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The Validity of Computed Tomography in Complicated Chronic Otitis Media

Background/Objective: We assessed the validity of computed tomography (CT) in the diagnosis of complicated chronic otitis media (COM).

Patients and Methods: The findings obtained from a pre-operative high resolution CT of temporal bone including coronal and axial views of 20 patients with complicated COM were compared to their intraoperative findings.

Results: In our study, CT was helpful in determining the anatomy of the mastoid and could accurately predict the mastoid air cell aeration, size and status of ossicles, presence of lateral semicircular canal (SCC) fistula and post-auricular fistula (All sensitivities equal to 100%). But it overdiagnosed the erosion of tegmen (positive predictive value of 50%). CT was unable to distinguish between cholesteatoma and fluid (abscess or effusion) and granulation tissue or polyps and was also unable to correctly reveal the facial nerve dehiscence and had a low sensitivity for showing erosion of facial canal (50%) and sigmoid sinus (60%).

Conclusion: Because most complications resulting from cholesteatoma are caused by bony erosions, CT is helpful in determining the complications of COM. CT can accurately predict the extent of disease and is helpful in detection of some complications such as fistula of Lateral Semicircular Canal (LSC), erosions of dural plate and ossicular erosions. However, it is unable to distinguish between cholesteatoma, mucosal disease and fluid, and little it did contribute to detecting the facial nerve course and dehiscence. It cannot also be used for the diagnosis of the sigmoid sinus problems which could be related to no contrast administration in our study.

Keywords: chronic otitis media, complication, computed tomography

Introduction

Computed tomography (CT) is essential for all patients suspected of having complication of otitis media. CT scan is a fast and reliable method for assessing the status of the middle ear, the mastoid air cell system, and for diagnosing intracranial complications of otitis media.[1,2] It clearly shows any progressive disease in coalescent mastoiditis and reveals erosion of the bony plates covering the sigmoid sinuses, cerebellum or tegment of the middle ear and mastoid, even the erosions of the bony mastoid itself.[2]

When intratemporal or intracranial complications are suspected, CT can be an adequate diagnostic tool for patients. So it was recommended as a routine evaluation for medically fit patients, children only, or patients with better hearing ears in whom tympanic membrane cannot be adequately visualized, patients who have had previous mastoid surgery and those with complications of the disease. CT is said to be capable of producing the fine details needed to detect lateral semicircular canal (SCC) fistula, and exposed dura facial canal. It can also demonstrate the ossicular chain.[1,3-5]

To determine the value of high resolution CT in evaluation of complications of chronic otitis media (COM), we did preoperative CT and compared the results with the operative findings.

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Received August 16, 2005;
Accepted after revision February 12, 2006.

Iran. J. Radiol. Spring 2007;4(3):175-179

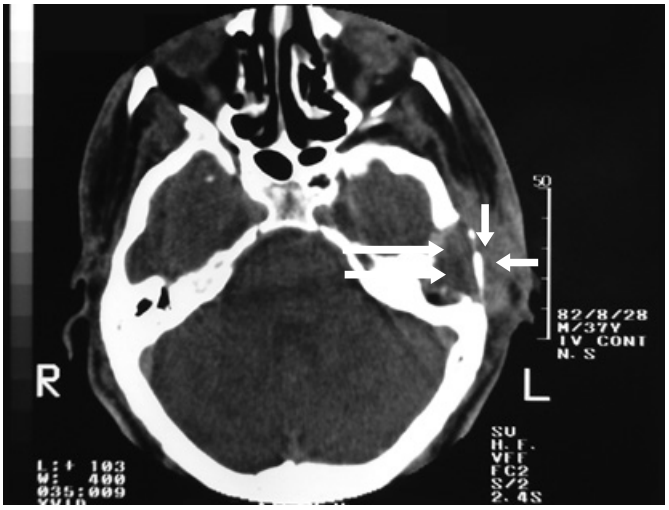

Fig. 1. A 37 years old male patient with left post-auricular abscess (short arrow). Note the bony defect in lateral mastoid wall (long arrow).

