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ROLE OF HIGH RESOLUTION COMPUTED TOMOGRAPHY FOR THE EVALUATION OF ACUTE AND CHRONIC OTITIS MEDIA

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Abstract

An acute otitis media infection is a middle ear infection. Otitis media with effusion (OME), chronic suppurative otitis media (CSOM), and acute otitis media (AOM) are some of the conditions that encompass this group. Bacteria, viruses, or coinfections can all cause middle ear infections. The purpose of this research was to assess and contrast the use of high-resolution computed tomography (HRCT) in diagnosing acute and chronic otitis media. After preforming the scan, all the required variables like age, gender, clinical findings history and the radiological features of patients' scan were noted in the questionnaire. All the data was recorded after taking consent from the patient. The statistical software SPSS version was used to analyze the data. Following an analysis of every variable, the mean standard deviations of all continuous variables were displayed. The distribution of the data was examined using descriptive analysis. We computed the mean and standard deviation (SD) for continuous variables. Out of patients that were included in our study, were females while remaining were males. All the patients presented with symptoms like fever, otalgia and hearing loss. After performing HRCT, we found that out of these patients, had acute while patients had chronic otitis media. Most commonly found HRCT features were middle ear opacification, fluid accumulation, osecular erosion, septations, thickened tympanic membrane and sclerotic mastoid cells. HRCT plays a key role in evaluating patients with acute and chronic otitis media.

INTRODUCTION

An acute otitis media infection is a middle ear infection. Otitis media with effusion (OME), chronic suppurative otitis media (CSOM), and acute otitis media (AOM) are some of the conditions that encompass this group. Bacteria, viruses, or coinfections can all cause middle ear infections. The three most common bacteria that cause otitis media are Streptococcus pneumoniae, non-typeable Haemophilus influenzae (NTHi), and Moraxella catarrhalis. Otitis media is most commonly caused by three bacterial agents: Moraxella catarrhalis, Streptococcus pneumoniae, and non-typeable Haemophilus influenzae (NTHi) []. Otitis media is a global problem that affects boys slightly more often than girls. It is challenging to pinpoint the precise number of cases annually because of a dearth of reporting and varying occurrences in numerous geographic locations []. Between six and twelve months of age, the incidence of otitis media peaks, and after age five, it starts to decline []. Between % and % of children will have otitis media with an effusion prior to school age, and about % of all children will have an episode of otitis media at some point in their lives []. To ensure

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appropriate management and reduce overall morbidity and mortality, it is critical to identify the potential otitic origin of such complications []. The signs and symptoms (obtained by history) include nonspecific symptoms (such as nausea, irritability, sleep disturbance, and anorexia), ear-specific symptoms (such as ear pain and hearing loss), and signs (such as fever and vomiting). A bulging tympanic membrane and decreased mobility on pneumatic otoscopy are the otoscopic indicators with the highest positive predictive value for acute otitis media []. Mild conductive hearing loss is the most frequent finding in symptomatic patients. The two most prevalent symptoms of chronic otitis media are hearing loss and ongoing otorrhea. A perforated tympanic membrane is seen by otoscopic examination []. High resolution computed tomography (CT) of the temporal bone (with a layer thickness below mm) is an imaging examination of choice in the planning of surgical treatment of this area. High spatial resolution and flawless bony structure visualization enable precise replication of the location of anatomical features important from a surgical perspective. []. The assessment of the condition of the ossicular chain, tympanic, and mastoid bones is where HRCT is crucial in the work-up of patients with otitis media. The results of HRCT temporal bone are categorized according to whether soft tissue attenuation is present or not, as well as whether bony erosion is evident []. Bony erosion combined with soft tissue attenuation is thought to be suggestive of cholesteatoma. Indications of chronic otitis media complications include dehiscence of the facial nerve canal, erosion of the lateral semicircular canal, and erosion of the scutum or ossicles []. There is a significant lack of research in this area of study. Aim of this study to better understand the role of HRCT in evaluating acute and chronic otitis media, leading to early diagnosis and better disease management. The study can have implications for clinical practice, as it can guide healthcare providers in the appropriate use of HRCT in the evaluation of otitis media. Additionally, the study can inform policy decisions related to the use of imaging modalities in the diagnosis and management of otitis media and fill the research gap that exists in this area of study.

