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Evaluation of chronic otitis media using computed tomography of temporal bone

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ABSTRACT

Introduction: Chronic otitis media is a inflammatory condition of middle ear, which is treated by appropriate surgery. Prior to surgery to evaluate extent of disease, complications and anatomical variation is essential. Our study is to determine the reliability of HRCT temporal bone for this purpose.

Methodology: Chronic otitis media patients attending ENT OPD who underwent HRCT temporal bone and treated surgically were taken in the study after obtaining informed consent with the clearance of Institutions Ethical committee.

Results: HRCT exhibited excellent sensitivity and specificity in identifying different abnormalities within the temporal bone, including erosion of the scutum and malleus, mastoiditis, and mastoid abscess, achieving 100% sensitivity and specificity. Moreover, it demonstrated high sensitivity in detecting cholesteatoma across various regions of the middle ear and mastoid, with a sensitivity exceeding 80%. Nevertheless, its sensitivity varied depending on the complication, with facial canal dehiscence and tegmen erosion showing 100% specificity but lower sensitivity for other complications.

Discussion: Similar results with other studies were found and has shown HRCT as a reliable investigation for preoperative evaluation.

Conclusion: HRCT showed high sensitivity and specificity in identifying different abnormalities within the temporal bone. To make a more valid comparison with the conventional research, another population-based study with a longer length Interval is required.

1. INTRODUCTION

Chronic otitis media, a common middle ear condition, often results from prolonged inflammation, posing risks due to its association with mastoid air cells. Recurrent infections can lead to permanent damage to the tympanic membrane, potentially causing intracranial complications. A radiographic evaluation of the temporal bone is necessary to assess inflammation before surgery.

Understanding the types of chronic otitis media is crucial for effective treatment. These include mucosal diseases (active, inactive, and healed) and squamous diseases (involving retraction pockets or cholesteatoma). Squamous types carry a higher risk of complications, emphasizing the need for prompt recognition and treatment to prevent hearing loss and serious health issues.

Despite antibiotic advancements, chronic otitis media remains prevalent, highlighting the importance of early evaluation to prevent irreversible hearing loss and further complications. Computed tomography aids in determining severity and guiding clinical management.

Advances in radiology, particularly computed tomography, have significantly enhanced diagnosis and understanding of pathological changes in chronic otitis media. This non-invasive procedure provides detailed images of the temporal bone, aiding in the detection of abnormalities such as osseous erosion, indicative of cholesteatoma.

The study aims to establish a correlation between clinical evaluation, surgical technique, and CT findings in chronic otitis media patients, underscoring the necessity of comprehensive assessment for effective treatment planning and outcomes.

2. METHODOLOGY

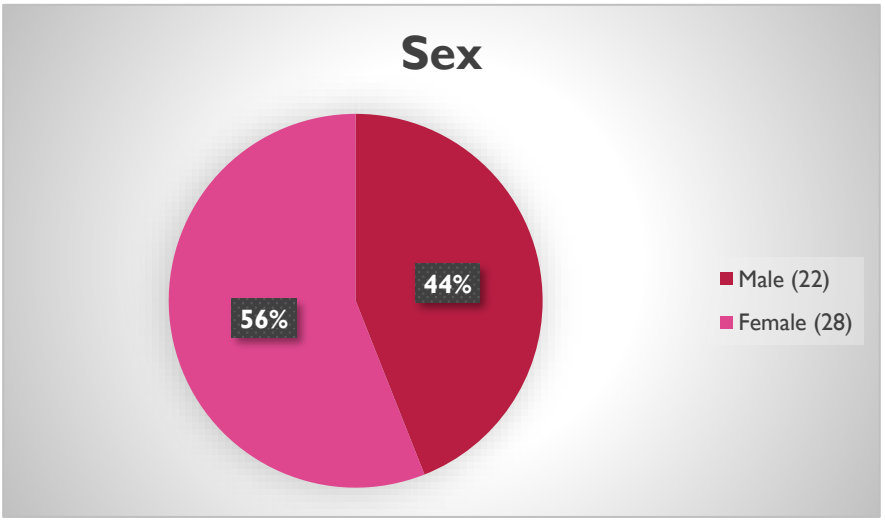
This study encompasses patients of all ages, including children and adults, diagnosed with chronic otitis media of both mucosal and squamous types, regardless of gender, who agree to undergo a CT scan of the temporal bone. Exclusions consist of pregnant individuals, clinically unstable patients, and those with a history of ear surgery. Upon approval from the institutional Ethics Committee, 50 eligible patients willing to participate in the study were taken. Comprehensive examinations and investigations were conducted, followed by appropriate surgery under general anesthesia, intraoperative findings meticulously documented. The collected CT data was compared and analyzed alongside intraoperative observations using statistical tools such as SPSS and Excel. This analysis aims to provide insights into the correlation between preoperative imaging and intraoperative findings, shedding light on the efficacy of CT scans in guiding surgical interventions for chronic otitis media.

