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Original research article

A study on correlation of preoperative HRCT finding with intraoperative findings in evaluation of cholesteatoma

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Abstract
The HRCT scan gives a good to excellent surgical correlation for the middle ear ossicles. 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. All patients with clinical picture of cholesteatoma such as chronic ear discharge, hearing loss with or without signs of impending complications or facial palsy referred for HRCT Temporal bone. HRCT scans showed the presence of a soft tissue mass in all the patients with cholesteatoma (100%), the location of the pathology on the scan was typical for cholesteatoma in 48 patients (96%) and in all the patients (100%) there was radiological evidence of erosion or destruction of the bony walls of the middle ear, mastoid antrum or ossicles. This study revealed that the accuracy and sensitivity was excellent regarding incus, malleus erosion, lateral semicircular canal fistula, sigmoid sinus plate erosion and intracranial complications, good correlation regarding stapes erosion, the tegmen tympani erosion and for the facial nerve canal.
Keywords: HRCT, cholesteatoma, correlation

Introduction

HRCT is the imaging technique of choice in case of a clinically suspected cholesteatoma [1]. HRCT is unique in its ability to display not only the internal bone architecture of middle ear and mastoid but also presence of soft tissue mass; that a negative scan effectively excludes possibility of cholesteatoma [2, 3]. Early use of HRCT in cases of cholesteatoma can save hearing and improve morbidity. HRCT, due to excellent spatial resolution, has a high sensitivity [4].

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. The HRCT scan gives a good to excellent surgical correlation for the middle ear ossicles. 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 [5].

It is also valuable in visualization of hidden areas such as sinus tympani and facial recess beyond microsopic examination which is important before decision of surgical strategy and also for complete eradication of the disease. Evaluation of recesses of the tympanic cavity is essential prior to surgery since the surgical approach may be altered by the presence of inflammatory disease medial to ossicular chain [6]. Complications of cholesteatoma, even in the mildest form, will compromise quality of life and if left unrecognized or untreated may result in higher mortality.

The present work, will be undertaken as a considerable number of patients with cholesteatoma attend the ENT department of our hospital, since it was felt necessary to study the clinical presentation of cholesteatoma with HRCT findings and intraoperative findings so that it helps to formulate proper surgical intervention and to avoid intraoperative complications by understanding the exact anatomical variations of landmarks in the temporal bone.

Methodology

Sample size: 50.
Type of study: Comparative.
Period of study: 18 Months.
Data acquistion
All patients with clinical picture of cholesteatoma such as chronic ear discharge, hearing loss with or

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without signs of impending complications or facial palsy referred for HRCT Temporal bone.

Inclusion criteria

1. All chronic otitis media patients with cholesteatoma diagnosed clinically.
2. All age groups and either sex group.

Exclusion criteria

Chronic otitis media without cholesteatoma.

HRCT examination

The study was done to all patients using 2 CT scanners GE Sytech CT/e Spiral scanner and TOSHIBA Aquilion 16.

Zooming and magnification were done for the petrous bone on each side and for the diseased side. The HRCT scan protocol includes the following factors:

Patient position: supine for the axial scanning, prone or supine with hyper extended neck for coronal scanning.

Results

Table 1: Age & sex distribution of chronic suppurative otitis media with cholesteatoma

Age group in years	Sex				Total	
	Male		Female			
	No.	%	No.	%	No.	%
10-19	03	11.1	01	04.3	04	08
20-29	10	37.0	08	34.7	18	36
30-39	06	22.2	07	30.4	13	26
40-49	04	14.8	03	13.0	07	14
50-59	03	11.1	03	13.0	06	12
≥60	01	03.7	01	04.3	02	04
Total	27	54%	23	46%	50	100

Table 2: Clinical presentations of the studied patients with cholesteatoma

Clinical presentation	No. of patients	%
Chronic ear discharge without hearing loss	15	30
Chronic discharge with hearing loss	28	56
Chronic discharge with signs of increased I.C.T	04	08
Chronic discharge with facial paresis	02	04
Chronic discharge with vertigo and SNHL	01	02
Recurrent cholesteatoma	00	00
Total	50	100

SNHL: Sensorineural hearing loss I.C.T: Intracranial tension.

