

HRCT Temporal Bone Findings in CSOM: Our Experience in Rural Population of South India

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Abstract:

Background and Purpose: To study the HRCT temporal bone findings in chronic middle ear infections with reference to its extent and complications.

Materials and Methods: After an initial clinical assessment, 50 patients diagnosed clinically with chronic suppurative otitis media (CSOM) were referred for a HRCT of temporal bone which was done with a GE brightspeed elite 16 slice CT scanner.

Results: Of the 50 patients, 52% were males and 48% were females. Otorrhoea (100%) is the most common symptom. Scutum was eroded in 23 cases. Incus (24 cases) is the most commonly eroded among the ossicles. Mastoiditis and mastoid abscess (20%) was the most common complication of CSOM followed by Sinus plate erosion (12%), Erosion mastoid Cortex (8%), Intracranial complications like abscess, dural sinus thrombosis (6%), Facial canal Dehiscence (4%), Tegmen tympani Erosion (2%), Cochlea erosion (2%), Tegmen mastoideum Erosion (2%) Lateral semicircular canal erosion (2%) Cholesteatomas were observed in 26 cases of which 9 cases were in attic, 6 cases were Attico-antral, 4 cases were in Mesotympanum, 7 cases were holotympanic. Various HRCT findings of temporal bone in chronic suppurative otitis media with cholesteatoma were Non-dependent soft tissue mass in 25 cases, Scutum erosion in 23 cases, Ossicle erosion in 20 cases, Labyrinthine fistula in 2 cases, Sigmoid sinus plate erosion in 6 cases, Mastoid cortex erosion in 4 cases, Tegmen erosion in 1 case and Mastoiditis with sub-periosteal abscess in 4 cases.

Conclusions: HRCT of temporal bone is useful in identifying various findings related to the location and extent of disease which are clinically occult and is of great importance in guiding the surgeon in planning the surgical approach.

I. Introduction

Chronic suppurative otitis media and resultant hearing loss remains a significant health problem in terms of prevalence, economics and sequelae. Short and long-term sequelae of otitis media may be devastating. It can be avoided if recognized early and properly treated. Early surgical intervention is needed to limit the disease. The presence, location and extent of disease along with the presence of any complications determine the surgical approach to be followed. As such imaging plays an important role in providing crucial information to the surgeon in this regard.

Many imaging modalities are available for the evaluation of the temporal bone, including plain radiographs, angiography, cerebrospinal fluid (CSF) analysis, air and non-ionic contrast cisternography, computed tomography (CT) with 2D and 3D reconstructions, and magnetic resonance imaging (MRI). CT and MRI are currently the most widely used techniques and have largely replaced other modalities.

Conventional radiography has been of value in screening the entire temporal bone. It produces a composite single plane image of a tridimensional temporal bone resulting in superimposition where larger and denser structures obscure smaller and less denser ones. CT scanning excels in the evaluation of bone and air space anatomy and disorders. Because CT scans are more accurate in identifying many soft tissue abnormalities and are much less prone to artifacts, they have largely replaced polytomography; there is also less radiation to the lens with CT scans than with polytomography. CT has the advantage of producing images with higher contrast and a better spatial resolution.¹

MRI has expanded the range of pathology that can be accurately evaluated because it can image many soft tissue entities not visible by other techniques. MRI studies can also be extremely useful in the evaluation of blood vessel related disorders of the temporal bone.

HRCT, a modification of routine CT provides a direct visual window into the temporal bone providing hitherto unavailable minute structural details. The purpose of the study is primarily to understand the capability of CT in diagnosis and detection of various pathological changes occurring in the temporal bone in a case of chronic suppurative otitis media.

II. Methods

This is a prospective cross-sectional study to evaluate the role of HRCT of temporal bone in 50 patients clinically diagnosed with CSOM and referred to the Department of Radiodiagnosis and Imaging, PES Institute of medical sciences, Kuppam for HRCT scan of temporal bone between October 2013 to September 2015. All male and female patients between 1yr and 80yrs referred with clinical diagnosis of CSOM were imaged.