1. Material and methodology

1.1. Research Design:

This research employed cross-sectional analytical research design to study the role of high resolution Computed Tomography in evaluating acute and chronic Otitis Media. The study was conducted in radiology department of Sir Ganga Raam Hospital, Lahore and data was collected in form of questionnaire. The formula used for sample size calculation was:

$$n = \frac{Z^2 \times p \times (1-p)}{d^2}$$

n=

Convenient sampling technique was used. This descriptive study lasted for almost months .

1.2. Selection Criteria:

Inclusion Criteria:

Patients with Sudden onset of ear infection, Patients who present with sudden onset of pain in ear, Patients with vertigo, Patients with persistent Ear Infection for more than weeks, and Patients with Hear loss secondary to ear infection were included.

Exclusion Criteria:

Patients who do not have any clinical findings associated with ear infection. Patients with contraindications to High Resolution Computed Tomography (HRCT) such as pregnancy, severe claustrophobia or allergic reactions to contrast media.

1.3. Ethical Consideration:

The research was conducted in accordance with the guidelines established by Superior University's ethical committee in Lahore, and the participants' rights will be upheld.

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Every participant provided written informed consent. All data collection and information will be kept private. All study participants will maintain their anonymity. The participants were made aware that there are no risks or drawbacks to the study's methodology. Additionally, they were made aware of their freedom to leave the study at any moment. There were no dangers involved in this study. We'll take every precaution to keep your privacy safe. No publication that comes out of this study will reveal who you are. It is entirely voluntary for you to participate in this research study. You have the freedom to decline participation and to revoke your consent at any moment. If you choose not to participate in this study or withdraw, you won't face any consequences.

Data Collection Procedure

"Toshiba Aquillon Slicer CT" was used for scan. After preforming the scan, all the required variables like age, gender, clinical findings history and the radiological features of patients' scan were noted in the questionnaire. All the data was recorded after taking consent from the patient.

1.4. Scanning technique:

High-resolution computed tomography (HRCT) of the temporal bone was performed with the patient in a supine position, head first, and the head secured to minimize motion artifacts. The scan was typically acquired in the axial plane parallel to the infraorbital meatal line, with coronal images reconstructed from the axial data or obtained directly by positioning perpendicular to the axial plane. Thin sections of .–. mm were taken using a small field of view focused on the temporal bones to achieve high spatial resolution. A high-resolution bone algorithm was applied, with tube voltage around kVp and tube current adjusted according to the patient's size to optimize image quality while minimizing radiation dose.

1.5. Data Analysis Procedure

Data was evaluated and analysed using the Statistical Package for the Social Sciences (SPSS) version . All variables were analysed in which all continuous variables were presented as mean standard deviations. Descriptive analysis was performed to investigate the distribution of data. Mean and standard deviation (SD) was calculated for continuous variables.

2. Results:

Out of patients that were included in this study, were females while remaining were males. All the patients presented with symptoms like fever, otalgia and hearing loss. After performing HRCT, it was found that out of these patients, had acute while patients had chronic otitis media. Most commonly found HRCT features were middle ear opacification, fluid accumulation, osecular erosion septations, thickened tympanic membrane and sclerotic mastoid cells.

2.1. Age:

Acute Otitis Media is the second most common diagnosed condition in a paediatric emergency departments after respiratory infections. Age is an important variable while discussing these conditions. It was very important to determine correct ages of the subjects under study. This study included a total of patients, with the youngest being a years old patient while the eldest being a years old man**.** Around % of the patients were aged between - years.

