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Original Research Article

Clinicoradiological correlation between preoperative high-resolution computed tomography findings and intraoperative findings in chronic otitis media (squamous type)

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ABSTRACT

Background: Chronic otitis media is a major health problem with significant morbidity. High-resolution computed tomography (HRCT) is extremely useful for middle ear pathology and extension of the disease. The objective was to study the correlation between preoperative HRCT and intraoperative findings in chronic suppurative otitis media (squamous type).
Methods: This analytical study included 61 cases of chronic otitis media (squamous type). Preoperative HRCT findings were correlated with intraoperative findings. Sensitivity, specificity, PPV, NPV and kappa value were estimated.
Results: Out of 61 cases 32 were males and 29 were females. Presence of cholesteatoma found on HRCT with 80% sensitivity with k value 0.83 suggesting very good agreement. About ossicular status k value of incus, malleus and stapes were 0.76, 0.65 and 0.54 respectively with sensitivity of 91%, 85% and 58% respectively. Other critical areas on HRCT like sigmoid sinus plate erosion, tegmen tympani dehiscence, scutum erosion, lateral semicircular canal erosion, facial canal erosion and jugular bulb were seen with k value was about 1, 0.8, 0.9, 0.82, 0.72 and 0.65 respectively. So, HRCT shows perfect radiosurgical agreement for sinus plate erosion, very good agreement for disease extension, incus erosion, tegmen tympani erosion, scutum erosion and LSCC erosion and fair agreement for malleus erosion, facial canal erosion and jugular bulb dehiscence and poor agreement for stapes erosion.
Conclusions: HRCT is a reliable preoperative investigation in cases of chronic otitis media, squamosal type which would provide a bird's eye view in the disease process in the ear.

Keywords: HRCT, Chronic otitis media, Cholesteatoma, Radiosurgical agreement

INTRODUCTION

India has the second highest prevalence of chronic suppurative otitis media (7.8%) in the world.[1] Otitis media is an inflammation of part or all of the mucoperiosteal lining of the tympanomastoid compartment. Chronic otitis media is characterized by inflammatory process of the middle ear space which ends in the permanent changes like retraction pocket, perforation, tympanosclerosis and cholesteatoma formation.[2]

Preoperative imaging like HRCT is useful in chronic otitis media as it gives information about ossicular chain status, location and extent of disease, asymptomatic complications and degree of bone destruction, evaluating

the facial nerve, tegmen and sinus plate and determining identification of the nature, site, size, extension and invasion into adjacent structures and tissue plane including the intracranial extension has been made possible by HRCT thereby affecting the course of the management.[4]

The use of HRCT in the preoperative evaluation of the patient with chronic otitis media is still controversial. Some autologist use it regularly aiming to evaluate the extension of the disease, which helps to plan the surgical strategies and helps to reduce the postoperative risks. Others reserve its utilization for cases of suspicion of complications ,recurrence or diagnostic doubts, using the surgical indication only.[5]

The objective was to correlate HRCT findings and intraoperative findings in chronic otitis media squamous type.

METHODS

This analytical study was carried out at the department of ENT, head and neck surgery of Shree Krishna hospital Kramasad, Anand over a period between June 2018 to September 2020. Total 61 patients of clinically suspected chronic otitis media were included in this study.

Inclusion criteria

All patients of both sex, who were diagnosed with chronic otitis media squamous type (with or without complications) and patients with recurrent or residual chronic otitis media were included in this study.

Exclusion criteria

There was no criteria for exclusion in this study.

All patients were subjected to complete ENT clinical examination, microscopic examination, otoendoscopy examination followed by preoperative HRCT temporal bone in both coronal, sagittal and axial sections. HRCT scan performed by using high resolution and bone algorithm with coronal scans performed in 1.0 mm sections and axial scan performed in 0.6 to 5.0 mm sections.

Following areas were looked up in the HRCT scan like status of mastoid air cells, Tegmen plate, sigmoid sinus plate, ossicular chain status, fallopian canal, semicircular canal, outer attic wall (scutum), pathological process (cholesteatoma and its extension).

All patients underwent surgical exploration and type of surgery was determined by the clinical diagnosis, HRCT findings and intraoperative findings. All intraoperative dural sigmoid sinus and jugular bulb status.[3] Accurate findings are recorded. Cohen's Kappa coefficient was used to calculate correlation between HRCT and intraoperative findings. This was an analytical study using sensitivity, specificity, positive preductive value and negative preductive value for HRCT findings comparing with intraoperative findings.