Fig. 2. A 27 years old male patint with right tegmen tympani erosion .

Patients and Methods

The study population consisted of all patients with complicated COM who had undergone preoperative CT of temporal bone within a period of one year (2002 to 2003) in Amir Alam Hospital. Because this hospital is a referral center for otological diseases, many patients with complicated COM are operated at this hospital.

Twenty patients who were scheduled for mastoid surgery for complicated COM according to clinical-findings had undergone a high resolution CT of petro-temporal bone without contrast (CT system Xvid Toshiba, 1989). CT was performed in axial and coronal view at two-mm slices. The scans were assessed by an experienced radiologist who was blind to clinical picture of patients. A formatted data collection form was used in assessing the radiological features of patients and the same form was used to assess the operative appearance of ear during mastoid surgery.

These questions are included in questionnaire form:

1) Is any pathology present in ossicular Chain? 2) Has the tegmen been eroded? 3) Has the lateral SCC been eroded? 4) Has the facial nerve canal been eroded? 5) Is any soft tissue mass seen in the middle ear? and 6) Is any post-auricular fistula present?

Comparison was then made between the radiological and intraoperative findings for each patient's ear.

Results

From the 20 patients studied, the main complications were as follows: Seven fistula formation (vertigo and sensory neural hearing loss [SNHL]), six mastoid abscesses and post-auricular fistula, three facial nerve palsies and two headaches due to sigmoid sinus thrombosis. A summary of CT findings accuracy is as follows: 1) CT could correctly show the presence of disease in mastoid cavity and the middle ear, size and aeration of mastoid system, ossicular presentation and continuity and fistula of mastoid cavity to skin (All sensitivities equal to 100% and specificities greater than 93%) (Fig.1) (Table1); 2) 6 Cases had false positive results in evaluation of tegmen (12 cases in CT versus 6 cases in surgery) (Figs 2 and 5-7) (Table1); 3) two cases incorrectly diagnosed as having lateral SCC fistula (false positive) (Figs 3-5), but correctly distinguished the others (Figs. 3-5)(table1); 4) two cases had erosion of sigmoid sinus plate, which were not diagnosed by CT scan (false negative) and two case of sigmoid sinus thrombosis were missed by CT scan (table1); 5) false positive and false negative results in evaluation of facial nerve dehiscence was 2 & 3 cases respectively (Fig 3, 6 & 8) (Table1) The sensitivity, specificity, positive and negative predictive values of CT scan in detection of these pathologic findings has been mentioned in table1.

One patient had post-auricular fistula without vertigo and SNHL in whom lateral SCC fistula was found in both operation and CT. Another patient was operated, because he was suspected of having a sigmoid sinus thrombosis. Both on CT and at operation he found to have lateral SCC fistula. Comparison of radi-

Table 1. Comparison of CT and intraoperative findings

Patologic Finding	Appearance on CT n=20	Operative Finding	Sensitivity CT	Specificity CT	Positive Predictive Value	Negative Predictive Value
Ossicular erosion	9	8	1	0.92	0.89	1
Tegmen erosion	12	6	1	0.57	0.5	1
Erosion of sigmoid sinus plate	3	5	0.6	1	1	0.88
Lateral SCC fistula	11	9	1	0.82	0.82	1
Post-auricular abscess	7	6	1	0.93	0.86	1
Mass in mastoid (abscess, cholesteatoma, granulation tissue, *etc.*)	19	19	1	-	-	1
Facial nerve dehiscence	5	6	0.5	0.86	0.6	0.8

ological and intraoperative findings is shown in Table 1. 6) CT could not differentiate between cholesteatoma, granulation tissue and fluid.