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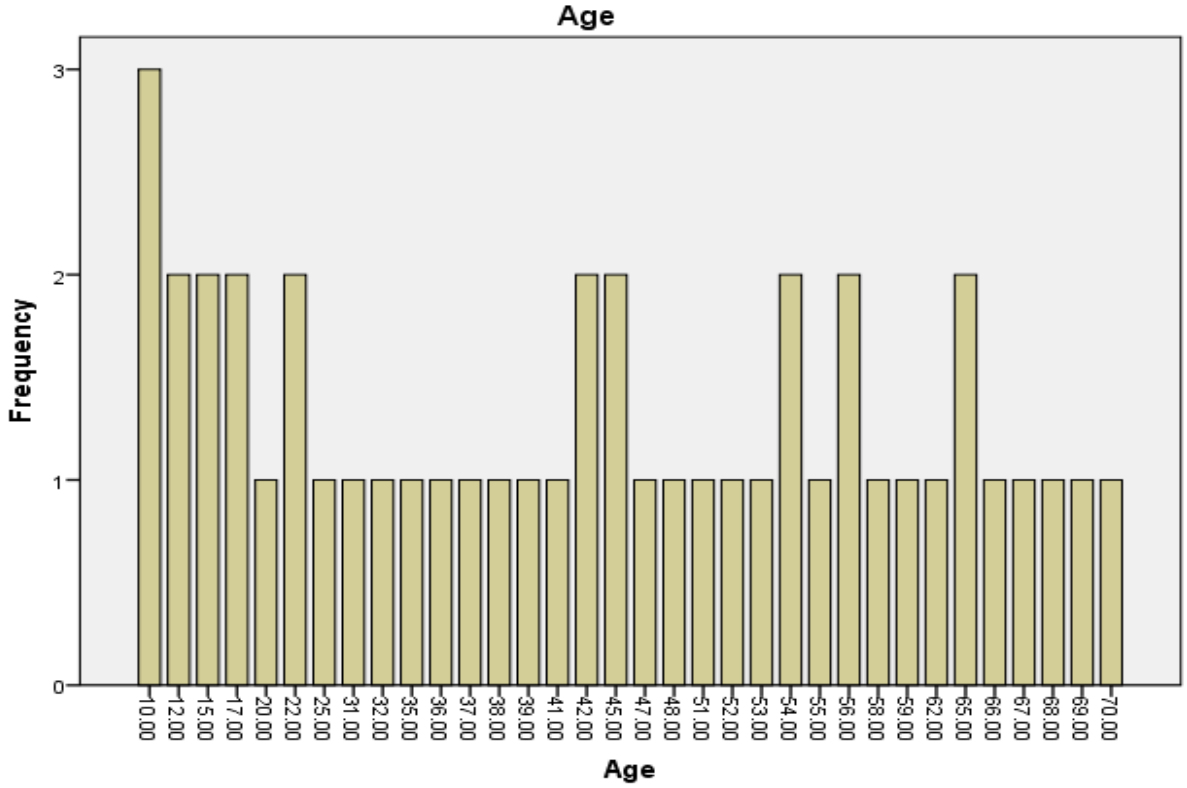

Figure .: Histogram representing the frequency distribution of different age groups of patients

2.2. Gender:

Gender of a patient was very important factor in determining the different aspects of the study. Many conditions are gender specific and situations develop differently based on the gender. It was very important to correctly analyze the data and determine the gender ratio. Females and males were included in this study

Table .: Descriptive statistics of genders of patients in this study

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Females	27	60.0	60.0	60.0
	Males	18	40.0	40.0	100.0
	Total	45	100.0	100.0	

2.3. FEVER :

This study included total patients in which patients presented with mild fever, with severe while patients didn't present with fever. Which was graphically described below