3. RESULTS

The study was conducted on CT temporal bone in COM patients at the ENT Department. The study revealed the following results:

DEMOGRAPHICS:

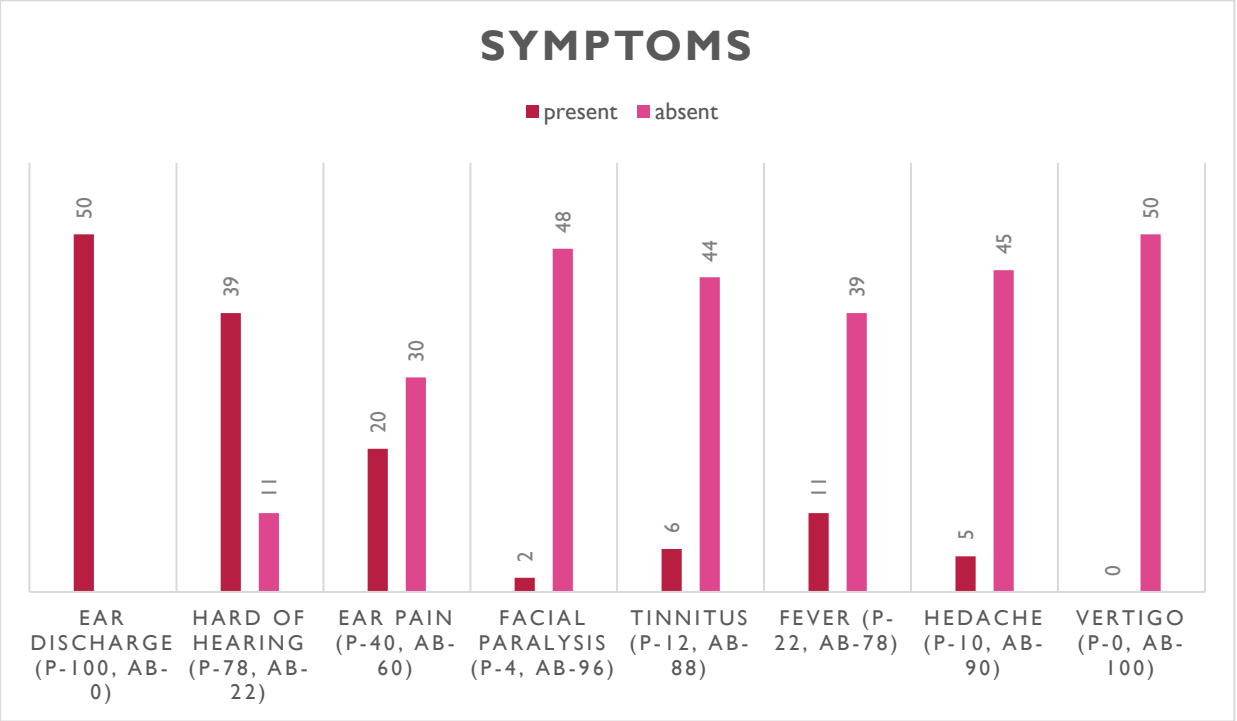
- 56% of the study population were female, and 44% were male.



- The age distribution was as follows: 20% were ≤ 20 years old, 34% were between 21 and 30 years old, 30% were between 31 and 40 years old, and 16% were between 41 and 50 years old. The mean age was 27 years.

