Role of Computed Tomography in diagnosis of complications in chronic suppurative otitis media.

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Abstract: Chronic otitis media is chronic inflammation of middle ear cavity, it present with longstanding discharging ear and perforated tympanic membrane with or without cholesteatoma and other complications. Cross sectional study was performed to identify the role of computed tomography in diagnosis of complications in chronic suppurative otitis media among 40 patients between June 2018 and June 2019. Aim: To identify role of CT scan in diagnosis of anatomical and pathological effects of chronic suppurative otitis media as: pneumatisation of mastoid, soft tissue mass in middle ear cleft and mastoid, cholesteatoma, bones erosions, facial nerve canal dehiscence, labyrinthine and semicircular canal fistula. Patient and Methods: 40 patients included in our study between period June 2018 to June 2019, they are referred from otology department to radiology department in Al Hillah General Teaching Hospital that thin slices CT temporal bone was taken for all these patients.

Results: Age incidence: between 15-20 years was 3 of 40 patients (7.5%), 20-40 was 25 (62.5%), 40-50 was 12 of 40 patients (30%). Mean age is 32.77 years. 16 of 40 patients were female (40%), 24 of 40 patients were male (60%). Male to female ratio 1.5:1. Incidence of symptoms and signs was: headache & pain in 6 patients (15%), vertigo in 5 (12.5%), hearing loss in 30 (75%), discharging ear in 40 (100%), and facial palsy in 2 (5%).

Pathology in middle ear: Granulation in 20 cases (50%), cholesteatoma in 15 (37.5%), and polyp in 5 (12.5%).

Pneumatisation of mastoid bone: well in 25 cases (62.5%), sclerotic in 13 (32.5%), and poor in 2 (5%). Middle ear and mastoid mass: in CT scan 25 cases (62.5%) and in surgery 24 (60%). Cholesteatoma incidence: in CT scan 15 cases (37.5%) and in surgery 15 (37.5%). Incidence of complications: scutum erosion in CT 14 (35%) in surgery 15 (37.5%), ossicular erosion in CT 11 (27.5%), in surgery 8 (20%), facial canal dehiscence in CT 2 (5%), in surgery 3 (7.5%), labyrinthine fistula in CT 2 (5%), in surgery 1 (2.5%), semicircular canal fistula in CT 3 (7.5%), in surgery 2 (5%), tegument erosion in CT 1 (2.5%), in surgery 2 (5%), and tegument tympani erosion in CT 1 (2.5%) in surgery 1 (2.5%).

Key word: chronic otitis media, CT: computed tomography


Introduction:

Historical: The CT scan system was invented in 1972 by Godfrey Newbold Hounsfield of EMI Central Research Laboratories using X-rays (1). There are 4 generations of CT scanners. Modern multi-row CT systems can complete a scan of the chest. The number of cross sectional images that can be produced has increased from about a 12 to many hundreds (2).

Chronic suppurative otitis media (CSOM)

Is chronic inflammation of the middle ear and mastoid mucosa, with recurrent discharge (at least 2 weeks) from perforation of tympanic membrane (3).

COM classified into (4).

1. Head COM
Active mucosal COM: There is chronic inflammation of mucosa of the middle ear and mastoid and submucosal fibrosis, hypervascularity and an inflammatory infiltrates. There is also granulation tissue clinically described as aural polyps, which have protruded through the perforated tympanic membrane (5).

Cholesteatoma: Is a benign keratinizing epithelial-lined cystic structure in the middle ear and mastoid. It can destructs the local structures – ossicular chain and otic capsule, leading to complications such as hearing loss, vestibular dysfunction, facial paralysis and intracranial disease or infection. The term ‘cholesteatoma’ was first coined by the German physiologist Johannes Muller in 1838 (6). The annual incidence of cholesteatoma was approximately 3 per 100000 in children and 9.2 per 100000 in Caucasian population in Northern Europe (7).

Imaging of COM:
High – resolution CT scanning in coronal and axial planes of the temporal bone is recommended in the pre-operative evaluation of cholesteatoma (8). CT may help to assess the extent of disease in a partially aerated mastoid. However, cholesteatoma appears as a homogenous mass with similar density to oedematous mucosa and to brain tissue. CT show pneumatisation of the mastoid which may influence surgical approach and will demonstrate any anatomical variants. It may show bony labyrinth erosions, most commonly the lateral semicircular canal, the tegmen tympani, or the facial canal (9).