RESULTS

Out of 61 patients 32 were males and 29 were females. Majority of the patients were in the age group between 16-30 years. Most common presenting complain was the otorrhoea followed by hearing loss.

Otoscopic findings and microscopic findings were key to clinical diagnosis. On otoscopic examination retraction pocket with cholesteatoma in the posterosuperior quadrant was the commonest finding. 34.42% cases had retraction in the pars tensa and 18.03% cases had retraction in the pars flaccida. Cholesteatoma was seen by otoscopy in 24% cases in posterosuperior quadrant and 16% cases in attic region. Polyps and granulations present in about 11.47% cases.

In this study HRCT showed nondependent homogenous soft tissue (cholesteatoma) in the middle ear cavity with 80.00% sensitivity and 91% specificity. HRCT was 80% sensitive for epitympanum disease, 87.80% sensitive for aditus and antrum disease, 83.33% sensitive for mesotympanum disease, 81.80% sensitive for sinus tympani disease.

Ossicular chain erosion was found in most of the cases (around 80%). Incus was the most commonly involved ossicle for erosion. HRCT showed 91.83% sensitivity and 91.66% specificity in detecting incus erosion. In HRCT sensitivity of malleus erosion was 83.33%. HRCT showed 58.82% sensitivity in detecting stapes erosion due to inconsistent visualization of stapes.

Facial canal erosion seen in total 11 (18%) cases in CT scan and 16 (26%) cases intraoperatively. So, HRCT has 68.75% sensitivity to detect facial canal erosion as per our study. Kappa value was 0.72 which suggest fair agreement for the correalation between HRCT and intraoperative findings for the facial nerve canal erosion.

Lateral semicircular canal erosion seen in 5 (8.19%) cases in CT scan and 7 (11.47%) cases during intraoperatively with high specificity of about 100% and k value was 0.82 which showed very good agreement for correlation.

Scutum erosion visualized in 24 (40%) cases in CT scan and in 27 (44%) cases intraoperatively with 88.88% sensitivity of HRCT and k value was 0.90 which showed very good agreement between HRCT and intraoperative findings.

Table 1 : Correlation between radiological findings and intraoperative findings of status of ossicular chain and other critical areas.

Other critical areas	CT	Surgery	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	K value
Malleus erosion	34	36	83.33	72.00	81.08	75.00	0.65
Incus erosion	46	49	91.83	91.66	97.82	73.33	0.76
Stapes erosion	18	30	58.82	96.77	94.44	69.76	0.54
Facial canal dehiscence	11	16	68.75	97.77	91.66	89.70	0.72
LSCC dehiscence	05	07	71.00	100.00	100.00	96.42	0.82
Sigmoid sinus plate erosion	03	03	100.00	100.00	100.00	100.00	1.0
Outer attic wall erosion	24	27	88.88	100.00	100.0	91.89	0.90
Tegmen tympani dehiscence	11	11	90.90	98.03	90.90	98.03	0.89
Jugular bulb dehiscence	02	04	50	100	100	98.33	0.65

Table 2: Calculated Cohen's kappa value of HRCT temporal bone in COM squamous type.

Outcome variables	Cohen's kappa	Inferences
Disease activity	0.83	Very good agreement
Malleus erosion	0.65	Fair agreement
Incus erosion	0.76	Good agreement
Stapes erosion	0.54	Poor agreement
Facial canal erosion	0.72	Fair agreement
Lateral SCC erosion	0.82	Very good agreement
Sigmoid sinus plate erosion	1.0	Perfect agreement
Outer attic wall erosion	0.9	Very good agreement
Tegmen tympani dehiscence	0.89	Very good agreement
Jugular bulb dehiscence	0.65	Fair agreement

Sigmoid sinus plate erosion was seen 3 (4%) cases in both with 100% sensitivity in HRCT with k value was 1.0 which suggested perfect agreement for correlation and Tegmen tympani dehiscence which was seen in 11 (18.03%) cases in both CT scan and intraoperatively with 90.90% sensitivity of HRCT.

Jugular bulb dehiscence seen in 2 (3%) cases in CT scan and 4 (6%) cases intraoperatively with 50% sensitivity and 100% specificity of HRCT.

