

Comparison of preoperative computerized tomography scan imaging of temporal bone with the intra-operative findings in patients undergoing mastoidectomy

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ABSTRACT

الأهداف: مقارنة معدلات التماسك لنتائج ما قبل إجراء العملية للتهاب الأذن الوسطى (CSOM) التقيحي المزمن للمرضى.

الطريقة: في دراسة على شريحة مقطعية، خضع 80 مريضاً يعانون من التهاب الأذن الوسطى التقيحي المزمن (CSOM) للفحص بالتصوير المقطعي قبل العملية الجراحية وتم مقارنة نتائجهم مع النتائج السريرية أثناء العملية الجراحية لخزغ الخشاء للعظم الصدغي، خلال الفترة ما بين 2000م وحتى 2004م، في قسم الأذن - مستشفى أمير المؤمنين - جامعة العلوم الطبية جيلان - رشت - إيران. تم تقييم الحساسية، التحديد، الإيجابية، السلبية للقيمة التنبؤية للأشعة المقطعية (CT) في الطبلية، الخشاء، ورم الأذن الوسطى اللؤلؤي، تآكل سلسلة العظيومات، تآكل سقف الطبلية، وتفتح القناة الوجهية وصارفة القناة نصف الدائرية على الجانبين (LSCC). ثم تم حساب الصلة بين النتائج الإشعاعية والنتائج أثناء العملية.

النتائج: بلغ متوسط العمر للمرضى 27.9 ± 16.3 عاماً. كان أغلبهم من الذكور عدد=57، (71.25%). كانت الصلة للتصويرات الإشعاعية مع النتائج السريرية أثناء العملية الجراحية متوسطة إلى جيدة على ورم الأذن الوسطى اللؤلؤي الورم الشحمي الخشائي، وتآكل سلسلة العظيومات، ولكنها كانت ضعيفة وغير ملحوظة في حالات تآكل سقف الطبلية وتفتح القناة الوجهية وصارفة القناة نصف الدائرية على الجانبين (LSCC).

خاتمة: قد تكون الأشعة المقطعية (CT) قبل العملية الجراحية مفيدة في قرار إجراء العملية في حالات ورم الأذن الوسطى اللؤلؤي وتآكل العظيومات. وعلى الرغم من محدوديات الفحص الإشعاعي إلا إنها مفيدة في علاج التهاب الأذن الوسطى التقيحي المزمن.

Objectives: To compare the consistency rates of pre- and intra-operative radiological findings in patients with chronic suppurative otitis media (CSOM).

Methods: In a cross-sectional study, 80 patients with CSOM underwent pre-operative CT scanning and

we compared the results with intra-operative clinical findings during mastoidectomy from 2000-2004 in the Otolaryngology Department, Amiralmomenin Hospital of Guilan Medical University, Rasht, Iran. Sensitivity, specificity, positive and negative predictive value of CT scan in tympanic and mastoid cholesteatoma, ossicular chain erosion, tegmen tympani erosion, dehiscence of facial canal, lateral semicircular canal (LSCC) fistula were assessed. Then, correlation between radiological findings and intra-operative findings were calculated.

Results: The mean age of the patients was 27.9 ± 16.3 years. Mostly were males ($n=57$ [71.3%]). Correlation of preoperative radiological images with intra-operative clinical findings were moderate to good on tympanic cholesteatoma, mastoid cholesteatoma and ossicular chain erosion, but weak and insignificant in cases of tegmen tympani erosion, facial canal dehiscence and LSCC fistulae.

Conclusion: Preoperative CT scan may be helpful in decision-making for surgery in cases of cholesteatoma and ossicular erosion. Despite of limitations radiological scanning is a useful adjunct to management of CSOM.

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Otitis media is one of the most common diseases in the childhood leading to infectious and non-infectious complications and considerable morbidity.^{1,2} Acute or recurrent infection of the middle ear may cause a permanent perforation of tympanic membrane and irreversible inflammatory changes in middle ear and mastoid known as chronic otomastoiditis.^{2,3} Epidermoid inclusion cysts in middle ear and mastoid are among the important complications of chronic otitis media (COM) leading to a high morbidity rate and it is termed as cholesteatoma.⁴ One third of chronic suppurative otitis media (CSOM) is associated with the cholesteatoma. Clinical manifestations of cholesteatoma range from the asymptomatic phase to life-threatening phase causing destruction of Ossicles and attic capsule.⁵ Surgical intervention is the only treatment option for eradication of cholesteatoma, to avoid the complications and secondary restoration of the middle ear.⁶ Decision for the choice of surgical technique, preservation of higher hearing rate and prevention from complications such as infection, cerebral hernia, recurrence and treatment failure, is of particular importance.^{7,8} Thus, pre-operative radiological imaging especially CT scan for determination of size, spread of cholesteatoma, and the condition of mastoid and ossicles have been considered essential and useful.⁹⁻¹² Migirov et al¹¹ revealed that the sensitivity and the specificity of CT scan in the diagnosis of complication caused by the acute oto-mastoiditis were 97% and 94% respectively. Results obtained from some studies showed that CT scan in simple chronic otitis media (COM) was useless but its application in the cases we suspect the cholesteatoma or during revision.¹³ Considering the existing contradictions regarding the predictive value of CT scan preoperatively in diagnosing pathologic lesions of the middle ear in patients with CSOM, we planned this study in Guilan University of Medical Science at Rasht Iran.