Patients who were clinically diagnosed with chronic suppurative otitis media were subjected for HRCT examination.

The visualization of small bone structures, location and extent of lesions and the radiological changes were evaluated.

Patients with electric devices at the skull base, such as cochlear implants, those who have undergone previous temporal bone surgeries and those with history of trauma to the temporal bone were excluded from the study.

All the HRCT scans were performed at our institute on the GE Brightspeed Elite 16 slice MDCT. After written informed consent patients were scanned in the axial plane.

Topograms were taken routinely in all patients before starting the scan. Scanning commenced from the lower margin of the external auditory meatus including the inferior mastoid and extended upward to the arcuate eminence of the superior semicircular canal as seen on lateral topogram. Slight extension of the head was given to avoid gantry tilt and thereby protect the lens from radiation.

Helical acquisition in the axial plane was performed. Reformatted coronal images were obtained perpendicular to the axial plane from the cochlea to the posterior semicircular canal.

Scanning parameters: 140 kV, 200 mA s, 0.625 mm section thickness, 0.625 mm interval, 10-mm beam collimation, 0.562:1 pitch.

The contralateral temporal bone was included for comparison. The images were reconstructed with a bone algorithm. All images were interpreted on GE advantage workstation using source images, multiplanar reformations and required window settings.

Intravenous contrast was administered to study the intracranial extension of middle ear disease.

III. Results

Of the 50 patients, the age at presentation ranged from 1 year to 77 years. The mean age was 34 years and the maximum numbers of patients affected belonged to the age group of 41 to 50 years. In this study CSOM was slightly more common in males (52%) than females (48%). Otorrhoea (100%) is the most common symptom followed by hearing loss (62%), otalgia (30%), vertigo (12%), tinnitus (10%), fever with chills and rigors (10%), headache (8%), nausea and vomiting (6%), swelling behind the ear (6%) and facial weakness (4%). The disease was more common on right side (38%) compared to left side (36%) followed by bilateral disease (26%).

Scutum was eroded in 23 cases. Incus (24 cases) is the most commonly eroded among the ossicles followed by stapes (15 cases) and malleus (15 cases).

The mastoid air cells were well pneumatized in 22 cases (44%), sclerotic in 25 cases (50%) and diploic in 3 cases (6%).

Wide spectrum of complications of CSOM were observed in the study population. Mastoiditis and mastoid abscess (20%) was the most common complication followed by Sinus plate erosion (12%), Erosion mastoid Cortex (8%), Intracranial complications like abscess, dural sinus thrombosis (6%), Facial canal Dehiscence (4%), Tegmen tympani Erosion (2%), Cochlea erosion (2%), Tegmen mastoideum Erosion (2%) Lateral semicircular canal erosion (2%)

The disease was seen to involve protympanum in 11 cases (22%), Mesotympanum in 14 cases (28%), Posterior-tympanum in 16 cases (32%), Epitympanum in 28 cases (56%), Hypotympanum in 14 cases (28%), Peri-labyrinthine cells in 7 cases (14%), Aditus in 26 cases (52%), Antrum in 28 cases (56%) and Mastoid air cells in 24 cases (48%)

Cholesteatomas were observed in 26 cases of which 9 cases were in attic, 6 cases were Attico-antral, 4 cases were in Mesotympanum, and 7 cases were holotympanic.

Various HRCT findings of temporal bone in chronic suppurative otitis media with cholesteatoma were Non-dependent soft tissue mass in 25 cases, Scutum erosion in 23 cases, Ossicle erosion in 20 cases, Labyrinthine fistula in 2 cases, Sigmoid sinus plate erosion in 6 cases, Mastoid cortex erosion in 4 cases, Tegmen erosion in 1 case and Mastoiditis with sub-periosteal abscess in 4 cases.

IV. Discussion

In an attempt to establish the HRCT imaging features of temporal bones in CSOM, a total number of 50 patients were studied. The maximum number of patients were in the third and fourth decades of life (mean age-34 years) which is similar to study by Paperella & Kim2.

