

Role of High Resolution Computed Tomography for The Evaluation Of Acute & Chronic Otitis Media



SUPERIOR UNIVERSITY

**Thesis Submitted to
The Superior University Lahore
In Partial Fulfillment of the
Requirement for the Degree of
Master of Science in Allied Health
Sciences**

By

RABIA TARIQ

Roll No. SU91-MSAHW-F23-071

Session: 2023-2025

Faculty of Allied Health Sciences

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I hereby state that my MS thesis titled “**Role of High Resolution Computed Tomography for the Evaluation of Acute & Chronic Otitis Media**” is my work and has not been submitted previously by me for taking any degree from this University, **The Superior University, Lahore**, or anywhere else in the country/world.

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Supervisor Name: Dr. Farah Javed

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No part of this thesis has been submitted anywhere else for any other degree. This thesis is submitted to the Faculty of Allied Health Sciences, The Superior University, Lahore in partial fulfillment of the requirements for the degree of Master of Science in the field of **“Allied Health Sciences”** in Faculty of Allied Health Sciences at The Superior University, Lahore.

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DEDICATION

I dedicate this research thesis to my respected Supervisor, **Dr. Farah Javed** whose invaluable guidance, academic insight, and continuous support provided the foundation for this work. Her thoughtful feedback, patience, and encouragement throughout every stage of this research journey have deeply inspired me and helped me grow both academically and personally. I would also like to dedicate this work to my co-supervisor for her generous support, critical input, and constructive suggestions that added clarity and depth to this recent researches. Furthermore, I extend my heartfelt dedication to my family, whose unconditional love, prayers, and moral support have always been my strength and motivation. Their constant belief in my abilities enabled me to pursue and complete this research with determination and resilience.

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LIST OF ABBREVIATIONS

(Abbreviations not explained in the text)

ACC	Acyl CoA-Carboxylase
AFIP Pathology	Armed Forces Institute of
AGEs Products	Advanced Glycation End
BMI	Body Mass Index
DNL	de novo hepatic lipogenesis
ETC	Electron Transport Chain
FDA Administration	Food and Drug

ABSTRACT

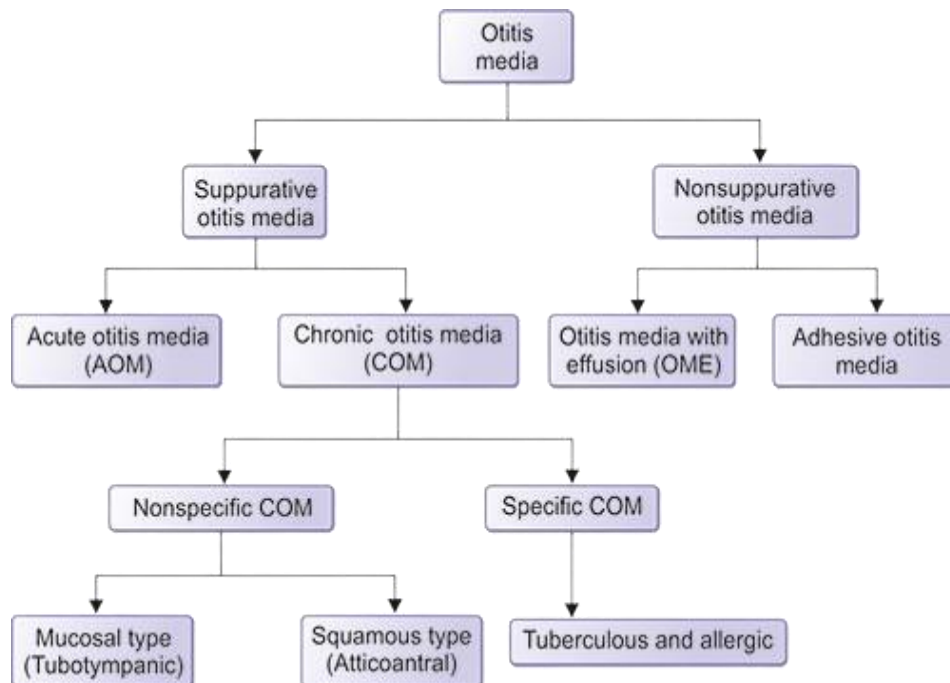
An acute otitis media infection is a middle ear infection. Otitis media with effusion (OME), chronic suppurative otitis media (CSOM), and acute otitis media (AOM) are some of the conditions that encompass this group. Bacteria, viruses, or confections can all cause middle ear infections. The purpose of this research was to assess and contrast the use of high-resolution computed tomography (HRCT) in diagnosing acute and chronic otitis media.. After performing 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 25 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 45 patients that were included in our study, 27 were females while remaining 18 were males. All the patients presented with symptoms like fever, otalgia and hearing loss. After performing HRCT, we found that out of these 45 patients, 30 had acute while 15 patients had chronic otitis media. Most commonly found HRCT features were middle ear opacification, fluid accumulation, ossicular erosion, septations, thickened tympanic membrane and sclerotic mastoid cells. HRCT plays a key role in evaluating patients with acute and chronic otitis media.