DISCUSSION

The natural progression of an untreated cholesteatoma is expansion at the expense of the bony structures and confines of the middle ear space. Preoperative knowledge of the extent of the disease and anatomical landmarks of the mastoid air system is helpful in anticipating the structures involved and deciding the technique used for mastoid surgery. Subtle changes like ossicular erosion, involvement of hidden areas and erosion of the facial canal and the lateral semicircular canal (LSCC) is better assessed by HRCT scan of the temporal bone.

Out of the 61 patients included in the study, maximum number, 30 patients (49%) were in the age group between 16-30 years. The mean age in the present study was 25 years which is similar to the study done by Chintale et al. In the present study which included 61 cases, 32 (52.45%) were males and 29 (47.54%) were females. We observed a male predominance in the disease occurrence because attention to males are common in health care society which are comparable with a study performed by Kemppainen et al.[6]

In HRCT scan disease status (presence of cholesteatoma) was reported in 45 (73.77%) cases while frank cholesteatoma was present intraoperatively in 51 cases (83.6%). HRCT was 80.80% sensitive and 91% specific for diagnosing cholesteatoma. The observations of our study are in contrast with the observations made by Sirigiri et al who observed that HRCT was 92% sensitive and 66% specific for diagnosing cholesteatoma. In our study sensitivity of HRCT was 80.80% because soft tissue density areas in middle ear and mastoid without bone erosion were suggested as chronic otitis media or granulations tissue, thus specificity is more as compared to other study.[7]

In present study the sensitivity of HRCT for diagnosing disease in epitympanum, mesotympanum, antrum and aditus were 80%, 83.3%, 87% and 87% respectively and

specificity was 91%, 95.70%, 100% and 100% accordingly suggest that it was an excellent investigation for those without the disease. In the study done by Tak et al sensitivity of HRCT for diagnosing disease in epitympanum, mesotympanum, antrum and aditus was found to be 85%, 87%, 90% and 88% respectively which is in concordance with our study.[3]

Ossicles erosion

In the present study, incus was the commonest ossicle to be involved by cholesteatoma. As in our study HRCT temporal bone was found to be 91.8% sensitive and 91.66% specific for incus erosion which correlates well with the study done by Tak et al who showed 91% sensitivity and 95% specificity.[3] Malleus was second most common eroded ossicle seen in 60% cases with sensitivity 83.33% and specificity 72.00% in our study which is almost similar to the study by Garg et al who studied 60 patients with 90.9% sensitivity and 80% specificity for malleus erosion.[8] Stapes erosion had moderate sensitivity of 58% and specificity 96% as per our study which is concordance with the study done by Shah et al and Jackler et al who observed 62% sensitivity and 94% specificity for stapes erosion.[9,10] This low sensitivity of the stapes erosion detection by the HRCT is due to occasional deceptive appearance of stapes as soft tissue density in the oval window niche. In the present study, Cohen's kappa for ossicular erosion was calculated to be 0.65, 0.76 and 0.54 for malleus, incus and stapes respectively. Radiosurgical agreement was good for incus and fair for malleus and poor for stapes.

Tegmen tympani dehiscence

In our study HRCT was found to be 90.90% sensitive and 98% specific in detecting tegmen tympani erosion which is concordance with the study by Tak et al and Jackler who reported a sensitivity of 100% in identifying tegmen tympani erosion.[3,10] In our study the kappa value calculated for correlation for tegmen tympani dehiscence between HRCT and intraoperative findings was found to be 0.89 denoting a very good agreement.

Sigmoid sinus plate erosion

In this study, sinus plate erosion was noted with 100% sensitivity and 100% specificity. Chatterjee et al have reported almost similar findings with 98.89% sensitivity and 100% specificity for sinus plate erosion.[11] Cohen's kappa was calculated in our study was 1 which suggests a perfect radiosurgical agreement for sinus plate erosion. These findings were consistent with the Bathla et al, Karki et al, Chatterjee et al.[11-13]

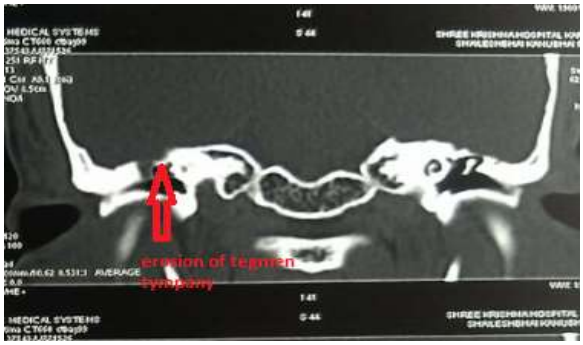

Figure 1: Coronal image showing tegmen tympany erosion.