CT has been the standard imaging for many years. It provides very good resolution of anatomical landmarks. Its disadvantage is poor differentiation of cholesteatoma from soft tissues, granulation tissue, or cholesterol granuloma (10).

Bone erosion of scutum and incus and malleus and though rarely the stapes can be demonstrated. CT can often demonstrate erosion of the inner ear with fistula formation or dehiscence of the facial nerve, but negative CT does not rule out a fistula. It may demonstrate erosion of the bony labyrinth, most commonly the lateral semicircular canal, the tegment tympani or of the facial canal.

Patient and Methods:
40 patients included in our study between period June 2018 to June 2019, they are referred from otology department to radiology department in AL Hillah General Teaching Hospital that thin slices CT temporal bone was taken for all these patients. All patients were complaint chronic discharging ears (chronic suppurative otitis media) with complications. Different age groups included youngest was 15 years and eldest is 50 years, both males and females were included. All patients examined in ENT depart by otologist diagnosed a cases of chronic otitis media by otoscopic examination divided into active squamous and active mucosal types with complications like cholesteatoma, hearing loss, vertigo, facial palsy, then consent taken from all patients to perform CT scan temporal bone for them axial and coronal views. After that mastoid surgery done for all patients and compares of pre-operative and post-operative results confirmed. CT scan temporal bone taken for all patients, high resolution (HRCT, Type is Phillips-64), axial and coronal views in supine with 0.6 mm slices. Sections from lower margin of external auditory canal and extend upwards to arcuate eminence of superior semicircular canal. Slight extension of the head done to avoid the tilt so protect lens from radiation. Coronal images performed perpendicular to the axial plane from the cochlea to the posterior semicircular canal. Axial image should include top of petrous apex to the inferior tip of mastoid process (11). After CT scan taken read the findings of CSOM and complications as:

1. Soft tissue density in middle ears and mastoid.
2. Cholesteatoma or granulation tissue.
3. Bone erosions as scrotum, tegument tympani and tegment erosions.
4. Facial canal dehiscence.
5. Labyrinthine and semicircular canal fistula.
6. Ossicular chain erosion.
Then after patients operated on by mastoid surgery by otologist, mastoidectomy, with assessment of findings during surgery and compared with findings in preoperative CT scan.

**Results**

**Age incidence:** Group A (15-20 years): 3 of 40 patients (7.5%). Group B (20-40): 25 of 40 patients (62.5%). Group C (40-50): 12 of 40 patients (30%). Mean age is 32.77 years.

**Sex incidence:** 16 of 40 patients were female (40%), 24 of 40 patients were male (60%). Male to female ratio 1.5:1.

![Diagram (1): sex incidence](image)

**Incidence of symptoms & signs:**

<table>
<thead>
<tr>
<th>Symptoms &amp; signs</th>
<th>number</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache &amp; pain</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Vertigo</td>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td>Hearing loss</td>
<td>30</td>
<td>75</td>
</tr>
<tr>
<td>Discharging ear</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>Facial palsy</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

Table (1): symptoms & signs incidence (n=40)

**Incidence of pathology in middle ear:**

<table>
<thead>
<tr>
<th>Pathology</th>
<th>No. of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granulation tissue</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>Cholesteatoma</td>
<td>15</td>
<td>37.5</td>
</tr>
<tr>
<td>Polyp</td>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td>Total no.</td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

Table (2)

Pneumatisation of mastoid bone:
### Table (3)

<table>
<thead>
<tr>
<th>Mastoid air cells</th>
<th>No.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well pneumatised</td>
<td>25</td>
<td>62.5</td>
</tr>
<tr>
<td>Sclerotic</td>
<td>13</td>
<td>32.5</td>
</tr>
<tr>
<td>Poor</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total no.</strong></td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

Middle ear and mastoid mass:

<table>
<thead>
<tr>
<th>Mass</th>
<th>No. of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>In CT scan</td>
<td>25</td>
<td>62.5</td>
</tr>
<tr>
<td>In surgery</td>
<td>24</td>
<td>60</td>
</tr>
</tbody>
</table>

Table (4)

**Table 5: Cholesteatoma incidence:**

<table>
<thead>
<tr>
<th>Cholesteatoma</th>
<th>No.</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>In CT</td>
<td>15</td>
<td>37.5</td>
</tr>
<tr>
<td>In surgery</td>
<td>15</td>
<td>37.5</td>
</tr>
</tbody>
</table>