Keywords: HRCT, Otitis Media, Tympanic Membrane, Otalgia, Middle Ear Opacification

Chapter 1

INTRODUCTION

Acute otitis media is an infection of the middle ear. These encompass various disease processes, such as acute and chronic suppurative otitis media (CSOM) and otitis media with effusion (OME). The pathogens of the middle ear infection could be viral, bacterial or the co-infection. The predominant bacterial pathogens are *Streptococcus pneumoniae*, non-typeable *Haemophilus influenzae* (NTHi), and *Moraxella catarrhalis*. After introduction of the conjugate pneumococcal vaccines, pneumococcal strains have shifted to non-vaccine types. The most common viral etiological agents of otitis media are the respiratory syncytial virus (RSV), coronaviruses (1).



The rate of otitis media is international, and this disease appears to be a little more common in males than in females. "The exact number of cases per year is hard to determine because we do not keep a record and it varies in so many regions throughout the world" (2). The highest number of cases of otitis media is between six and twelve months with a reduction after five years. Approximately 80% of all children will experience a case of otitis media during their lifetime, and between 80% and 90% of all children will experience otitis media with an effusion before school age. Otitis media is less common in adults than in children, though it is more common in specific sub-populations such as those with a childhood history of recurrent OM, cleft palate, immunodeficiency or immunocompromised status, and others (3).

There is a severe public health problem (high risk populations) in communities with over 4% of the children affected by chronic perforation of tympanic membrane. There are also increased rates of invasive pneumococcal disease, pneumonia and chronic suppurative lung disease (including bronchiectasis). These children will frequently be helped by adequate management of persistent (or recurrent) bacterial infection (4). Neurologic manifestations of acute and chronic otitis media in some cases may manifest as signs and symptoms. The potential otitic etiology of complications needs to be widely acknowledged so that appropriate approach can be made, and overall morbidity and mortality reduced accordingly (5).

Features and history (Source: Obtained from history) -Otic symptoms (eg, ear pain, hearing loss), nonspecific symptoms (eg, anorexia, sleep disturbance, irritability nausea), and signs (fever and vomiting). Bulging on otoscopy followed by lack of mobility on pneumatic otoscopy are the otoscopic findings most predictive of AOM (6). The degree of redness of the tympanic membrane is less invariable, but may be used diagnostically if other signs, like middle-ear effusion are also present. In OME, most children are without symptoms (7).

Symptomatic patients usually have a mild conductive hearing loss. The most frequent complaints in chronic otitis media are permanent otorrhea and hearing impairment. A perforation of the tympanic membrane is noted on otoscopic examination. The effusion in the middle ear can be long-lasting, and children affected with this problem sometimes demonstrate reduced ability to learn in terms of language control as well as cognitive activities (8).



These sequelae of chronic Otitis media being a healthy killer not only cause financial morbidity and mortality are certainly preventable. HRCT the non-invasive method of investigation that provides information about presence, location and extent of disease also, it gives suspicion for congenital anomalies and subject with history of previous surgery causing loss of surgical landmarks. Complications and death from otitis media are less frequent with the proper development, suitable antibiotics, better imaging and multidisciplinary care. Antibiotic resistance and covering of the signs and symptoms may, though, be future challenges (9).

In the present day, imaging studies in COM have become an essential aspect of diagnostics, complementing both clinical and audiological assessment. The new trend in surgery for middle ear cholesteatoma is toward minimally invasive and limited intervention, necessitating accurate knowledge of the extent of the disease. High resolution thin slice CT (layer thickness < 1 mm) of the temporal bone is an ideal imaging modality to plan surgical management in this region. With its high spatial resolution and optimal bony tissue representation, it permits accurate reconstruction of the position of surgically relevant anatomical structures. Cholesteatoma in the inflamed middle ear can be suspected solely according to indirect clinical signs: erosions of ossicles, semicircular canals and roof or when soft tissues are found located in the air space of the middle ear at a site typical for acquired cholesteatoma (Prussak cavity) (10).