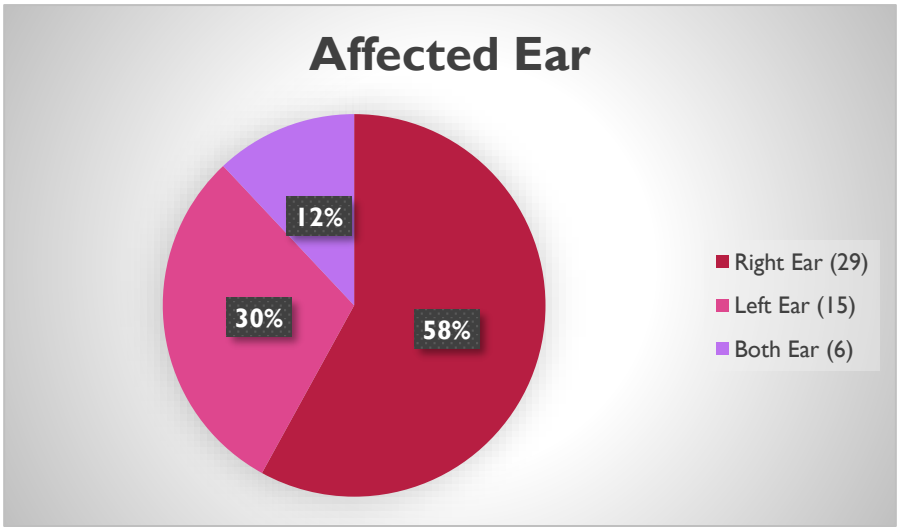
SYMPTOMS:

- All study participants presented with ear discharge, 78% had hearing loss, 40% had otalgia, 6% had tinnitus, 2% had facial paralysis, 11% had fever, and 5% had headaches. None experienced vertigo.



AFFECTED EAR:

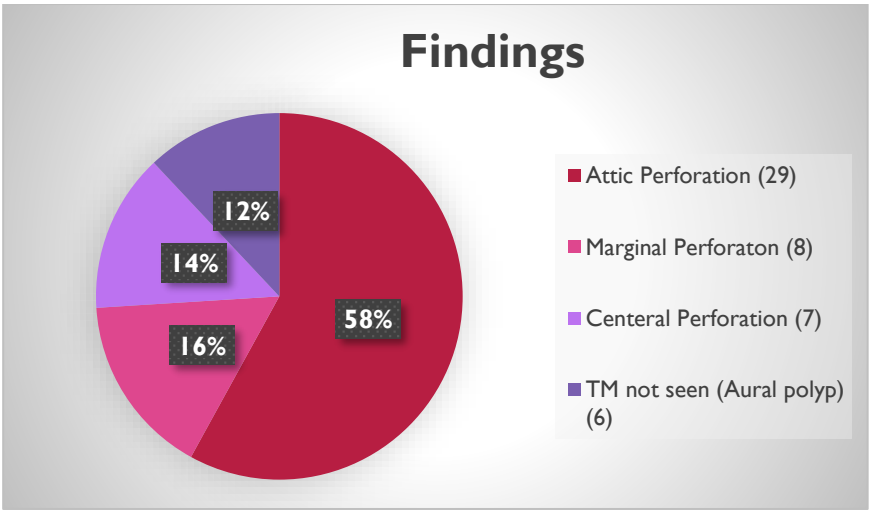
- 58% had the right ear affected, 30% had the left ear affected, and 12% had bilateral ear involvement.



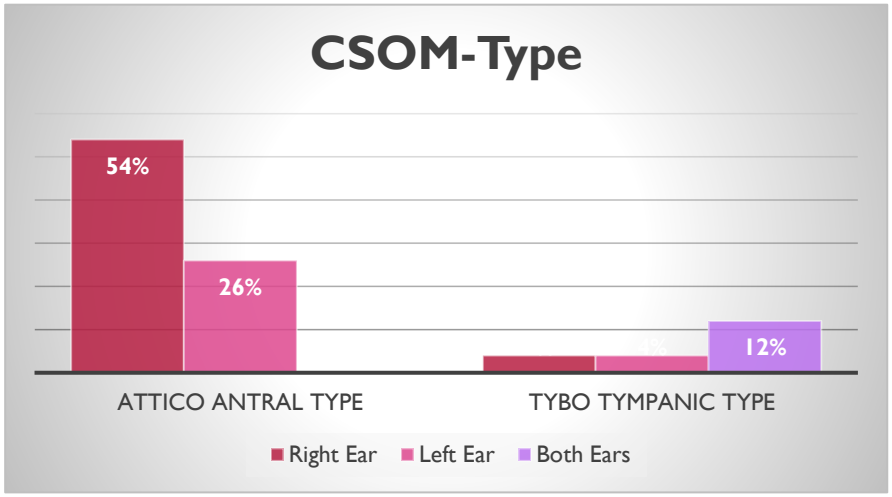
FINDINGS:

- Discharge was observed in all study participants, with 12% having polyps in the EAC.

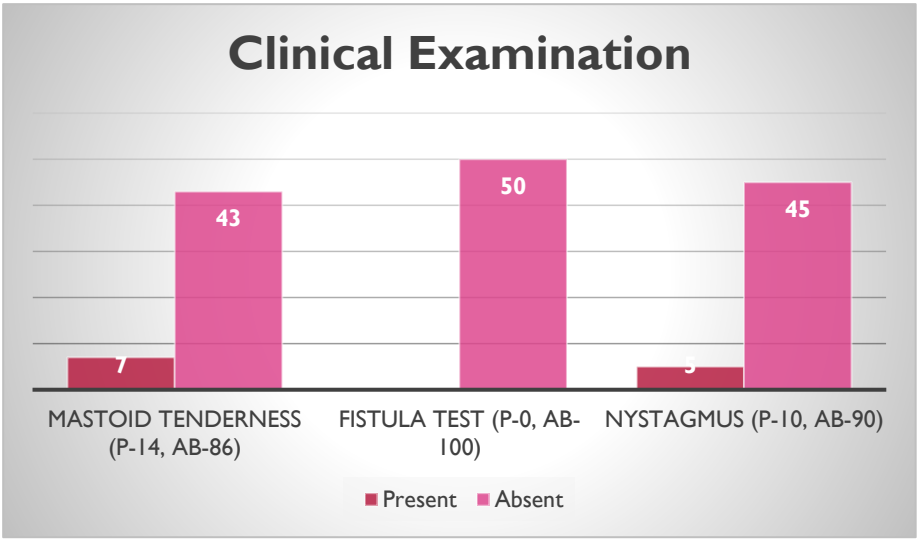
- Attic perforation was found in 58% of cases, marginal perforation in 16%, central perforation in 14%, and the tympanic membrane was not visualized in 12%.



- 80% of cases were atticoantral, of which 54% were right-sided and 26% were left-sided, undergoing canal wall down mastoidectomy. 20% were tubotympanic, with 12% having bilateral involvement and 4% each having right and left ear involvement, undergoing tympanoplasty and canal wall up mastoidectomy.



- CLINICAL EXAMINATION revealed mastoid tenderness in 7% of the population, nystagmus in 5%, and absence of fistula test in all.



4. CT FINDINGS

- Pre-operative temporal bone HRCT diagnosed cholesteatoma in 64% of cases (32 out of 50 patients).

- Bony erosion, an additional sign for the presence of cholesteatoma, was identified in 35 out of 50 cases, correctly indicating its presence in 64% of cases.

- Soft tissue density was observed in 11% in protympanum. During surgery, cholesteatoma was found in 8.75% of cases, with 3% false positive cases. (P<0.5) Significant for HRCT Temoporal bone.

- In terms of tympanic compartments, soft tissue density was observed in 15% of mesotympanum, 4.35% in posterior tympanum, 35% in epitympanum, and 15.22% in hypotympanum on HRCT. On intraoperative findings, soft tissue was present in 12.5% of mesotympanum, 3.75% in posterior tympanum, 30.43% in epitympanum, and 12.5% in hypotympanum.