Methods. This study is a prospective descriptive-cross-sectional study of 80 consecutive patients presenting with CSOM admitted for mastoidectomy to Amiralmomenin University Hospital in Rasht-City within 5 years (2000-2004). All cases with diagnosis of CSOM were included in our study, but those 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 diseases and pregnancy) were excluded. Diagnosis of CSOM was based on the clinical and otoscopic ground. High resolution computed tomography (HRCT) of temporal bone had been requested for all the cases. High resolution computed tomography report in 2 coronal and axial

cross-sections with cuts of 2mm slices was made by a single radiologist at the Radiology Department, Guilan Medical University, Rasht, Iran. This research protocol has been supervised and duly approved by the Research Ethical Committee of Guilan Medical University at Rasht, Iran. Study variables were mastoid cholesteatoma, tympanic cholesteatoma, erosion of ossicles, dehiscence of facial canal, erosion of tegmen tympani and lateral semicircular canal (LSCC) fistulae. Surgical decision was made without considering the response of HRCT. Intra-operative findings were regarded as a gold standard for determination of sensitivity and specificity of HRCT scan for preoperative diagnosis of 6 variables. Data were analyzed using standard research methodology and software package SPSS-10. Statistical method of kappa was used for evaluation of the results in a 95% confidence interval (CI).

Results. One hundred and three cases were included in the study. Only 85 cases succeeded to perform temporal bone HRCT due to economic problems. Five cases from this population refused from undergoing surgery, or postponed it. The mean age of the study subjects (80 cases) was 27.9 ± 16.3 years (age range of 13-70 years). Mostly were 50 males (71.3%) and the rest were females [n=23 (28.8%)]. Out of 36 incidences of mastoid cholesteatoma, 32 cases were compatible with the CT scan results. The results obtained showed that the sensitivity and specificity of the CT scan for the preoperative diagnosis of the mastoid cholesteatoma were 65% and 87% respectively. Consistency rates of radiological and clinical results in diagnosing the mastoid cholesteatoma were reported from moderate to good, suggesting an acceptable coordination between HRCT and intra-operative anatomic and pathologic findings. Positive confidence interval (PCI) in this regard was in the range of 45%-67% and negative confidence interval (NCI) regarding cholesteatoma ranged from 43-69% (Table 1). Among 36 cases of peri-operative tympanic cholesteatoma, radiological findings had predicted in 32 cases. Sensitivity and specificity of CT scan in diagnosing the tympanic cholesteatoma were stated. Compatibility of radiological and clinical results in diagnosing the tympanic cholesteatoma was reported from moderate to good. Positive confidence interval was in the range of 53-75% and NCI 49-75%. Out of 54 cases of ossicular chain erosion, radiological findings suggested the diagnosis in 35 cases. Sensitivity and specificity of CT scan in diagnosing the ossicular bone erosion were 92% and 54% respectively. Compatibility of radiological and clinical results in diagnosing the ossicular erosion was reported as moderate to good. Positive confidence interval was reported in the range of 50-72% and NCI 48-64%. Among 12 cases of dehiscence in the facial

nerve canal detected on surgery, none of these had been shown by HRCT. The results indicated that sensitivity of CT scan in diagnosing the facial canal dehiscence was 0% and specificity 84%. Correlation of radiological and intra-operative results in diagnosing the facial canal dehiscence was stated weak. Positive confidence interval was declared equal to zero and NCI was 6-90%. Out of 4 patients suffering from erosion of Tegmen tympani found intraoperatively, only 2 were correctly reported by CT scan. Compatibility of radiological and intra operative results in diagnosing the erosion of tegmen tympani were found weak. Positive confidence interval as reported in the range of 1-13% and NCI 50-68%. Among 4 LSCC fistula cases, HRCT could not reveal this pathology in any case. The biostatics results obtained indicated that sensitivity and specificity of CT scan in diagnosing the LSCC fistulae were 0% and 95%. Correlation of radiological and clinical results in diagnosing the LSCC fistula was weak. PCI was stated equal to zero and NCI as 86-98%.