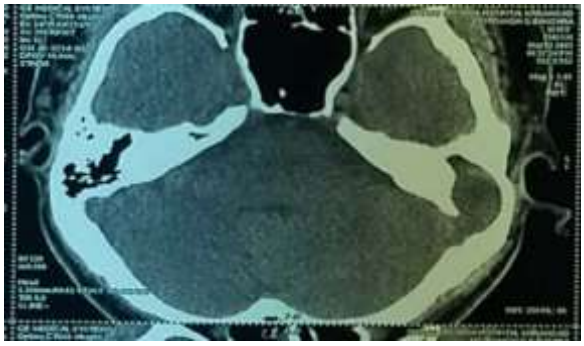

Figure 2: HRCT scan showing sigmoid sinus erosion.

Facial canal dehiscence

In our study facial canal erosion was reported on HRCT with moderate sensitivity 68.75% but high specificity 97.77% which is consistent with the studies done by O'reily et al and Jackler et al noted that reporting of dehiscence in the facial nerve canal by HRCT had a sensitivity of 60% and specificity of 90%.[8,14] The reason for the low sensitivity of HRCT to detect facial canal erosion is probably due to the thin bony floor of the facial canal which is not visualized on coronal and axial plane sometimes and in some cases there is soft tissue overlying the canal which obscuring a small erosion.

Figure 3: Intraoperative facial canal dehiscence.

Lateral semicircular canal erosion

In our study we noted lateral semicircular canal erosion with 75% sensitivity and 100% specificity. Rogha et al who studied correlation between HRCT and intraoperative findings of lateral semicircular canal erosion reported 75% sensitivity and 87.5% specificity. We found a very good radiosurgical correlation for lateral semicircular canal dehiscence with kappa value of 0.83 which correlated with the study done by Bathla et al, Karki et al and Chatterjee et al.[11-13]

Jugular bulb dehiscence

In present study jugular bulb dehiscence was present with moderate sensitivity of 50% and high specificity of 100%. Study done by Prakash et al showed 100% sensitivity and specificity in detecting jugular bulb dehiscence. This variability is probably due to the fact that at times jugular bulb dehiscence is visualized on HRCT as a thinning of the jugular bulb wall and falsely reported as intact jugular bulb.

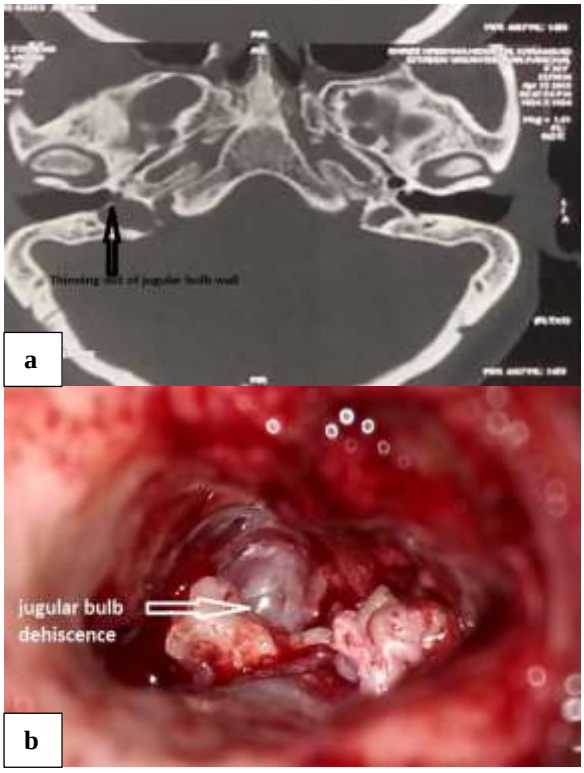

Figure 4: (a) axial image of HRCT showing jugular bulb dehiscence; (b) intraoperative finding showing jugular bulb dehiscence.

Limitations

Main disadvantage of the HRCT is that it could not differentiate between soft tissue density, soft tissue density in middle ear and mastoid without erosion suggested as chronic otitis media or granulations. Thus specificity is more than sensitivity in comparison to other study.

CONCLUSION

HRCT is a reliable preoperative investigation in case of chronic otitis media, squamosal type which would provide a bird's eye view of the disease process in the ear facilitating anticipation of structures eroded and ossicular reconstruction required intraoperatively and potential complications that encountered during surgery can be prevented.

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