**Table 6: Incidence of complications in CSOM**

<table>
<thead>
<tr>
<th>Complication</th>
<th>No in CT</th>
<th>Percentage</th>
<th>No in surgery</th>
<th>percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scutum erosion</td>
<td>14</td>
<td>35</td>
<td>15</td>
<td>37.5</td>
</tr>
<tr>
<td>Ossicular bone erosion</td>
<td>11</td>
<td>27.5</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Facial canal dehiscence</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>7.5</td>
</tr>
<tr>
<td>Labyrinthine fistula</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>Semicircular canal fistula</td>
<td>3</td>
<td>7.5</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Tegument erosion</td>
<td>1</td>
<td>2.5</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Tegument tympani erosion</td>
<td>1</td>
<td>2.5</td>
<td>1</td>
<td>2.5</td>
</tr>
</tbody>
</table>
Discussion

In our study we diagnosed complications of CSOM by CT scan and compared findings with surgery.

Age incidence in our study, the youngest was 15 years and eldest was 50 years, group 15-20 years 3 of 40 patients (7.5%), group 20-40 years 25 of 40 patients (62.5%), group 40-50 years 12 of 40 patients (30%), in comprise with study in Mysore Medical College and Research Centre, Karnataka, India (12), was that 20 patients of 50 (40%) between 21 years and 30 years. The mean age in our study is 32.77 years; compared with above study was 26.88 years, difference due to age variation.

Male to female ratio was 1.5:1 compared with study done by Petrosvltsaraks et al (13) was 1.77:1.

The presenting symptoms in our study was discharging ear 100% which is commonest, hearing loss 75%, headache and pain 15%, vertigo and facial palsy 12.5% and 5% respectively. The most presenting symptoms in study of Mysore Medical College and Research Centre, Karnataka, India, JuveriaMajeed et al (12), was otorrhea (92%) and hearing loss (96%) followed by tinnitus (76%), facial palsy in 3 cases.

Our study identified incidence of middle ear pathology as: granulation in 20 patients (50%), cholesteatoma in 15 (37.5%) and polyp in 5 (12.5). other study JuveriaMajeed et al (12), showed incidence of these pathology as: granulation in 10 patients (40%), cholesteatoma in 9 (36%) and polyp in 2 (8%).

Pneumatisation of mastoid varies from well to sclerotic as follow:

Well pneumatized in 25 cases (62.5%), sclerotic in 13 (32.5%) and poor in 2 (5%). In other studies as Dr.RohitVallabhaneni and et al (14), which presented cholesteatoma with pneumatisatinof mastoid as follow: well in 22 cases of 50 (44%), sclerotic in 25 (50%) and diploic in 3 cases (6%). Also in near to study of Petros V Vlastarakos et al (15).
Patients’ undergone mastoid surgery in different centres of otolaryngology and we identified findings which compared with preoperative CT scan findings of complications of CSOM then identified incidence of these complications which compared with results of other studies as follow:

Middle ear mass (polyp/granulation) founded in CT scan 25 cases (62.5%) in surgery 24 (60%), cholesteatoma in 15 cases (37.5%) same no. and percent in surgery. In study of Juveria Majeed et al (12), found near to our results as: middle ear mass in CT scan 15 of 25 patients (60%), in surgery same no. 15 (60%), cholesteatoma in 9 cases (36%). While study of Rohit Vallabhaneni et al (14), found soft tissue opacity was present in 96.1% and cholesteatoma in 52%.

Complications of CSOM in our study reported and compared between CT scan and surgery findings as follow: Scutum erosion in CT was 14 (35%) in surgery 15 (37.5%), Ossicular bone erosion in CT 11 (27.5%) in surgery 8 (20%), Facial canal dehiscence in CT 2 (5%) in surgery 3 (7.5%), Labyrinthine fistula in CT 2 (5%) in surgery 1 (2.5%), Semicircular canal fistula in CT 3 (7.5%) in surgery 2 (2.5%), Tegmen antri erosion in CT 1 (2.5%) in surgery 2 (5%), and Tegmen tympani erosion in CT 1 (2.5%) in surgery 1 (2.5%).

