Comparison of pre-operative temporal bone high resolution CT scan and intraoperative findings in patients with chronic suppurative otitis media

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Abstract

Background and objectives: To compare the findings of high resolution computed tomography of temporal bone with intraoperative findings of patients suffering from chronic suppurative otitis media.

Methods: This is a prospective randomize case study which was conducted on 100 patients complaining from chronic ear discharge and hearing impairment. The study was conducted at otolaryngology department, Rizgary Teaching hospital, Erbil City-Iraq from January 2016 to December 2018. The surgical procedures were the same for all patients as mastoid exploration. Based on the intraoperative finding it was decided either to choose canal wall up mastoidectomy or canal wall down mastoidectomy procedure   that to be appropriate for particular case with studying and comparing the radiological finding accordingly.

Results: Of the 100 patients,47% were males and 53% females. Eighteen cases were diagnosed with cholesteatoma and 82 cases were without. The high resolution computed tomography of temporal bone offered very high sensitivity in detecting erosion of scutum (100%), semicircular canal (100%), ossicles erosion (94%), but it gave low sensitivity 33% regarding prediction of facial nerve canal dehiscence. However, the prediction of the dehiscence of the facial canal should be not excluded regardless of images show intact facial canal in high resolution CT scan.

Nearly 100% specificity obtained for erosion of scutum, semicircular canal, dehiscence of facial canal and sigmoid sinus wall. Whereas it is relatively less specific for erosion of ossicles and differentiation between the cholestatoma and granulation tissue**.**

Conclusion: We concluded that high resolution computed tomography scan of temporal bone is a golden investigation before surgery for cases of chronic suppurative otitis media to plan for the type of surgery accordingly

Keywords: High resolution computed tomography, Temporal bone, Chronic suppurative otitis media

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Introduction

Chronic suppurative otitis media(CSOM) remains a significant health problem in terms of prevalence, economics and sequelae[1]. It is a common condition seen in patients attending otolaryngological department. It is a condition in which there is chronic infection of middle ear cleft, which can cause severe destruction of the middle ear structures and mastoid, leading on to various complications, as temporal bone is surrounded by many vital structures such as brain, internal carotid artery, jugular bulb and facial nerve[2].A variety of standard surgical approaches is currently used for treating CSOM, which are categorized as canal wall up mastoidectomy or canal wall down mastoidectomy approaches.The selection of surgical technique is of particular importance to preserve a higher hearing threshold and prevent recurrence and treatment failure. This is done by prior knowledge of temporal bone anatomy, the extent of disease that may help surgeons to plan and to choose the appropriate type of the surgery and avoid complications[3].In CSOM the otologist can diagnose most cholesteatoma otoscopically but one cannot determine the size and extent of the lesion in the epitymapanum and mastoid antrum and the state of the ossicles[3].To minimize the

intra operative errors of mild bone erosions, particularly the tegmen, the lateral semicircular canal and horizontal portion of the facial nerve canal, familiarity with the radiographic variations and comparison with the normal side is necessary[4].Historically, chronic otitis media has been assessed with only plain x-rays. Recently, high resolution computed tomography (HRCT) scanning has evolved as the standard imaging technique for temporal bone, but its exact role in preoperative assessment of patients with chronic otitis media disease still remains controversial[4-6].Computerized tomography is capable in diagnosis and detection of various pathological changes occurring in the temporal bone in a case of chronic suppurative otitis media[7].This helps us to formulate proper surgical intervention and to avoid intraoperative complications by understanding the exact anatomical variations of landmarks in the temporal bone[5].The computerized tomography evaluation of the acquired cholesteatoma is based on the detection of focal area of bone destruction and a non-dependent, homogenous soft tissue mass. The bone destruction is most reliable finding since radiographic density of a cholesteatoma is the same as that of granulation tissue and

other soft tissue masses[4].The aim of this study is to compare the findings of high resolution computed tomography of temporal bone with intraoperative findings of patients suffering from chronic suppurative otitis media.

Patients and methods

A prospective randomize case study was conducted over a period of 2 years (January 2016 to December 2018) on 100 patients with chronic suppurative otitis media attended Otoalrynglogy department in Rizgary Teaching Hospital.All patients were examined carefully–before surgery. Hearing status was assessed by pure tone audiometric examination.All age groups and both sex were included in the study. All patients who had CSOM were included. Criterion of inclusion in the study was CSOM with choesteatoma and tubotymapnic type.