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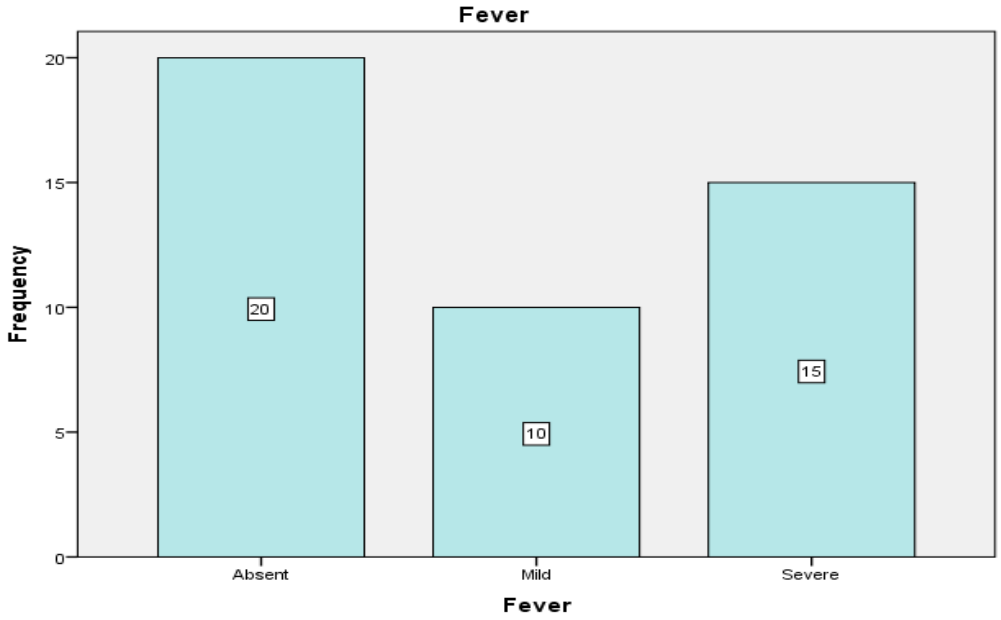

Figure .: otitis media linked with fever

2.4. MIDDLE EAR OPACIFICATION:

Middle ear opacification is ought to be very common in patients with acute and chronic otits media, but it was really important for this study to determine wheter the opacification was complete or partial. In this study, middle ear opacification was not seen in patients, while patients had complete middle ear opacification and had partial opacification of their middle ear.

Table .: Classification of patients based on the extent of middle ear opacification

		Frequency	Percent	Valid Percent	Cumulative Percent
	Absent	2	4.4	4.4	4.4
	Complete	25	55.6	55.6	60.0
	Partial	18	40.0	40.0	100.0
	Total	45	100.0	100.0	

2.5. OSECULAR EROSION:

It was very important to determine the extent of erosion in middle ear osecles. In the current study, it was found that middle ear osecles were intact in patients , while they were partialy erosed in patients. Extensive erosion of middle ear osecles was seen in patients out of total patients

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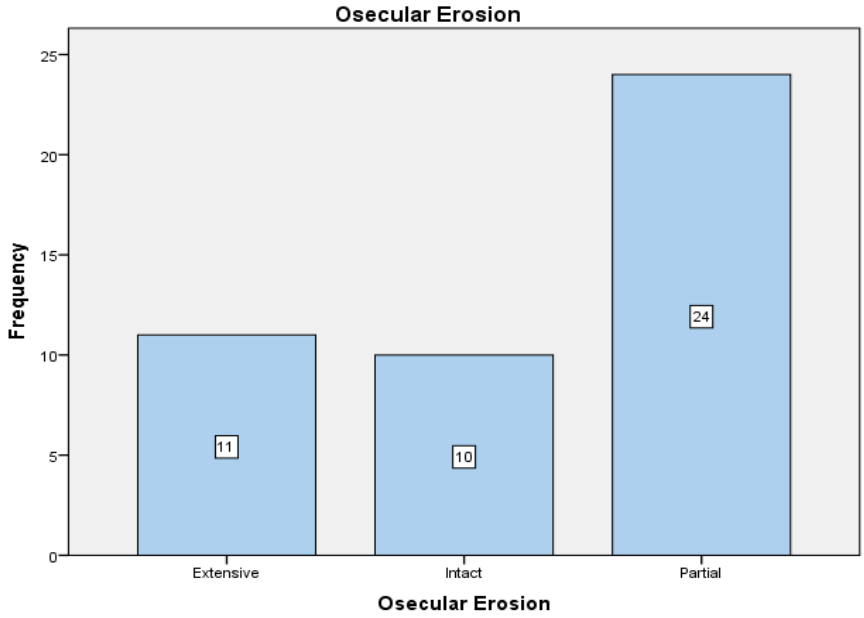

Figure .: Frequency Statistics of patients with different types of erosions.