Discussion

The majority of intracranial complications of COM are apparent on the basis of clinical symptoms. In a case in whom complications are clinically suspected, imaging is indicated. CT is the method of choice in pre-operative evaluation of COM.[1] High resolution CT scans have been shown to give detailed information on the anatomy of the middle ear and mastoid, and there is excellent correlation between CT scans and intraoperative findings in ears with cholesteatoma.[1,2,4]

As a general rule, structures are best seen in an image oriented in a plan perpendicular to the axis of the structure. Imaging of the structures lying parallel to the imaging plane may not be accurately seen. Given this consideration, at least two projections (axial and coronal) are required for adequate temporal bone evaluation. The axial projection begins superiorly at the arquate eminence and continues inferiorly to the jugular fossa. The coronal projection can be obtained when the patient is lying either supine or prone and extends from the anterior extension of the bony eustachian tube to the posterior extent of the posterior semicircular canal.[1]

Administration of contrast is not indicated in routine imaging for COM and should be revered for those patients in whom clinical suspicion justifies its use. Contrast may be helpful in differentiation between cholesteatoma and other masses such as Glomus tumor or granulation tissue which will take up the contrast agent. Contrast will make a CT more sensitive for the detection of intracranial complica-

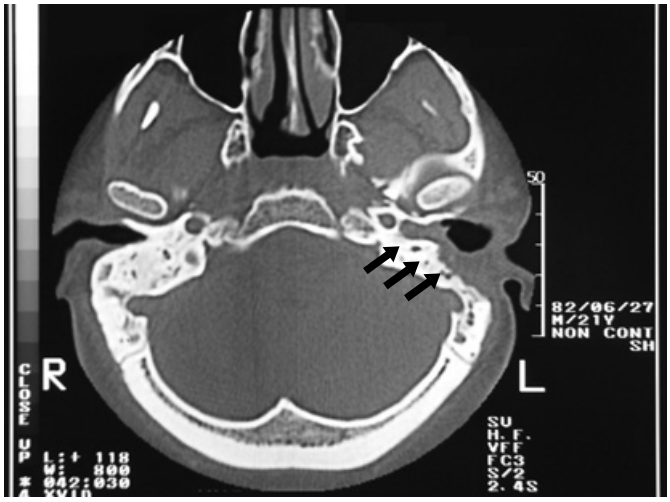

Fig. 3. A 21 years old patient with left lateral semicircular canal fistula and facial canal dehiscence.

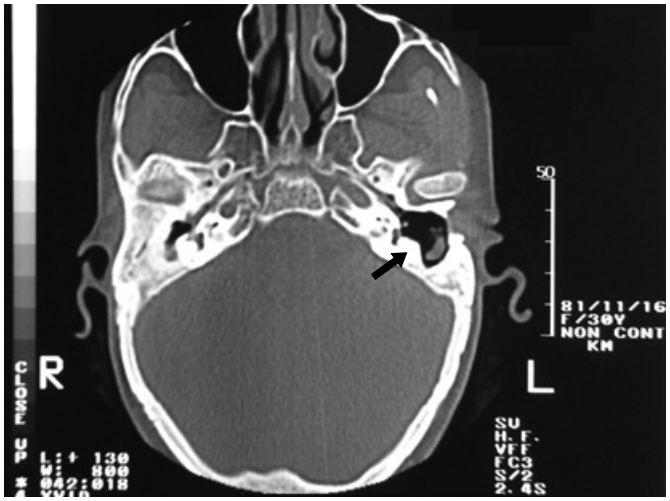

Fig. 4. A 30 years old patient with Left lateral semicircular canal fistula.