	Soft tissue density in HRCT	Cholesteatoma found during surgery
Protympanum	10.87% (10)	8.75% (7)
Epitympanum	30.43% (28)	35% (28)
Mesotympanum	15.22% (14)	12.5% (10)
Hypotympanum	15.22% (14)	12.5% (10)
Posterior tympanum	4.35% (4)	3.75% (3)
Normal	23.91% (22)	27.5% (22)

	Soft tissue density in HRCT	Cholesteatoma found during surgery
Attic	40% (28)	36.84% (28)
Aditus	21.43% (15)	17.11% (13)
Antrum	21.43% (15)	17.11% (13)

- In the aditus, soft tissue with bone erosion was observed in 21.43% on HRCT and 17.11% intraoperatively. Similar findings were observed in the antrum.

- 30% had only epitympanum involvement, 15% had mesotympanum and hypotympanum involvement, 10.87% had protympanum involvement, and 4.35% had posterior tympanum involvement. A cholesteatoma sac was found in 64% of the

study population. CT scan and intraoperative findings showed similar percentages for attic, aditus, and mastoid antrum soft tissue involvement.

- In terms of ossicular erosion, incus showed the highest percentage on CT (43.21%) and malleus showed the highest percentage intraoperatively (40.51%).

- Scutum erosion was observed in 68% on CT and 54% intraoperatively.

- Similar findings were observed for tegmen tympani.

- Pneumatized air cells were found in 36%, diploic cells in 10%, and sclerotic air cells in 54% of the mastoid on both CT and intraoperatively.

- Facial canal erosion was observed in 28% on CT and 22% intraoperatively.

- Anterior lying sinus plate abnormalities were seen in 2% on CT and 10% intraoperatively.

- 2% had anterior lying sinus plate involvement, and 8% had semicircular canal involvement on CT.

	CT	Intra OP
Scutum erosion	68%	54%
tegmen tympani	68%	54%
Facial canal erosion	28%	22%
anterior lying sinus plate	2%	10%
semicircular canal involvement	8%	6%
Pneumatized mastoid	36%	36%
Diploic mastoid	10%	10%
Sclerotic mastoid	54%	54%

COMPLICATIONS:

- 8% of CT scans showed mastoiditis/mastoid abscess, but none were observed intraoperatively.

- No intra-cranial complications were observed on CT, but 8% were seen intraoperatively.

- 88% of the study population underwent canal wall down and 12% underwent canal wall up procedure.

5. DISCUSSION

A total of 50 patients were randomly selected for this study. The youngest patient was 12 years old, while the oldest was 50 years old. The majority of patients, 17 (34%), were between the age of 20 and 30. The average age of participants in the study was 27 years, which is close to Gerami H. et al (2009)[1]. According to Paperella and Kim (1977)[2], the average age is around 35 years. Chronic otitis media is more common in individuals with a low socioeconomic status and who are in their second or third decade of life in our country, which explains the variation.

According to Petros V. Vlastarakos et.al (2021)[3] , 22 patients were male (44%) and 28 patients were female (28%) in this study.

Otorrhea (88%) was the most common clinical manifestation, followed by hearing loss (78%) and otalgia (7%). (40%). Tinnitus, fever with chills, and facial palsy were among the less prevalent symptoms. This showed that patients were more aware of the condition and might be able to receive treatment more quickly which was similar to the study conducted by car ES book her LM at all in a free or regular and post are regular region are all exam was seen in 16% of the cases indicating acute mustered it is similar to the study conducted by Karki S Pokharel M et al (2017)[4].

Pinna, pre-auricular, and post-aricular regions are all examined. Auricular edoema was seen in 16% of the cases, indicating acute mastoiditis similar to the study conducted by Karki S, Pokharel M et al (2017)[4].

In this study, left ear discharge was detected in 15 (30%) cases, right ear discharge in 29 (58%) cases, and bilateral ear discharge in 6 (12%) cases similar to study conducted by Karki S, Pokharel M et al (2017)[4] .

We found 6 patients with poly (12%) and the rest (88%) had discharge in their EAC during an external artery canal examination, 4% of the participants had facial palsy, while 10% had nistagmus which was similar to the study conducted by

Himi T, Sakata M et al (2000)[5].

According to Lane JI et al (2006)[6] the majority of the cases in this study were AAD (80%) with the remaining (20%) being TTD.

In this study, patients had canal wall up mastoidectomy in 12% of cases and canal wall down mastoidectomy in 88% of cases similar to study conducted by Chee NW, Tan TT (2001)[7].