In this study, male: female ratio was 1.08:1 which is in accordance with the study by Kemppainen et al.3. However, in study by Petros V. Vlastarakos et al.4, there was a slightly higher incidence in females.

The most common presenting symptom was otorrhoea followed by hearing loss and otalgia which is in accordance with a study by E. Yorgancilar et al.5. The incidence of patients presenting with tinnitus, vertigo, nausea, vomiting, fever with chills and rigors and facial nerve palsy were in significant numbers in present series. This probably indicates that the patients come to hospital relatively late and are reluctant for initial treatment. In the present study, right ear was affected more commonly.

Bone erosion was identified in 80% cases. This value is in accordance with data by Firas Q. Alzoubi et al.6 and O'Reilly et al.7. This finding is however not correlating with Jackler et al.8, O'Donoghue et al.9 and Mafee et al.10. Scutum erosion was seen in 88.5% cases with cholesteatoma which is in accordance with that seen by Gaurano JL et al.11. This is slightly higher than the values observed by Mehrdad Rogha et al.12

Ossicular erosion was observed in most cases of CSOM associated with cholesteatoma. Though there was some variation in the incidence of erosion of each ossicle in different studies, it was identified that incus is the most commonly involved ossicle in all the studies. Most studies have stated that erosion of scutum is also a common finding associated with cholesteatoma. Also involvement single or multiple ossicle is associated with the severity of disease process and a poor prognostic indicator.

Patterns of mastoid pneumatization were in agreement with findings of Petros V Vlastarakos et al. 4.

In this study, facial canal dehiscence was noted in 2 patients amounting to 4% of the study population which was similar to that found by Firas Q Alzoubi et al.6 and Garber et al.13

Tegmen Tympani erosion was seen in 1 case, i.e. about 2% of study population which is in agreement with results by Jackler RK8, O'Reilly BJ et al.7 and Gerami H et al.14

Cochlear promontory fistula was seen in one case in this study. As such incidence of cochlear erosion accounts for 2% of the patients which is similar to study by Firas Q. Alzoubi et al.6

Incidence of cortical erosion of mastoid was slightly less than the findings of Ranga Reddy Sirigiri et al.15

Sigmoid sinus plate erosion was observed in 12% of the cases which is in accordance with studies by Petros V.Vlastarakos et al. 4

In this study erosion of tegmen mastoideum is found in 1 case which is in correlation with the study by Ranga Reddy Sirigiri et al. 15

Lateral semicircular canal erosion was seen in 1 case which is similar to study by O'Reilly BJ et al.7, Petros V.Vlastarakos et al. 4 and Zhang X et al.16

Mastoiditis and mastoid abscess are the most common complication observed in the study. This is in keeping with the findings of E. Yorgancilar et al. 5 who stated that mastoiditis and mastoid abscess was the most common complication intracranial complications were identified in 6% of the study population. One case had a cerebral abscess, one had right sigmoid and transverse sinus thrombosis and one more case had meningitis, subdural empyema and cerebral venous thrombosis. The incidence of intracranial complication was less compared to the study by E. Yorgancilar et al. 5. This variation might be because of early diagnosis and intervention in cases of CSOM.

In this study, the incidence of cholesteatoma in the protympanum, mesotympanum, posterior tympanum, epitympanum, Hypotympanum was in agreement with studies by Ranga Reddy Sirigiri et al. 15

Involvement of aditus and antrum were however lower than that observed by Ranga Reddy Sirigiri et al. 15 who stated an incidence of 84%.

In this study there were 26 cases of cholesteatoma. There was considerable variation in the location extent of involvement of cholesteatoma in the study population. Attic was the most common location, similar to that observed by Gaurano JL et al.11

In this study, non-dependent soft tissue opacity was present in 96.1% of patients with chronic otitis media with cholesteatoma which is similar to findings by Ranga Reddy Sirigiri et al. 15.

In this study, 88.4% of patients with chronic otitis media with cholesteatoma had scutum erosion. Ossicle erosion was seen in 76.9% of patients with chronic otitis media with cholesteatoma. This is similar to findings by Saat Keskin et al.17. Incus was the commonest ossicle to be involved.