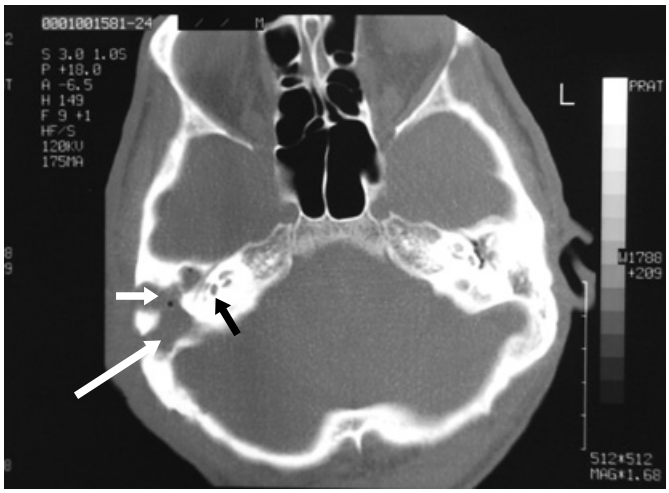

Fig. 5. Right tegmen tympani (short arrow), tegmen mastoidum erosion (long arrow) and lateral semicircular canal fistula (black arrow).

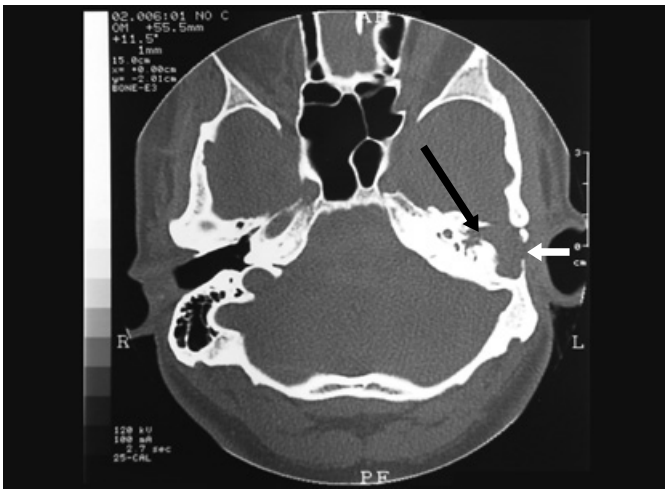

Fig. 6. Left tegmen tympani erosion (short arrow) and facial canal dehiscence (long arrow).

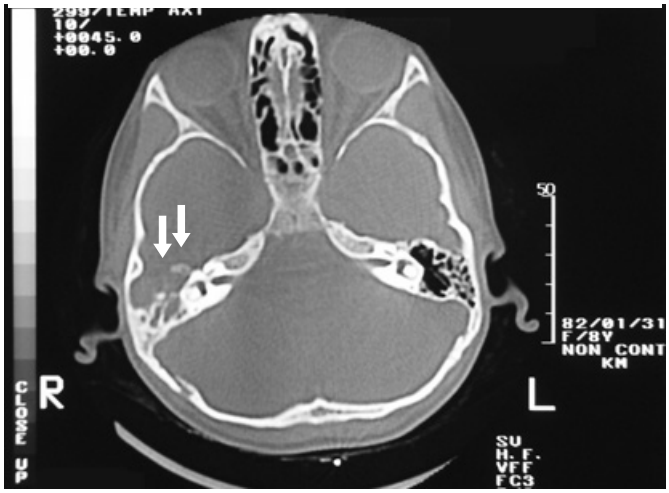

Fig. 7. A 8 years old girl with right erosion of the middle fossa tegmen

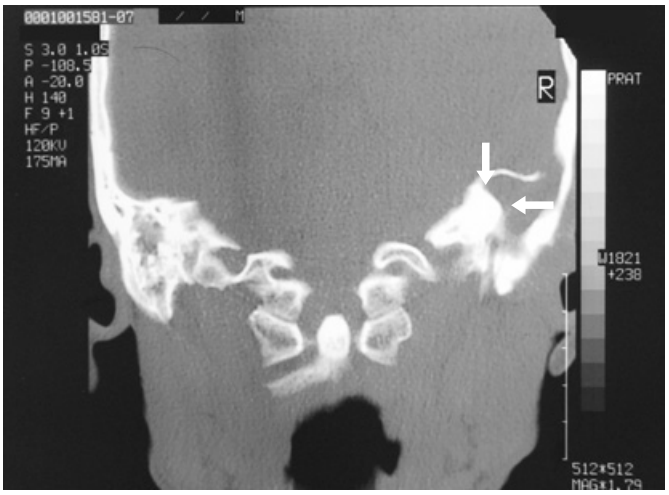

Fig. 8. Right facial canal dehiscence.