The mastoid was found to be well-pneumatizatized in 36% of the cases, sclerotic in 54%, and deploic in 10% of the cases contradicting the study conducted by Lane JI et al (2006)[6] having 60% of well pneumatized, 40% of sclerotic.

Low lying dura was appropriately diagnosed by CT temporal bond in 2% of patients in this investigation, with 100% sensitivity and specificity similar to study conducted by Ranga Reddy Sirigiri et al (2011)[8].

Only 1% of the time, the anterior lying sigmoid was spotted, making it only 50% sensitive in detecting and atomical changes similar to study conducted by Ranga Reddy Sirigiri et al (2011)[8].

HRCT has 100% sensitivity in this study, which is consistent with study by Ranga Reddy Sirigiri et al(2011)[8], but 90% specificity, which is somewhat higher than the 84% given by Ranga Reddy Sirigiri et al(2011)[8] to detect cholesteatoma in the protympanum, which is also consistent.

HRCT has a sensitivity of 90% in detecting in mesotympanum, which is similar to Walshe P (2002)[9] findings, and a specificity of 87.5% in detecting cholesteatoma.

HRCT had a sensitivity of 100% in the posterior tympanum, which is consistent with Walshe P (2002)[9] investigations, and specificity of 87.1% which is slightly higher than the 75% reported by Ranga Reddy Sirigiri et al(2011)[8].

HRCT revealed 96.5% sensitivity and 100% specificity in epitympanum, which is close to Ranga Reddy Sirigiri et al(2011)[8] findings.

HRCT sensitivity in hypotympanum was 100%, which agrees with Ranga Reddy Sirigiri et al (2011)[8] findings, and specificity was 91.9% which was greater than the 75% found by Ranga Reddy Sirigiri et al(2011)[8].

HRCT sensitivity in the antrum was 92.8% which is close to Ranga Reddy Sirigiri et al(2011)[8] observations, and specificity was 90.9%, which is significantly higher than the 66% found by Ranga Reddy Sirigiri et al(2011)[8].

HRCT sensitivity was 88.8% and specificity was 100% in mastoid air cells, which is close to Gerami H, et al. (2009)[10] results

HRCT has a sensitivity of 84% and a specificity of 88.8% in detecting soft tissue mass. Jackler et al. (1984)[43] and Garber et al. (1994)[11] found it to be less sensitive and specific, while Mafee et al. (1988) and O'Reilly et al. (1991) found it to be similar. HRCT, on the other hand, is less effective at distinguishing cholesteatoma from granulation.

In 78 % of cases, bone erosion properly predicted the presence of cholesteatoma. This figure is similar to that found by O'Reilly et al. (1991) in 79% of instances, as well as Jackler et al.(1984), O'Donoghue et al. (1987), and Firas Q.Alzoubi et al. (2008) in 80% of cases. Bone damage was identified in 100% of instances of acquired cholesteatoma, according to Mafee et al. (1988)

Scutum erosion was identified in 68% of cholesteatoma cases, which is lower than the 86% found by Gaurano JL et al. (2004). According to this study, HRCT is 100% sensitive and specific for detecting scutum erosion. This agrees with a study by Rocher P et al. (1995), but disagrees with a study by Vlastarakos PV et al. (2010), which revealed no correlation.

HRCT properly identified eroding malleus in 16% of patients. As a result, HRCT is 100% sensitive and specific for diagnosing malleus erosion. Zhang X et al. (2004), Rocher P et al. (1995), and Chee NW et al. (2001)26 have all found similar results.

Only 35% of HRCT images accurately detected incus erosion, despite the fact that it was present in 40.5% of cases. As a result, HRCT was 85% sensitive and 100% specific, which is consistent with findings by Zhang X et al. (2004) and Chee NW et al. (2001)

Only 16% of 19% of HRCT scans successfully revealed stapes erosion. HRCT was 75 % sensitive and 100% specific in three false negative cases. This is similar to research by O'Donoghue et al. (1987), but it differs with studies by Chee NW et al. (2001)[33], which found great correlation, and Zhang X et al. (2004), who discovered that HRCT was ineffective in detecting stapes erosion.