Table 3: Correlation between CT findings and operative features

Features	Finding in CT	Operative Features	False Negative	False Positive	Accuracy (%)	Sensitivity (%)
Tissue mass	50	50	0	0	100	100
Typical location	48	48	0	0	100	100
Bony erosions	50	50	0	0	100	100
Incus erosion	18	18	1	0	100	100
Malleus erosion	05	05	0	0	100	100
Stapes erosion	25	26	1	0	96.4	96.1
LSC fistula	02	02	0	0	100	100
Tegmen erosion	05	06	1	0	94.4	83.33
Facial canal intact	46	46	0	0	100	100
Eroded	01	02	0	1	96	83.33
Dehiscent	02	02	0	0	100	100
Eroded SSP	01	01	0	0	100	100

LSC: lateral semicircular canal SSP: Sigmoid sinus plate.

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Table 4: Correlation between CT findings and Operative findings

Features	Finding in CT	Operative features
Tissue mass	50	50
Typical location	48	48
Bony erosions	50	50
Incos erosion	18	18
Malleus erosion	5	5
Stapes	25	26
LSC fistula	2	2
Tegmen erosion	5	6
Intact	46	46
Eroded	2	1
Dehiscent	2	2
Eroded SSP	1	1
Eroded KS	18	18

Karl Pearson's Correlation coefficient, r= + 0.99, P < 0.01, S

Test statistics

[DataSet0]

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	CT	20.9	13	20.545	5.698
	OT	21.0	13	20.579	5.708

Paired Samples Correlations				
		N	Correlation	Sig.
Pair 1	CT & OT	13	1	0

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	CT-OT	-0.077	0.494	0.137	-0.375	0.221	-0.562	12	0.584

[DataSet0]

Correlations				
			CT	OT
Spearman's rho	CT	Correlation Coefficient	1	.990**
		Sig. (2-tailed)	.	0
		N	13	13
	OT	Correlation Coefficient	.990**	1
		Sig. (2-tailed)	0	.
		N	13	13
**. Correlation is significant at the 0.01 level (2- tailed).				

NPar Tests

Comments		
Input	Active Dataset	DataSet0
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	13
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TEST
		/WILCOXON=CT WITH OT (PAIRED)
		/MISSING ANALYSIS.
Resources	Processor Time	00:00.0
	Elapsed Time	00:00.0
	Number of Cases Alloweda	112347
a. Based on availability of workspace memory.		

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Wilcoxon Signed Ranks Test

Ranks				
		N	Mean Rank	Sum of Ranks
OT-CT	Negative Ranks	1a	2	2
	Positive Ranks	2b	2	4
	Ties	10c		
	Total	13		
a. OT < CT				
b. OT > CT				
c. OT = CT				

Test Statisticsb	
	OT-CT
Z	-.577a
Asymp. Sig. (2-tailed)	0.564
a. Based on negative ranks.	
b. Wilcoxon Signed Ranks Test	

HRCT scans showed the presence of a soft tissue mass in all the patients with cholesteatoma (100%), the location of the pathology on the scan was typical for cholesteatoma in 48 patients (96%) and in all the patients (100%) there was radiological evidence of erosion or destruction of the bony walls of the middle ear, mastoid antrum or ossicles. All patients had at least one of the above radiological features. Based on these features 50 ears with cholesteatoma (96%) were accurately diagnosed by the HRCT scans.
This study revealed that the accuracy and sensitivity was excellent regarding incus, malleus erosion, lateral semicircular canal fistula, sigmoid sinus plate erosion and intracranial complications, good correlation regarding stapes erosion, the tegmen tympani erosion and for the facial nerve canal.