Exclusion criteria from study included, patient with revision surgery, history of temporal bone fracture, known cases of temporal bone neoplastic/ granulomatous diseases and cases unsuitable for surgery or scanning (such as ischemic heart disease or pregnancy).High resolution CT scan images were acquired in axial plane with sections made scanning commenced from the lower margin of the external auditory meatus and extended upward to the arcuate eminence of the superior semicircular canal as seen on lateral tomogram.Coronal and sagittal

reconstructions were made and images were analyzed. The contralateral temporal bone was included for comparison.A correlation between operative findings and temporal bone high resolution CT scan images findings were performed by using sensitivity (Se), specificity (Sp), negative predictive value (NPV), and positive predictive value (PPV) were calculated.The golden standard in this study is the intra-operative surgical findings using the parameters of presence of cholesteatoma, erosion of outer attic, erosion of middle ear ossicles, erosion of lateral SCC, erosion of sigmoid sinus wall and dehiscence of the facial canal.All patients underwent mastoid exploration. The type of surgery was determined based on the intra operative findings. The type and extent of disease, ossicular erosion and complications were recorded during surgery.All patients were followed up regularly in otolaryngology outpatient clinic after four weeks and then every two months regularly for one year post operation. The state of the mastoid cavity, healing status and outcome result of the surgery were recorded.

Results

The youngest patient studied was 9 years old and the oldest was 60 years. There were 47 males and 53 females in this study. The type of pathology, surgical operation, side of operation and sex are shown in table (1).

Table 1: Gender of patients, side, type of pathology and surgical intervention.

Variables	Categories	Percent
Sex	Male	47
	Female	53
Pathology	CSOM	82
	Cholesteatoma	18
Side of pathology	Right	49
	Left	51
Type of operation	Canal wall up	86
	Canal wall down	14
	Total	100%

The data of table (2) shows that erosion of outer attic wall was measured by CT scan and used as screening test in comparison to its measurement during surgery. The screening test had sensitivity 100%, specificity 99%, positive predictive value (PPV) of 50%, negative predictive value (NPV) of 100% and accuracy rate of 99%. The reliability or reproducibility of the CT scan was moderate which was measured by Kappa test and was equal to 0.66.

Table2: Erosion of outer attic wall by CT scan versus operation.

Erosion of outer attic wall CT	Erosion of outer attic wall Operation		Total
	Yes	No	
Yes	1	1	2
No	0	98	98
Total	1	99	100

The results of table (3) show that if the CT scan was used as screening test to measure the erosion of lateral SCC in contrast to operation which was the golden standard test, the screening test had sensitivity of 100%, specificity of 98%, positive predictive value (PPV) of 33%, Negative predictive value (NPV) of 100%, accuracy rate of 98% and Kappa test equal to 0.30.

Table 3: Sensitivity, specificity, PPV, NPV, Accuracy rate and Kappa test of CT scan.

Erosion of lateral SCC CT	Erosion of lateral SCC Operation		Total
	Yes	No	
Yes	1	2	3
No	0	97	97
Total	1	99	100

The results of table (4) show that if the CT scan was used as screening test to measure the erosion of middle ear ossicles in contrast to operation which was the golden standard test, the screening test had sensitivity of 94%, specificity of 79%, positive predictive value (PPV) of 68%, Negative predictive value (NPV) of 96%, accuracy rate of 84% and Kappa test equal to 0.66.

Table 4: Sensitivity, specificity, PPV, NPV, Accuracy rate and Kappa test of CT scan.

Erosion of middle ear ossicles CT	Erosion of middle ear ossicles Op		Total
	Yes	No	
Yes	30	14	44
No	2	54	56
Total	32	68	100

The results of table (5) show that if the CT scan was used as screening test to measure the erosion of sigmoid sinus wall in contrast to operation which was the golden standard test, the screening test had sensitivity of 17%, specificity of 98%, positive predictive value (PPV) of 33%, Negative predictive value (NPV) of 95%, accuracy rate of 93% and Kappa test equal to 0.19.

Table 5: Sensitivity, specificity, PPV, NPV, Accuracy rate and Kappa test of CT scan.

Erosion of sigmoid sinus wall CT	Erosion of sigmoid sinus wall Op		Total
	Yes	No	
Yes	1	2	3
No	5	92	97
Total	6	94	100

The results of table (6) show that if the CT scan was used as screening test to measure the dehiscence of the fascial canal in contrast to operation which was the golden standard test, the screening test had sensitivity of 33%, specificity of 97%, positive predictive value (PPV) of 25%, Negative predictive value (NPV) of 98%, accuracy rate of 95% and Kappa test equal to 0.26

Table 6: Sensitivity, specificity, PPV, NPV, Accuracy rate and Kappa test of CT scan.