2.6. SCLEROTIC MASTOID CELLS:

These air filled cavities in temporal region serve a very important role in overall hearing. It was an important variable to determine and analyse the health of mastoid cells. In this study we found that, Mildly Sclerotic Mastoid Cells were found in patients, while patients had advanced sclerotic mastoid cells. Only patients had normal mastoid cells.

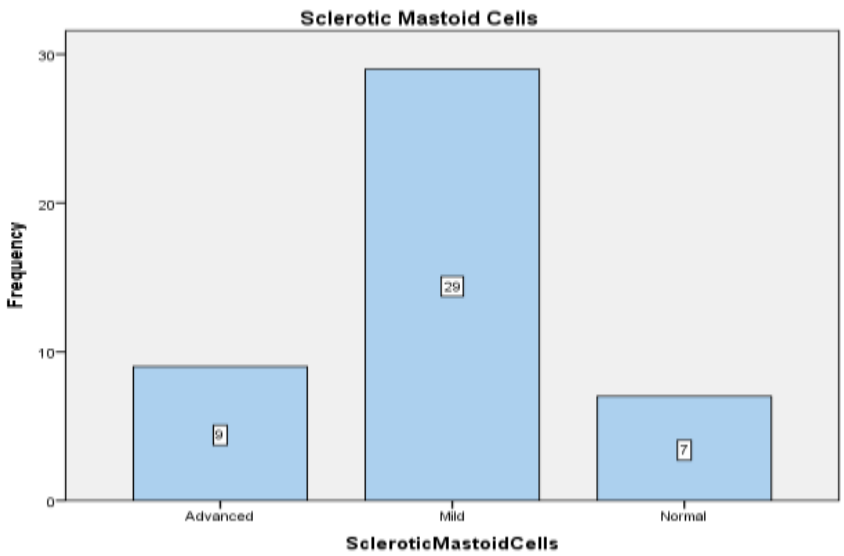

Figure .: Frequency distribution table for patients based on sclerosis in their mastoid air cells.

2.7. FLUID ACCUMULATION:

Fluid accumulation in patients ear canal can be due to a lot of other reasons and it can indicate a lot, that's precisely why we focused on it as well. In this study, No Fluid accumulation was seen in patients. Mild effusion was seen in patients while only patiients were found to have severe effusion.

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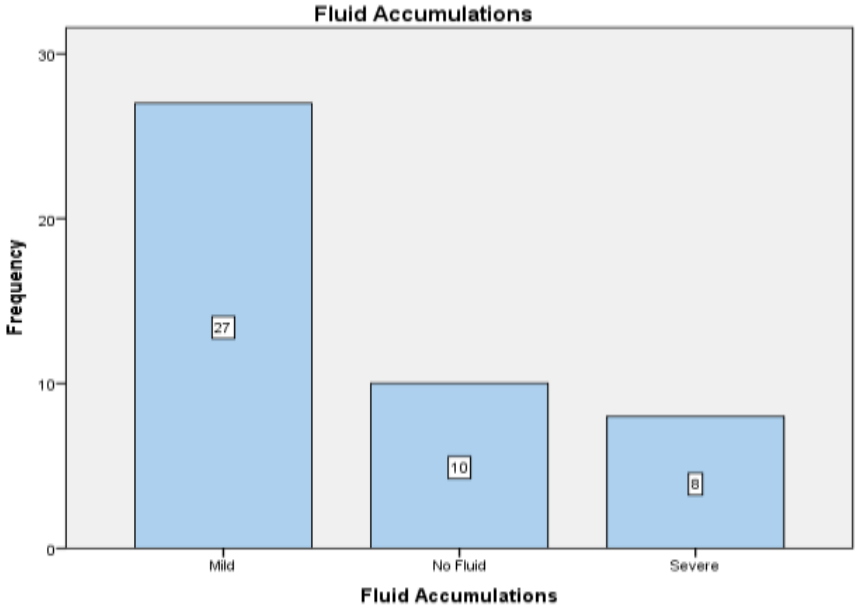

Figure .: Descriptive analysis of patients with fluid accumulation in ear cavity.

