, hence the imaging results can be validated immediately. The study is to compare the accuracy of computed tomography findings on patients undergoing surgery for Cholesteatoma with the surgical findings and to establish the importance of HRCT Temporal Bone in a patient with cholesteatoma.

## MATERIAL AND METHODS

Cross-sectional Study was done on a Patients with complaints of ear pain, discharge and hearing loss attending the OPD of ENT department, Aarupadai Veedu Medical College and Hospital, Pondicherry for a period of 2 years from November 2019 to October, 2021 (2 years) for 40 patients in Department of Radiology, AVMC&H. The type of sampling technique used is consecutive sampling and CT MACHINE

used is GE BRIVO 385 of 16 slices, with inclusion criteria of patients who were diagnosed as cholesteatoma on otoscopic examination were indicated for HRCT temporal bone. Patients associated with Acute Suppurative otitis media, history of trauma, unfit/ not willing for surgery and who are suspected of malignancy / granulomatous disease are excluded from the study.

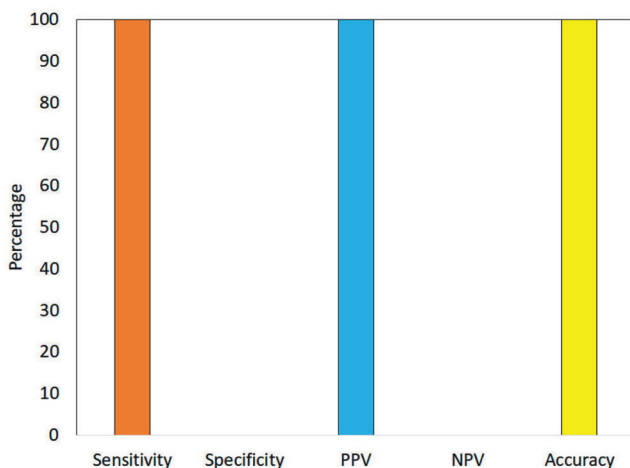
## STATISTICAL ANALYSIS

“Data was analyzed using Statistical Package for Social Sciences, version 21.0. Level of agreement between HRCT and surgical findings was analyzed using kappa-statistic. The diagnostic efficacy of HRCT for different parameters was evaluated in terms of sensitivity, specificity, positive predictive value, negative predictive value and accuracy. The confidence level of the study was kept at 95% and hence a ‘p’ value less than 0.05 indicated a statistically significant association”.

## RESULTS

Age wise distribution of the patients are depicted in table 1. Majority of patients were aged between 21 and 40 years (57.5%). Majority of patients (60%) were males. There were 16 (40%) females. Sex-ratio of study population was 1.5. On HRCT, mastoid sclerosis was the most common finding seen in all the 40 (100%) cases followed by Aditus ad antrum widening (87.5%), scutum erosion (77.5%), incus ossicular destruction (70%), stapes ossicular destruction (67.5%), malleus ossicular destruction (42.5%) and medial ossicular displacement (27.5%) . None of the patients had fistula of posterior semi-circular canal and fistula of superior semi-circular canal.

Intra-operatively, all the cases showed mastoid sclerosis (100%). Aditus ad antrum widening was the next most common abnormal finding (85%) followed by scutum erosion (80%), incus ossicular destruction (75%), stapes ossicular destruction (62.5%), facial canal erosion (25%), fistula in lateral semicircular canal (17.5%), lateral ossicular displacement (12.5%), tegmen tympani erosion (7.5%) and superior semicircular canal fistula (5%) respectively. No abnormality in posterior semicircular canal was seen (table 4).



**Figure-1:** Diagnostic efficacy of HRCT against intraoperative finding of mastoid sclerosis

Within the study population, HRCT was 100% accurate in diagnosing mastoid sclerosis. The sensitivity and positive predictive value of HRCT for this diagnosis was thus 100% as depicted in fig. 1.

There was a strong agreement ( $\kappa=0.684$ ;  $p<0.001$ ) between intraoperative and HRCT findings of aditus antrum widening. Correspondingly, the sensitivity, specificity, positive predictive, negative predictive and accuracy values were 97.1%, 66.7%, 94.3%, 80% and 92.5%. as shown in fig. 2.