Ossicular erosion was identified in 66% of cases with cholesteatoma, which is lower than the 76% found by Gaurano JL et al. (2004), Rocher P et al. (1995). HRCT properly diagnosed ossicular erosion in 66% of cases, which is comparable to studies by Mafee et al. (1988), Garber et al. (1994)30, Jackler et al. (1984), and Schwartz et al. (1983), but differs from a research by O'Reilly BJ (1991), which found poor correlation. Incus was the most commonly involved ossicle in our investigation, accounting for 56% of cases, similar to Mafee et al. (1988), O'Reilly BJ (1991) and Jackler et al. (1984).

HRCT was also found to be 100% sensitive to detect cortical erosion of the mastoid, accurately detecting all 8% of cases, which differs from the findings of Ranga Reddy Sirigiri et al (2011), who found it to be just 75% sensitive.

HRCT was 75% sensitive for diagnosing sigmoid sinus plate erosion with two false negative cases, which is in line with research by Vlastarakos eft (2010), who found it to be 100% sensitive.

HRCT was insensitive in the instance of posterior fossa dural plate erosion, as it missed all of the 2% of cases. This research is similar to that of BJ O'Reilly et al. (1991) HRCT was also able to detect lateral semicircular canal erosion with a sensitivity of 8%. This is similar to research by O'Reilly BJ (1991), Vlastarakos et al. (2010)", and Zhang X et al.(2004), but not to studies by Gerami H et al. (2009) and Jackler RK (1984), where it was poor, and Firas Q. Alzoubi et al. (2008), Chee NW et al.(2001), Mafee and Rocher P(1995) where it was 100% sensitive. HRCT was found to be an excellent tool to detect the other complications like mastioditis and mastoid abscess with 100% sensitivity and specificity.

In this study, HRCT was used to correctly detect low lying dura in 2% of the patients, giving it 100% sensitivity and specificity. Zhang X et al. (2004) and Chee NW et al (2001) have found similar results. In comparison to studies by Zelikovich El, (2004), who found it in 7.7% of patients, and Lin Zhaohui et al. (2006), who found it in 21.8% of cases, the incidence of low lying dura is lower.

However, out of two cases of anterior lying sigmoid, HRCT failed to detect one, making it 50% sensitive but 100% specific in detecting this anatomical variant. In this investigation, the incidence of anterior lying sigmoid was low, compared to Zelikovich El (2004), who found it in 36.5 % of cases, and greater than Tomura N et al. (1995), who found it in 1.6% of cases.

HRCT had a P value of 0.05 for all of the factors in this investigation. According to HRCT, facial nerve dehiscence was present in 28% of patients with cholesteatoma and 22% of patients intra-operatively in this study. This is significantly lower than the 27% reported by Maglilo G et al.(2011)[13] in their study. Their sensitivity and specificity were respectively 69% and 87 %. According to Liu Zhaohui et al. (2006), Tomura N et al. (1995), Maglilo G et al. (2011)[11,12,13], the location was tympanic segment in 83 % of cases, whereas it was tympanic segment in 92% of cases.

Cholesteatoma was found in 64% of patients with chronic otitis media in this investigation. This matches the findings of Ranga Reddy Sirgiri (2011)[8], who found it in 72% of the cases.

Scutum erosion was found in 68% of patients with chronic otitis media with cholesteatoma in this investigation. This is greater than Suat Keskin et al., (2011)[14], who discovered it in 54% of their patients.

Ossicle erosion was found in 66% of individuals with chronic otitis media and cholestetoma in this investigation. This matches what Suat Keskin et al. (2011)[14]. discovered in 76.78 % of their patients. Incus was the most commonly involved ossicle in 35% of cases, compared to 86.1 % in Ghodrat Mohammadi et al. (2021)[15]. The stapes was the second most commonly found in 16% of patients, while the malleus was the least common in 15%. This is comparable to the findings of Garap et al. (2001)[16], who identified it in 34% of the stapes and 32% of the malleus.

In this study, well-pneumatized mastoids were seen in 36%, sclerotic mastoids in 54%, and diploic mastoids in 6%. These findings are similar to those of Ashwani Sethi et al. (2006)[17,18,19], who observed well-pneumatized mastoid in 48% of patients and weakly pneumatized mastoid in 52%.