2.8. TYMPANIC MEMBRANE THICKNESS:

The tympanic membrane is a very delicate and important part of our middle ear. Its thickness was an important variable to calculate as it could tell us a lot about the otitis media and related complications as well. In this study, the tympanic membrane was normal in patients, mildly thickened in patients while patients had quite marked tympanic membrane thickness

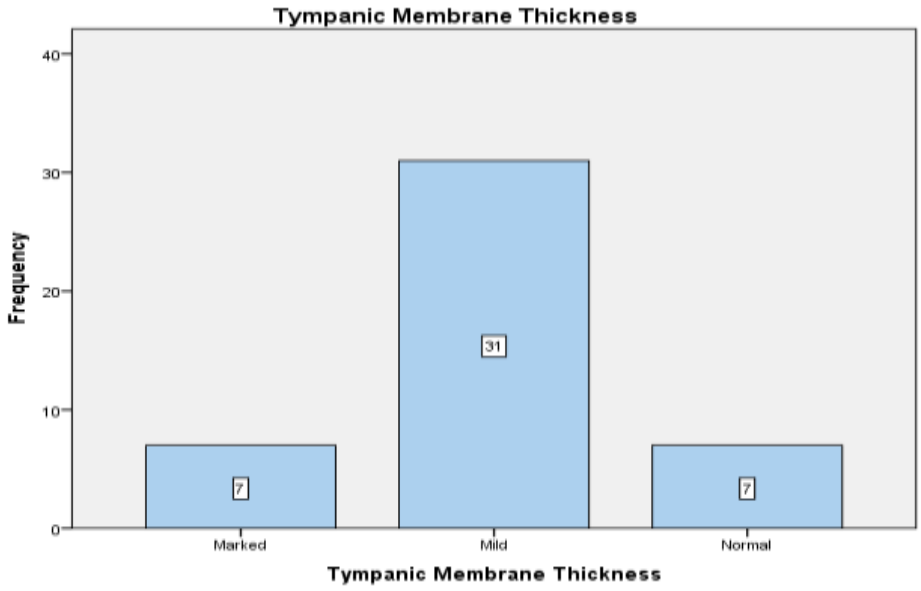

Figure .: Histogram representing the patients with different extents of tympanic membrane thickness.

2.9. OTITIS MEDIA:

Otitis media is a complication that could be both acute and chronic. It is very important to know the stage in order to treat it. That's why we focused on knowing the ratio of patients with acute and chronic otitis media. Of all the patients with Otitis Media in this study, patients had acute, while patients had

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chronic otitis media.

Table .: Frequency of Acute vs Chronic Otitis Media in this study

Otitis Media					
Valid					
Acute Chronic	Acute	Acute	Acute	Acute	Acute
	Chronic	Chronic	Chronic	Chronic	Chronic
	Total	Total	Total	Total	Total

Discussion

Chronic otitis media (COM) and its related complications are known to lead to significant economic impacts and health repercussions, but they can be prevented. High-resolution computed tomography (HRCT) is a non-invasive method that provides detailed information on the presence, location, and extent of the disease; it may also assist in identifying congenital anomalies and in patients with a history of past surgeries that have obscured surgical landmarks. The role of HRCT in assessing patients with otitis media is crucial for evaluating the condition of the ossicular chain, as well as the tympanic and mastoid bony structures [].

The predominance of females observed in our study aligns with findings from Vlastarakos et al. []. Additionally, the age distribution parallels that noted by Mafee et al., where the peak incidence of chronic suppurative otitis media occurs in people in their thirties and forties [].