In this study, patients with CSOM associated with cholesteatoma showed well-pneumatized mastoid in 44%, sclerotic in 50% and diploic in remaining 6%. These values are comparable to studies by Ashwani Sethi et al.18

In this study, labyrinthine fistula was seen in 7.6% of patients with cholesteatoma. Out of this one case was seen in lateral semicircular canal and one in cochlear promontory. These values are similar to the findings of Saat Keskin et al. 17

Sigmoid sinus plate erosion was found in 23% of patients with cholesteatoma which is slightly higher than that reported by Abdel. Rahim Ahmed Abdel. Karim et al.19

In our study, mastoid cortex erosion was seen in 15.3% of patients and tegmen erosion was seen in 3.8% of patients with CSOM associated with cholesteatoma.

Mastoiditis complicated with subperiosteal abscess was found in 15.3% cases of chronic otitis media with cholesteatoma.

The radiological findings of temporal bone in patients with chronic otitis media were presence of non-dependent soft tissue mass in most of the cases followed by ossicle erosion, scutum erosion, sigmoid sinus plate erosion, labyrinthine fistula, tegmen erosion and mastoid cortex erosion. Other findings included mastoiditis with sub-periosteal abscess.

In ossicular erosion, incus was most commonly involved followed by stapes and malleus. Most of the mastoid in this study were sclerotic followed by pneumatized and diploic.

The extent of involvement of middle ear and mastoid in cholesteatoma in decreasing order of frequency are highest involvement of epitympanum and antrum followed by aditus, mastoid air cells, posterior tympanum, mesotympanum, hypotympanum, protympanum and peri-labyrinthine air cells.

Chronic otitis media and associated complications can be, at times life threatening as such early diagnosis and treatment is very important. Advent of HRCT and multiplanar assessment ability has definitely improved study of temporal bone in patients with chronic otitis media which includes evaluation of the extent and sites of involvement and inter-relationships of the tympanomastoid compartment with adjacent neurovascular structures.

One of the main drawback in our study is that soft tissue changes like labyrinthitis could not be evaluated on HRCT. MRI has a higher soft tissue resolution in identification of labyrinthitis. Similarly differentiation between cholesteatoma, granulation tissue and effusion is difficult on HRCT. However on MRI this is possible, especially diffusion weighted imaging where cholesteatoma restricts but granulation tissue does not restrict. As such HRCT apart from diagnosis, is mainly useful in the preoperative evaluation of the type, location and extent of disease process to help the surgeon in planning further management.

Also a further population based study for a longer duration is needed to make a more reliable comparison with the standard studies.

V. Conclusion

CSOM is a common disease that can have serious, life threatening complications. As such early diagnosis and treatment is of importance for a good patient prognosis. HRCT of temporal bone is of great value in the diagnosis and preoperative assessment of a case of CSOM. CSOM is more common in the younger age group with a slight male preponderance. Patients usually present with otorrhea. Other symptoms include hearing loss, otalgia, vertigo, tinnitus, fever with chills and rigors, headache, nausea, vomiting, swelling behind the ear and facial weakness. Scutum and ossicular erosion is often present in a case of CSOM with cholesteatoma. Incus is the most commonly involved ossicle, followed by stapes and malleus. Mastoiditis and mastoid abscess is the most common complication, followed by sinus plate erosion, mastoid cortex erosion, intracranial complications, facial canal dehiscence, tegmen tympani erosion, cochlear erosion and LSCC erosion. Epitympanum is the most commonly involved site followed by posterior tympanum. Cholesteatoma was most often noted in the attic followed by holotympanic type extending to the mastoid antrum. The various findings observed in the patients with CSOM are nondependent soft tissue mass, scutum and ossicular erosion, labyrinthine fistula, sigmoid sinus plate erosion, mastoid cortex erosion, tegmen erosion, and mastoiditis. HRCT of temporal bone is useful in identifying various findings related to the location and extent of disease which are clinically occult and is of great importance in guiding the surgeon in planning the surgical approach.

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