Dehiscence of the facial canal CT	Dehiscence of the facial canal Op		Total
	Yes	No	
Yes	1	3	4
No	2	94	96
Total	3	97	100

The results of table(7) show that if the CT scan was used as screening test to measure the presence of cholesteatoma in contrast to operation which was the golden standard test, the screening test had sensitivity of 94%, specificity of 76%, positive predictive value (PPV) of 54%, Negative predictive value (NPV) of 98%, accuracy rate of 79% and Kappa test equal to 0.50.

Table 7: Sensitivity, specificity, PPV, NPV, Accuracy rate and Kappa test of CT scan.

Cholesteatoma CT	Cholesteatoma Op		Total
	Yes	No	
Yes	17	20	37
No	1	62	63
Total	18	82	100

Discussion

We found that, the high resolution computed tomography (HRCT) is an excellent tools regarding the erosion of ossicles and predicting it before surgery, so that the surgeon preparing himself for ossiculoplasty as one step surgery for improving the hearing threshold after surgery. The sensitivity reaches 94% and specificity up to 79%.Thirty-two cases showed erosion of ossicles, incus was most commonly involved, followed by stapes and malleus.These findings are consistent with the finding by Karki S et al, Gyanul J et al, Sagar N et al, Chee NW et al and Gerami H et al [3-,5,8,9]. While the finding is in contrast to study done by Tatlipinar A et al[10] who observed sensitivity 62% and specificity 85%. Among various parts of temporal bone assessed for bony erosion, is the scutum erosion.Only one case was found with erosion of scutum, this gives very high sensitivity 100% and specificity 99%, while 24 cases (60%)with erosion were found in study done by Karki et al[3] and Sagar N et al[5] that gives same specificity and sensitivity 100%. This is in agreement with our study

regarding the sensitivity and specificity. Therefore, high resolution CT scan gives good preoperative prediction for scutum erosion. While Ozbayetal[11] and Yildirim-Baylan M et al[12]gave lower sensitivity and specificity rate 83% and 85% respectively. Erosion of lateral semicircular canal is an important finding if it's predicted before surgery. Our result gave high accuracy rate up to 98%. Our sensitivity 100% and specificity 98%.That is concomitant with study done by Siriggiri RR et al13who gave 100% sensitivity and 94% specificity. But Rogha M et al[14] and Karki S et al [3] gave lower rate regarding the sensitivity and specificity. Finding erosion of sigmoid sinus plate is important point to avoid damaging the sigmoid sinus and avoiding huge bleeding that may occur at the beginning of surgery when one starts drilling over the bone covering the sigmoid sinus. Our study gives accuracy rate up to 94% and specificity up to 98%. The similar finding was found bykarki S et al, Gyanul J et al, Sagar N et al, Rogha M et al and Madan G et al [3-5,14,15] Avoiding damaging of facial nerve is one of the most important point during surgery and predicting it's dehisce in its pathway in the fallopian canal regards as an important finding preoperatively. In our study only 3 cases present with dehiscence

and only one case predicted by the HRCT and confirmed by surgery, while other 2 cases found during operation gave us false negative by the CT scan. Our accuracy rate reached95% but with low sensitivity of 33%. The finding is concomitant with the study done by Gerami H et al 9 and Gyanul J et al4 who showed low sensitivity rate.While karki S et al[3] found erosion of horizontal part of facial nerve was correctly diagnosed in 3 case out of 4, with sensitivity 100% and specificity 75%. In this study the mastoid exploration done for 100 patients, 18 patients came with cholesteatoma and 82 patients without cholesteatoma. The true positive were 17 patients and false positive were 20 patients, false negative one case, true negative 62 cases, with accuracy rate 79% with high sensitivity rate 94% and low specificity 76%. Sagar N et al found the same result of low specificity around 37% and accuracy rate 70% which is compatible with our result. Low specificity of HRCT in detecting cholesteatoma may be due to inability of HRCT to differentiate between cholesteatoma and granulation tissue mass based on attenuation values of high resolution CT scan. Ossicular erosion which may be also found in some cases of chronic mucosal inflammation of the middle ear with granulation tissue. In contrast to our

high sensitivity rate 94%; the study of Gyanul J et al[4] showed that the CT scan is less sensitive in differentiate cholesteatoma from granulation tissue in which some cases had both granulation tissue and cholesteatoma, which could not be radiographically distinguished . Santosh UP

16showed that the lower attenuation value in high resolution CT scan that associated with cholesteatoma and the presence of well-defined edge of the mass is an indicator of cholesteatoma rather than the granulation tissue.