In our study, the most prevalent complaint was ear discharge, reported by % of patients, which is similar to the results from Gyanu et al., where otorrhea was noted as the presenting symptom in all cases, as well as in the study by Yorgancilar et al. [,]. In addition, % of patients reported hearing loss, % reported tinnitus, % reported fever, % reported ear pain, % reported dizziness, and % reported facial weakness. These symptoms—which include fever, dizziness, ear pain, hearing loss, and facial weakness—indicate possible side effects of COM, such as bony erosion and ossicular erosion that affect the scutum, tegmen, lateral semicircular canal, or even dehiscence of the facial nerve canal. Consequently, HRCT is crucial for the timely detection and treatment of these issues [,]. Our examination of the mastoid region using HRCT of the temporal bone revealed that % of mastoid cells displayed mild sclerosis, while % showed advanced sclerosis, and % were classified as normal. This contrasts with Rai's study, which recorded % as well-pneumatized and % with sclerotic mastoid appearances []. On the temporal bone HRCT, % of patients had soft tissue attenuation; however, we were unable to determine the specific type of soft tissue density, making it difficult to distinguish between cholesteatoma, granulation tissue, and polyps. Although the incidence was higher, Gyanu et al. discovered soft tissue without bony erosion in % of cases and a slightly higher rate with bony erosion at .% []. In % of cases, Rai found soft tissue attenuation accompanied by bony erosion. Nevertheless, we were able to locate the soft tissue densities on the temporal bone's HRCT. A comparable distribution of cholesteatoma on HRCT was also noted by Phillips et al. []. When it came to confirming pathologies in patients exhibiting symptoms of complications, HRCT was very successful. The results of the HRCT closely matched the expected pathologies in patients exhibiting symptoms of complications. There were minor differences between the HRCT temporal bone results and the intraoperative observations of ossicular erosion or absence. Comparable to the findings of Swartz and Mafee et al. [,], osseous erosion was observed in % of cases, slightly less than the % reported by Gaurano and Joharjy. Mozumder et al. found that absent malleus was present in % of cases and absent incus in % of cases, while absent ossicles were found in % of cases. Albera et al. reported similar outcomes []. It was discovered during surgery that those who showed bony erosion suggestive of cholesteatoma on HRCT actually had cholesteatoma. Therefore, HRCT proved to be % accurate in identifying cholesteatoma. HRCT is highly sensitive and specific for identifying soft tissue masses, as shown by

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Mafee et al. and O'Reilly et al., but Jackler et al. and Garber et al. [,,] reported that its sensitivity and specificity were lower. O'Donoghue et al. observed bony erosion associated with cholesteatoma in % of cases [,,]. However, HRCT failed to differentiate between granulation tissue and polyps. In terms of identifying ossicular erosion, HRCT showed a sensitivity of % and a specificity of .%, revealing cases of undetected erosions. This aligns with the findings of Mafee et al., Garber and Dort, Jackler et al., and Swartz, yet contrasts with O'Reilly et al., who noted a poor correlation [,,]. With a specificity of % and sensitivities ranging from .% to %, HRCT demonstrated a high degree of accuracy in identifying bony erosions of the temporal bone. HRCT showed % specificity and .% sensitivity for scutum erosion. The findings of Vlastarakos et al., who found no correlation, are different from these results, which are in line with those of Rocher et al. [,]. Additionally, HRCT exhibited % sensitivity and specificity in identifying lateral semicircular canal erosion in patients, which mirrored the results of Mafee et al., Rocher P et al., and Chee NW et al. The incidence matched the % of LSCC fistulas identified by SuatKeskin et al. []. Radiological assessments can sometimes positively impact the decision-making process and duration of surgical exploration. As such, CT findings provide surgeons with insight into risk factors and prepare them for potential complications.

Conclusion:

HRCT plays a key role in evaluating patients with acute and chronic otitis media With respect to the previous chapters, it is apparent that High-Resolution Computed Tomography also called HRCT scan has been underemphasized for the evaluation of HRCT of complex and chronic otitis media. Its role as the diagnosis of the Disorder is HRCT. It enables to visualize the processes in the bones of the skull, and also the chronic processes of bone deconstruction, and also processes of bone deconstruction, the occurrence of cholesteatoma, and various other processes. It is helpful in the evaluation of the surgical approach. HRCT assumes its greatest value in chronic cases, as the anatomical changes are often advanced and surgical approach is not straightforward. This research showed that at the very least for every case cystic otitis media should be performed to increase the accuracy of surgical treatment, prevention of intraoperative surprises, and ultimately, final surgical treatment outcomes.

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