Discussion. The use of CT scan for evaluation of para nasal sinuses before endoscope sinus operations is a common procedure, but its application before mastoid surgery is not clear. Computed tomography scan imaging before endoscopy and interventions decreases the risk of damage to the adjacent structures such as orbit and skull base. For mastoid surgery, too much benefits of preoperative CT scan have been expressed such as imaging of anatomic details, extent of disease and the presence of any asymptomatic complication. Perhaps, the cost of the scan and irradiation would be the major drawbacks in performing preoperative temporal bone CT scanning. Mostly, the CT scan is indicated in the selected cases such as complicated CSOM, suspicion of congenital anomalies, and/or lack of anatomic landmarks due to the prior surgical operations. Watts

et al¹⁴ have shown that CT scan is less expensive and provides useful information about surgical trend and, thus, if a coordination can be made between the otologist and radiologist with an appropriate familiarity of the surgeon with CT scan, preoperative imaging is essential and very helpful. Yate et al¹⁵ suggested that the CT scan imaging is necessary for anatomic determination of the chronic otitis media, suspicion of congenital anomalies and to detect any loss of surgical landmarks caused by prior operation. Cholesteatoma in the middle ear is usually diagnosed by otoscopic and microscopic examination on surgical operation and is merely treated by surgery. Walshe et al¹⁶ have also revealed that imaging CT scan is helpful for anatomic determination of the middle ear and mastoid and it has a good predictive value in determining the extent of disease process in various locations of the middle ear and mastoid. Nonetheless, it is not able to diagnose the cholesteatoma, fluid and mucous diseases. As a result, it is not very helpful in surgery for these patients. Tendency of cholesteatoma towards the destruction of bones and the failure of non-surgical treatment for it, have caused conditions in which a proper diagnosis and an appropriate approach for dealing with it have become of great importance. Banerjee et al¹⁷ compared CT scan findings and intra-operative findings in patients with CSOM. They studied 60 patients with cholesteatoma, chronic perforation of tympanic membrane and chronic otorrhea. Their results showed that CT scan has helped the choice of surgical operation type, but cannot differentiate cholesteatoma from mucous inflammation. They also suggested that correlation of CT scan information with surgical findings was only possible in those procedures providing sufficient exposure. Results of present study are similar to Banerjee et al¹⁷ study regarding cholesteatoma and also confirm that CT scan could not predict bone loss over facial nerve and

Table 1 - Intra-operative screening criteria according to CT scan results as a gold standard.

Screening criteria	Sensitivity	Specificity	PPV	NPV	Kappa agreement
Mastoid cholesteatoma	65	87	88	61	Moderate to good
Tympanic cholesteatoma	65	87	88	61	Moderate to good
Ossicular erosion	92	54	64	88	Moderate to good
Dehiscence of facial canal	-	84	-	0.9	Weak
Tegmen tympani erosion	6	95	50	60	Weak
LSCC Fistula	-	94	-	97	Weak

PPV - positive predictive value, NPV - negative predictive value

tegmen tympani. In contrast, Leighton et al¹⁸ reported that CT scan of the temporal bone had an excellent predictive value for diagnosing the cholesteatoma and in another study by Gaurano and Joharjy¹⁹ reported that the correlation of pre-operative CT with surgical and histopathological findings was 97%. Chee and Tan²⁰ have also demonstrated that correlation of radiological and intra-operative results was in the range of good to excellent for diagnosis of cholesteatoma and tegmen tympani erosion, but weak for facial canal dehiscence. In the present study, correlation of radiological and intra-operative resulting in positive informative value were as follows: 88% for mastoid cholesteatoma (moderate to good) and tympanic cholesteatoma (moderate to good), 64% for ossicular erosion (moderate to good) this coefficient was statistically significant. Positive diagnosis agreement with a 95% confidence interval confirms the accuracy of diagnosis. The remaining variables such as dehiscence of facial canal, tegmen tympani erosion and LSCC fistula, the correlation were insignificant. Computerized tomography can determine the extent of middle ear cholesteatoma by revealing the combination of a soft tissue mass and bone erosion with 80% specificity.¹⁵ Results of our study also revealed that there was a moderate to good agreement in the diagnosis of ossicular erosion with sensitivity up to 92%. Facial canal dehiscence was found in 55 of the temporal bone CT scan. In 1993, Fuse et al²¹ carried out a similar study in 60 patients of facial canal dehiscence and LSCC fistula and suggested that surgical and CT scan findings were correlated. But the results of the present study revealed that the correlation and the sensitivity of the CT scan findings in the diagnosis of facial canal dehiscence, tegmen tympani and lateral semicircular canal fistula were weak and zero. This contradiction may be because of the difference of patient's selection and generation gap between the 2 studies. Fuse et al²¹ performed their study in approximately 18 years back and their cases were exclusively patients with facial canal dehiscence and LSCC, while the setting of our study were mostly CSOM with mixed complications.

In conclusion, the results of the present study suggest that the preoperative CT scan imaging in cases of mastoid cholesteatoma, tympanic cholesteatoma and ossicular erosion have a moderate to good correlation with the intra-operative findings (statistically significant with a 95% confidence interval). But the sensitivity and specificity of preoperative CT scan to detect facial canal dehiscence, tegmen tympani erosion and lateral semicircular canal fistula in patients of CSOM were weak and zero. Preoperative CT scan may be helpful in decision-making for surgery and the time for operation in cases of cholesteatoma and ossicular erosion. Despite

of limitations, we suggested that radiological scanning is a useful adjunct to management of chronic suppurative otitis media (CSOM).

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