Conclusions

High resolution computed tomography temporal bone acts one of the best investigation for diagnosis of chronic suppurative otitis media.It has high value for

planning an appropriate surgical procedure and predicting for the potential complications and alerts the surgeon to setup plan also for their management.

Conflict of interests

The authors recorded no conflict of interests.

References

1. Olszewska E, Wagner M, Bernal-Sprekelsen M, et al. Etiopathogenesis of cholesteatoma. Eur Arch Otorhinolaryngol. 2004; 261(1):6-24.

2. Garber LZ, Dort JC. Cholesteatoma: Diagnosis and Staging by CT scan. J Otolaryngol. 1994; 23(2):121-4

3. Karki S, Pokharel M, Suwal S, Poudel R. Correlation between Preoperative High Resolution Computed Tomography (CT) Findings with Surgical Findings in Chronic Otitis Media (COM) Squamosal Type. Kathmandu Univ Med J. 2017.;15(57):84-7

4. Gyanu J, Modwal A, Saboo R, Saxena G, Sapra G. A Study of the Correlation of the Clinical Feature, Radiological Evaluation and Operative Finding in CSOM with Cholesteatoma, Sch. J. App. Med. Sci., 2014; 2(6F):3259-69.

5.Sagar N, Devasamudra C. Clinical study of correlation between preoperative findings of HRCT with intra-operative findings of cholesteatoma in cases of CSOM. Indian J Otolaryngol Head Neck Surg. 2017;3(1):1-5. Available from:

DOI: 10.18231/2455-846X.2017.0001.

6. Walshe P, McConn R, Brennan P, Walsh M. The role of computerized

tomography in the preoperative assessment of chronic suppurative otitis media. Clin Otolaryngol Allied Sci. 2002; 27(2):95–7.

7. Vallabhaneni R, Babu S. HRCT Temporal Bone Findings in CSOM: Our Experience in Rural Population of South India, IOSR-JDMS. 2016; 15(1), 49-53

8. Chee NW, Tan TY. The value of pre-operative high resolution CT scans in cholesteatoma surgery. Singapore Med J. 2001; 42(4):155-9.

9. Gerami H, Naghavi E, Moghadam MW, Forghanparast K, Akbar MH. Comparison of preoperative computerised tomography scan imaging of temporal bone with the intra-operative findings in patients undergoing mastoidectomy. Saudi Med J 2009; 30(1):104-8.

10. Tatlipinar A, Tuncel A, Öğredik EA, Gökçeer T, Uslu C. The role of computed tomography scanning in chronic otitis media. Eur Arch Otorhinolaryngol. 2012; 269(1):33-8.

11. Ozbay S, Sütbeyaz Y, Okur A, Selimoğlu E, Aktan B, Ertaş A. The value of preoperatively computed tomography in chronic suppurative otitis media. KBB ve Baş Boyun Cerrahisi Derg.1994; 2(2): 106-10.

12. Yildirim-Baylan M, Ozmen CA, Gun R, Yorgancilar E, Akkuş Z, Topcu I. An evaluation of preoperative computed tomography on patients with chronic otitis media. Indian J Otolaryngol Head Neck Surg 2012; 64(1): 67-70.

13. Sirigiri RR, Dwaraknath K. Correlative Study of HRCT in Attico-Antral Disease. Indian J Otolaryngol Head Neck Surg. 2011; 63(2):155-8.

14. Rogha M. Comparison of preoperative temporal bone CT with intraoperative findings in patients with cholesteatoma. Iran J Otorhinolaryngol. 2014; 26(74):7-12.

15. Madan G, Turamanlar O, Bucak A, et al. Comparison of Preoperative Temporal Bone HRCT and Intraoperative Findings in Patients with Chronic Otitis Media. Erciyes Med J 2015; 37(4): 138-42

16. Santosh UP, Siddalingappa SM, Mathew S, Bhat V, Janardhan D; A study of the correlation of the clinical features, radiological evaluation and operative findings in chronic suppurative otitis media with cholesteatoma -Otolaryngol Head Neck Surg. 2011; 8 (1): 17-9.