There was a strong agreement ( $\kappa=0.776$ ;  $p<0.001$ ) between

SN	Age Group	No. of patients	Percentage
1.	≤10 Years	2	5.0
2.	11-20 Years	6	15.0
3.	21-30 Years	12	30.0
4.	31-40 Years	11	27.5
5.	41-50 Years	6	15.0
6.	51-60 Years	3	7.5
Mean Age±SD (Range) in years		30.83±12.30 (6-55)	

**Table-1:** Age wise Distribution of Patients enrolled in the study

SN	Gender	No. of patients	Percentage
1.	Male	24	60.0
2.	Female	16	40.0
Male: Female = 1.5			

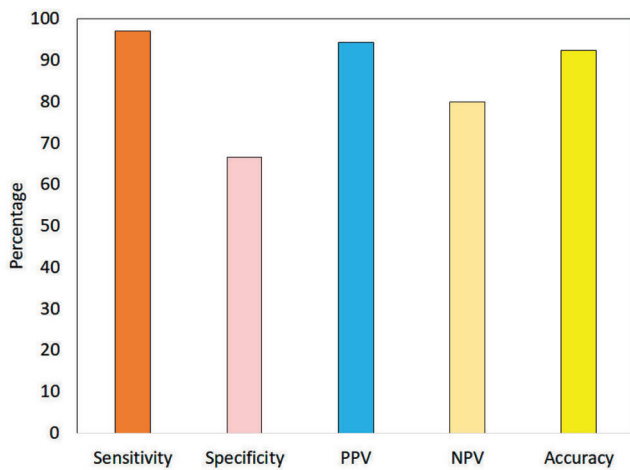
**Table-2:** Gender wise distribution

CT Diagnosis	No of cases	% of cases
“Ossicular erosion”	39	97.5
“Mastoid sclerosis”	40	100.00
“Aditus ad antrum widening”	35	87.5
“Scutum erosion”	31	77.5
“Facial canal involvement”	9	22.5
“Semicircular canal fistula”	7	17.5
“Tegmen erosion”	2	5

**Table-3:** Diagnosis on the basis of HRCT Findings

SN	Intraoperative Findings	No. of patients	Percentage
1	Scutum erosion	32	80.0
2	Aditus ad antrum widening	34	85.0
3	Medial Ossicular displacement	11	27.5
4	Lateral Ossicular displacement	5	12.5
5	Malleus Ossicular destruction	17	42.5
6	Incus Ossicular destruction	30	75.0
7	Stapes Ossicular destruction	25	62.5
8	Fistula Lateral semicircular canal	7	17.5
9	Fistula Posterior semicircular canal	0	0.0
10	Fistula Superior semicircular canal	2	5.0
11	Facial canal erosion	10	25.0
12	Tegmen tympani erosion	3	7.5
13	Mastoid sclerosis	40	100

**Table-4:** Intra-operative Findings



**Figure-2:** Diagnostic efficacy of HRCT against intraoperative finding of Aditus ad antrum widening

intraoperative and HRCT findings in scutum erosion. Correspondingly, the sensitivity, specificity, positive predictive, negative predictive and accuracy values were 93.8%, 87.5%, 96.8%, 77.8% and 97.5%.

All the 7 cases in whom lateral semicircular canal fistula was diagnosed during surgery were correctly diagnosed to have lateral semicircular canal fistula on HRCT, thus showing a 100% accuracy and absolute agreement ( $\kappa=1$ ).

Correspondingly, the sensitivity, specificity, positive predictive, negative predictive and accuracy values were 66.7%, 100%, 100%, 97.4% and 97.5% respectively. There was substantial agreement between HRCT and intraoperative findings in tegmen tympani erosion ( $\kappa=0.787$ ;  $p<0.001$ ).

## DISCUSSION

Cholesteatoma is “a cystic lesion composed of epithelium and stroma surrounded by inflammatory reaction. Cholesteatoma of the temporal bone usually occurs in the middle ear and can cause serious intrapetrous complications<sup>11</sup>. It is caused by keratinization of squamous epithelial that traverses from external ear to middle ear<sup>12</sup>. Bone erosion is one of the most characteristic feature of this chronic otitis media<sup>13</sup>. In the recent years HRCT has emerged as a powerful modality for pre-operative assessment of extent of underlying pathology and structured involved. Hence, the present study was planned to evaluate the efficacy of preoperative temporal HRCT in evaluation of cholesteatoma and to verify these findings surgically to assess the accuracy of HRCT evaluation.

A total of 40 cases scheduled to undergo surgical intervention for cholesteatoma were enrolled in the study. The age of patients was quite diversified ranging from 9 to 55 years with a mean age of 30.83 years. Half the patients were aged  $\leq 30$  years. These findings are in agreement with the observations in different series from India that have reported majority of patients of cholesteatoma requiring surgical intervention to be of young age. A number of them have reported the maximum prevalence in  $<20$  years of age<sup>6,14</sup>.