tions and will better define venous sinus patency.[1, 5-7]

CT findings indicative of cholesteatoma include the presence of soft tissue within the middle ear or mastoid with associated bony erosions. The antrum and epithympanum may show smooth expansion or a characteristic scalloped appearance. Erosions of scutum, tegment or ossicles are particularly suggestive.[1,8] We routinely use CT in selected cases. There is no doubt in its efficacy in certain circumstances such as infratemporal or intracranial complications because CT scans assess the anatomy of the middle ear and mastoid and accurately predict the extension of the disease. However, understanding the value of CT in different complications help us to find out how much we can rely on it for different sites. In our study, CT was not able to differentiate cholesteatoma from fluid, abscess and granulation tissue.[1,3-5]

In our study, CT discovered the presence of soft tissue in all patients. CT was very sensitive in assessing the position of tegment and its exposure, but it overdiagnosed the exposure of tegment (30%). CT was very sensitive for the presence of ossicles and had correlation with other studies.[5] In This study, CT had low sensitivity for diagnosis of erosions of facial nerve (50%), whereas in other studies, it had a moderate sensitivity of up to 60%.[1]

CT is quite helpful in appreciating the degree and pattern of pneumatization before surgery.

The malleus, incus and to a lesser extent, stapedius are usually seen on CT images. Radiographic evidence of erosion may indicate ossicular discontinuity that in the incus and malleus generally correlate well with operative findings.[1]

Medial or lateral displacement of the ossicles by soft tissue may be evaluated by CT, though the surgeon experience remains the cornerstone for avoiding fa-

cial nerve injury during surgery. For COM, preoperative images may show an acquired or congenital dehiscence which are quite common and are present in as many as 60% of subjects.[5]

In our experience, which coincides with reports in the radiological references, CT without contrast misses erosions and even thrombosis of the sigmoid sinus.[1,3,4] In our study, CT had a high sensitivity for detection of SCC fistula; the sensitivity and specificity were 100% and 90%, respectively. In other studies, these values were different. Although CT should be well suited for detection of fistulas as the bony structures surrounding the SCC is clearly imaged by CT, reported sensitivity varied from 75% to 95%.[4-6]

Labyrinthine fistula is a common complication of cholesteatoma which is identified in as many as 10% of patients and is more common in those with recurrent or residual disease.[3,4] A fistula can often be predicted on the basis of history and physical examination. Patients with long-standing COM and those presenting with vestibular symptoms or sensory hearing loss are more likely to have erosion of the otic capsule.[3,4,6] Inner ear fistula may be difficult to detect before surgery without the aid of appropriate CT images. The most common site of erosion inside the inner ear is at the interior convexity of lateral semicircular canal.[2,4] Such erosion may be identified on either axial or coronal CT images and should be diligently sought on both.[3] The use of coronal images alone may overdiagnose lateral SCC fistula and use of axial images will minimize the risk.

The principle value of CT in evaluation of patients with COM is its ability to demonstrate disease which is not clinically apparent because 50% of patients with fistula, especially those with lower ages had no signs of vertigo.[1,4]

Post-auricular abscess were found in seven patients at surgery; CT revealed it in six patients (85%). CT had acceptable sensitivity for the detection of post-auricular abscess. In other studies these values, however, were reported differently (80% to 100%).[2,7]

Because most complications resulting from cholesteatoma are caused by bony erosions, CT is helpful in determining the complications of COM. CT can accurately predict the extent of the disease and is helpful in detection of some complications such as fistula of LSC, erosions of dural plate and ossicular erosions. However, it is unable to distinguish between cholesteatoma, mucosal disease and fluid, a fact that has already been reported in literature [1,5,8] and little it did contribute to detecting the facial nerve course and dehiscence. It cannot also be used in the diagnosis of the sigmoid sinus problems.

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