Discussion:
Correlation between HRCT findings and operative data: HRCT findings of labyrinthine fistula were compared with operative features and fistula test. CT findings were coincident with operative data for all studied parameters and the least one is the integrity of the facial nerve canal.
Chee &Tan, 20017 concluded that (94.4%) of cases had at least 2 of the 3 criteria of CT features of cholesteatoma. O'Donoghue *et al*., 1987 [8], found cholesteatoma presents in 80% of the cases explored. O'Reilly *et al*. 1991 [9] detected 23 out of 29 cases (79%) of cholesteatoma. HRCT images may influence the decision and timing of surgical exploration. CT 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 [10].

Ossicular chain erosion: Bone resorption of the ossicles depends on the origin and mode of spread of cholesteatoma. In the present study, radio-surgical correlation for the middle ear ossicular erosion was (96.4%) for the stapes erosion and (100%) for the malleus and incus erosion. These features are matched with a study made by Chee & Tan, 20017 who found that, out of 31 incus, found at surgery to be eroded; 30 were demonstrated by CT scan with accuracy (96.8%) and out of the 15 malleus, 14 were seen by the scan with accuracy (96.8%). In a study done by Mafee *et al*., 1988 [11] the radio-surgical correlation was (94%) for the incus and (89%) for the malleus erosions. Hassman *et al*., 2003 [12] in a series of 60 ears operated between 1988-2001 reported that there is good correlation between CT finding and operative features in cholesteatoma for most middle ear structures except for the integrity of incus long process.
On the other hand, O'Reilly *et al*., 1991 [9] were able to correctly predict an intact ossicular chain in only (50%) of cases. O'Donoghue *et al*., 1987 [8] reported that erosion of the long process of the incus detected in (67%) of the scanned cases. While prior knowledge of the state of the ossicles is not critical 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 super-structure 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.

Labyrinthine fistula: In the present study only 2 patients with lateral semicircular canal fistulas, were diagnosed. The HRCT findings were correlated with fistula tests as well as operative data. A labyrinthine fistula is caused by resorption of the bone of the otic capsule by the action of enzymes associated with cholesteatoma or chronic active suppurative osteitis. The most common site for a fistula is the lateral semicircular canal. However, any of the canals may be involved and a cochlear fistula may occur in the middle ear or epi-tympanum).

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Menif *et al*., 2000 [13] stated that; HRCT scan assessment of osseous labyrinthine fistula coincided with the surgical findings (14 cases of labyrinthine fistula suspected by CT was surgically confirmed). Phelps and Wright 1990 advocated scanning in both axial and coronal planes when vestibular symptoms were present. Mafee *et al*., [11] stated that, axial sections may give a false impression of lateral semicircular fistula and another plane (coronal or sagittal) should be obtained. Even with the addition of axial scans, minute fistula may still be missed and the careful dissection of the cholesteatoma matrix over the dome of the lateral semicircular canal revealed a tiny bony canal fistula [14].

The axial scans are more satisfactory because they depicted the lateral semicircular canal in its entirety and were less like to produce false positives, but useful information could be gained from the coronal scans. We recommended both planes for accurate diagnosis.

Walshe *et al*., 2002 [12] stated that, there may be a medico-legal role for routine CT before mastoid surgery. For example, erosion of the lateral semicircular canal by cholesteatoma in the absence of vertigo is presumably due to cholesteatoma sealing the defect. When removed at mastoidectomy, such a patient may well become vertiginous. With evidence of erosion in the preoperative HRCT, any accusation of iatrogenic damage could be refuted.

Conclusion

HRCT provides the surgeon about possibility of normal anatomic variation that may be present such as overriding jugular bulb; alerting him before start surgery hence avoids intra-operative problems. Early use of HRCT in cases of chronic suppurative otitis media can save hearing and improve morbidity.

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