In comparison with studies found that bone erosions was 80% in study of Dr.RohitVallabhaneni et al and near study of Firas Q. Alzoubi et al (16), And near study of Reilly et al (17). Also study of JuveriaMajeed et al, shown bone erosion in CT scan 12%, in surgery 12%, which is co-ordinated with our study.

Scutum erosion reported in 46% in study of Dr.RohitVallabhaneni et al and 88.4% of cases with cholesteatoma and near study of MehrdadRogha et al (18).

Ossicular erosion seen by study of JuveriaMajeed et al in 64% in CT and 44% in surgery not coordinated with our study, also study of of Mehrdad Rogha et al (18) shown different as 88%, this difference due to less than 1.5 mm CT scan slices accuracy. In study of of Dr.RohitVallabhaneni et al was 78%, which found that incus erosion in 48% and stapes in 30%. In study of Sandeep Berry et al (19), showed malleus and incus intact in 60% and absent in 40% on CT but in surgery 20% confirmed to be intact and necrosis in 26.6% and absent in 53.3%.

By our study Facial canal dehiscence in CT 2 cases (5%) in surgery 3 (7.5%) compared with study Dr.Rohit Vallabhaneni et al 4% in CT, in study of Juveria Majeed et al was 8% in CT and 12% in surgery, which shown correlation with our study, while study of ThripthiRai (20), Had 4 false negative cases, 6.25% in CT and 18.75% in surgery.

Labyrinthine fistula by our study 2 cases in CT (5%) and in surgery 1 (2.5%), while study of Dr.RohitVallabhaneni et al presented cochlear promontory fistula in one case (2%) like study of Firas Q. Alzoubi et al (17). Study of ThripthiRai (20) labyrinthine fistula seen in 3%.

By our study Semicircular canal fistula 3 cases in CT (7.5%) in surgery 2 (2.5%), While study of Dr.RohitVallabhaneni et al reported 1 case (2%) and similar to study of O’Reilly et al and Petros V. Vlastarakos et al study. 9% seen by Suat Keskin et al (21). In study of Sandeep Berry et al found 1 case (3.3%) in which CT reported fistula but in surgery was intact, and erosion of LSC seen in 10%. Tegmen antri erosion in CT 1 case (2.5%) in surgery 2 (5%), and Tegmen tympani erosion in CT 1 (2.5%) in surgery 1 (2.5%). Compared with study of ThripthiRai et al, seen in 12%, 3% tegmen tympani and 9% tegmen antri erosion, which is higher to 7% seen by Suat Keskin et al (21).

In study of MehrdadRogha et al dural plate erosion was reported in CT 30% and in surgery 23.3%, and sinus plate in CT 20% and in surgery 6.67% (18).
Complications | Our study | JuveriaMajeed et al | Sandeep Berry et al | Dr.RohitVallabhaneni et al | ThripthiRai | MehrdadRogha et al
--- | --- | --- | --- | --- | --- | ---
Scutum erosion | 35% CT 37.5% SX | 12% 12% | - | 46% | - | -
Ossicular bone erosion | 27.5% CT 20% SX | 46% 44% | 00 70% | - | - | 46% 44%
Facial canal dehiscence | 5% CT 7.5% SX | 8% 12% | 00 16.6% | 4% | 6.25% 18.75% | -
Labyrinthine fistula | 5% CT 2.5% SX | - - | 2% | 3% | -
Semicircular canal fistula | 7.5% CT 5% SX | - | 1% 10% | 2% | - | -
Tegmen antri erosion | 2.5% CT 5% SX | - | 30% 23.3% | - | 9% | 30% 23.3%
Tegmen tympani | 2.5% CT 2.5% SX | - | 20% 6.6% | - | 3% | -

Table (6)

**Conclusion & recommendation:**

- All cases of clinically diagnosed CSOM and are planning for surgery should be scanned by CT which shows extent of disease and alarm surgeon for surgical technique.
- Coordination between clinical data and CT findings of temporal bone is of important value in diagnosis of CSOM complications.
- Computed tomography scan of temporal bone should take in thin slices 1.5 mm and in both axial and coronal views and if can do sagittal transformed views to show all thin anatomical structures, as facial canal, tegument and lateral semicircular canal, and pathological changes.
- CT scan of temporal bone important in diagnosis of complications of CSOM.
- CT finding of middle ear and mastoid opacity with bone erosion mostly indicate cholesteatoma complication.

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