The findings in the present study are in agreement with the observations of Datta *et al*<sup>15</sup>. In present study, 60% of patients were males. Thus male to female ratio (M:F=1.5) was skewed. Epidemiological studies, also report sex ratio to be skewed

towards male dominance<sup>16,17</sup> (M:F=1.4).

In present study, on HRCT evaluation the most common finding mastoid sclerosis (100%), aditus ad antrum widening (87.5%), scutum erosion (77.5%), incus ossicular destruction (70%) and stapes ossicular destruction (67.5%) were the major findings affecting majority of patients.

The profile of most common HRCT finding varies substantially in different studies. Gomaa *et al.* (2013)<sup>18</sup> reported eroded scutum (64.28%), eroded Koerner’s septum (64.28%), tegmen erosion (35.71%), and complete ossicular chain erosion (57.14%) as the major HRCT findings.

On the other hand, Ali *et al.* (2014)<sup>19</sup> reported ossicular erosion (81%), tegmen tympani erosion (28%), scutum erosion (61%), labyrinthine fistula (8%), and Eustachian canal erosion (27%) as the major findings in their study. One of the reason for differences in type of reported abnormalities is owing to difference in method of reporting.

In the present study, tegmen erosion (5%), semicircular canal fistula (17.5%) and facial canal erosion (22,5%) and were some of the less common findings. Sreedhar *et al.*<sup>20</sup> in their study also found tegmen erosion (12%), facial canal erosion (16%) and lateral semicircular canal erosion (16%) as some of the less common findings. However, Seema in their study found tegmen erosion in 36% of their cases.

With respect to major bony abnormalities, they found scutum erosion to be most common (72.5%) which is similar to 77.5% in the present study. Prakash and Tarannum<sup>21</sup> in a recent study from India reported scutum erosion in 90% of the cases However, Sreedhar *et al.*<sup>20</sup> who observed scutum erosion in only 28% of their cases on HRCT.

The HRCT findings of the present study are quite close to that observed by Prakash and Tarannum<sup>21</sup> who reported scutum erosion (90%), incus erosion (76.7%) and malleus erosion (60%) as the major HRCT findings which also exist as the major HRCT findings in the present study. Similar to our study they also found tegmen erosion (20%), facial canal dehiscence (13.3%) semicircular canal erosion (10%) as the relatively less common findings.

In present study, as far as extent and location of disease expansion was concerned, we could obtain a high accuracy for the most common finding in our study, *i.e.* mastoid sclerosis which was seen in all the cases on HRCT and was also confirmed in all the cases intraoperatively. The accuracy of detection for other major diagnoses such as aditus ad antrum widening, scutum erosion and stapes ossicular destruction was also high ranging from 92.5% to 97.5%. Among relatively less common findings for medial ossicular destruction, lateral semicircular canal erosion and lateral ossicular displacement the accuracy was 100%. Among other less common findings like malleolus ossicular destruction (95%), facial canal erosion (87.5%) and Tegmen tympani erosion the accuracy was 95%, 87.5% and 97.5% respectively. In the present study, only semicircular canal fistula was the finding that was missed by HRCT in two cases and was confirmed intraoperatively. Thus, overall the accuracy of HRCT was 90% or more (except facial canal erosion and semicircular canal fistula).

The findings of present study, despite certain limitations do not relegate the relevance of HRCT in evaluation of



cholesteatoma patients scheduled to undergo surgery, as it provided some useful information regarding extent and location of disease which was substantiated in 100% of cases. This is an important finding. Moreover for major surgical findings, the sensitivity and specificity rates of HRCT were encouraging. The study also underscored the need for larger studies, experience and training to obtain a better consensus between HRCT and surgical findings while at the same time stresses upon the usefulness of HRCT as a pre-surgical evaluation measure for cholesteatoma patients.

## CONCLUSION

The findings of the study showed a high level of accuracy of HRCT when compared with intraoperative findings. These findings thus suggest that HRCT is a useful preoperative assessment method in cases of cholesteatoma. Thus, HRCT could be successfully employed for a better visualization and surgical planning in cholesteatoma cases.

### Limitations

This study is conducted at a single centric hospital based study, with small sample size. The study has the potential to be conducted among larger population and at multiple setting of hospitals to assess the utility of the method and benefit to the patients. Another major setback of sample size was due to COVID-19.

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