HRCT revealed sigmoid sinus plate erosion in 4% of participants with cholesteatoma in this research. According to Abdel Rahim Ahmed Abdel Karim et al. (2010)[20] and Leskinen K et al. (2005)[21], this figure is less than 8%.

Tegmen degradation was observed in 2% of the participants in our study. This number is lower than that observed in a research by Singh R et al (2020)[32], Bathla M et al (2018)[33]

Mandal S et al (2019)[34], which found tegmen erosion in just 5% of patients. In this study, higher problems indicate a more aggressive disease.

Mastoiditis was discovered in 8 patients of chronic otitis media in this investigation. This is comparable to what Manik S et al (2021)[35] Rogha M. et al (2014)[36]. Mehanna AM, Baki FA et al (2014)[37] discovered in seven cases, but differed with the study conducted by Blom EF, Gunning MN et al (2015)[38] Martin TP., Weller MD. et al (2009)[39]. In HRCT, the extent of middle ear and mastoid involvement in cholesteatoma is as follows: epitympanum, antrum, aditus, attic, posterior tympanum, mesotympanum, hypotympanum, protympanum are 30%, 21.43%, 21.43 %, 40%, 4.35 %, 15.2%, 15.2%, 10.87 %, respectively similar to studies conducted by Buckingham RA et al (1970)[40], Proctor B et al (1980)[41], Ragavoodoo S et al. (1990)[42].

Ranga Reddy Sirigiri et al. (2011)[8], Bluestone CD et al. (2005)[43] discovered it in the epitympanum, antrum, aditus, mastoid air cell, posterior tympanum, mesotympanum, hypotympanum, and protympanum, with 34%, 25 %, 24%, 42%, 8.65%, 15%, 15.34%, and 12%, respectively.

6. CONCLUSION

The study was conducted focusing on 50 randomly selected cases of chronic otitis media. These cases underwent HRCT before mastoidectomy via the post-auricular approach. The study found that the median age of patients was 27 years, with ages ranging from 12 to 50 years. There was a predominance of females, accounting for the majority of patients. The condition was more commonly observed on the right side, with 12% of cases being bilateral. Clinical manifestations included otorrhea, hearing loss, and otalgia. HRCT demonstrated high sensitivity and specificity in detecting various abnormalities in the temporal bone, such as scutum and malleus erosion, mastoiditis, and mastoid abscess, with 100% sensitivity and specificity. It also showed high sensitivity in diagnosing cholesteatoma in different areas of the middle ear and mastoid, with a sensitivity of more than 80%. However, its sensitivity varied for different complications, with 100% specificity observed for facial canal dehiscence and tegmen erosion, though sensitivity was notably lower for other complications. The most common neurovascular structure involvement was facial canal dehiscence, accounting for 28% of cases. Scutum erosion and ossicular erosion were frequent findings, occurring in 68% and 66% of patients, respectively. Mastoiditis was observed in 8% of cases. Mastoid pneumatization varied, with 54% being sclerotic, 36% pneumatized, and 10% diploic. Cholesteatoma involvement was highest in the epitympanum and antrum, followed by aditus, mastoid air cells, posterior tympanum, mesotympanum, hypotympanum, and protympanum, in decreasing sequence of frequency. Mastoidectomy was performed in all cases, with 66% undergoing canal wall down and 34% canal wall up procedures.

SUMMARY

Chronic otitis media can be life-threatening, so all ENT surgeons should be aware with the conventional treatment for these patients. The introduction of HRCT and advances in radiological technique have significantly improved the study of the temporal bone in patients with chronic otitis media, which includes determining the extent and sites of involvement, as well as the inter- relationships of the tympano-mastoid compartment with the adjacent neurovascular structures.As a result, this study recommends that HRCT should be used not only in cases when potential problems are suspected, but also in all cases with COM to determine the extent of disease. The existence of anatomical differences and a variety of pneumatizations should notify the clinician and guide the surgical approach and treatment plan. The key to a successful diagnosis and surgical treatment of chronic otitis media is still a skilled, aware, and alert surgeon.

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