This new diagnostic information has the potential to assist physicians to more effectively and efficiently screen, manage, and refer patients based on quantitative data (11).

HRCT has great contribution in both medical and surgical management for patients with middle ear diseases. It validates the otoscopic findings more effectively, dispels many clinical doubts and may also guide the degrees of surgery when indicated in terms of this is going to be surgery as well as in procedure planning. Nevertheless, the role of routine HRCT in all cholesteatoma surgery can only be justified if it might affect clinical management (12). The role of HRCT in the evaluation of patients with otitis media is in relation to ossicular chain, the tympanic and mastoid bony status (13). The lesions are described on temporal bone HRCT as with or without soft tissue attenuation and bony erosion. Soft tissue attenuation with bony destruction is generally assumed to be indicative of cholesteatoma. Additional observations of scutum or ossicles erosion, lateral semicircular canal erosion and facial nerve canal dehiscence

are recorded as signs of complications of Chronic Otitis media (14). A thorough evaluation of the soft tissue on HRCT is important in making a correct diagnosis; clinical data must be available, and image findings have to be correlated with clinical presentation and otoscopic findings (15).

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.

AIM AND OBJECTIVES

To evaluate and compare the role of high resolution computed tomography (HRCT) for the evaluation of acute and chronic otitis media.

Chapter 2

LITERATURE REVIEW

A prospective study on diagnosis and treatment of acute and chronic otitis media by high resolution CT was managed by Hussain et al. A total of 60 patients, who were clinically suspected to have chronic otitis media, were recruited for the study. HRCT assessment was performed with Siemens Somatom Force 384 slice multidetector computed tomography scanner. In our practice, we radiologically measure the height of the tegmen taking LSCC as reference point on HRCT. The final result was calculated according to a correlation between the findings in imaging studies and during operative procedures. Diagnostic performance of HRCT temporal bone was analysed in terms of sensitivity, specificity, PPV, NPV and accuracy for preoperative estimation of tegmen height. The real tegmen height showed a highly significant correlation with the predicted height of the tegmen (using equation) $\{r = 0.457, P < 0.001\}$. The average tegmen height of exposed dura (ED) was 5.81 ± 1.71 (95% CI, 4.91–6.70), and that of non-exposed dura (NED) amounted to 8.40 ± 1.31 (95% CI, 8.02–8.78). The difference of mean tegmen height between the ED and NED groups was highly significant ($P < 0.001$) (16).

Sasmita et al carried out that the prospective study on evaluation of HRCT in temporal bone pathology other than otitis media. Patients with temporal bone involvement with a clinical suspicion were included. After detailed history taking and clinical examination, patients underwent HRCT temporal bone. CECT was done whenever necessary. Of 100 patients in our series, 50 were inflammatory, 20 traumatic, 10 neoplastic and normal in 20 cases. High resolution CT is superior to the traditional modality and it also has high spatial resolution and improved soft tissue contrast, appropriate for assessment of temporal bone and its adjacent structures proper clinical history and relevant clinical examination are very essential in reaching a definite diagnosis (17).

Chuni et al in their prospective study on significance of HRCT [High resolution Computed tomography] in chronic and acute otitis media. In this study, 50 patients were retrospectively referred to the radiology department with clinical suspicion of temporal bone/ear pathologies. The patients then underwent HRCT after detailed clinical examination. The imaging data were compared with the surgical data, whenever possible. The surgical findings were accepted as definitive. The incidence

of cholesteatoma was 83.33% (40/50). Surgical and radiological findings had high sensitivity for the diagnosis of cholesteatoma (89.29%). The sensitivity of HRCT is good (80.65%) in localizing the changes involving the ossicular chain surrounded by soft tissue. Erosion of lateral semicircular canal was clearly demonstrated in HRCT which was very informative. HRCT had a poor sensitivity of 33.33% in diagnostic assessment of facial canal dehiscence. In assessment of any congenital anomaly of the ear HRCT was found to be useful in depicting the anatomy (18).

40-42 Mohammad et al has done a prospective study concerning surgical correlation and assessment of acute and chronic otitis media by high resolution CT scan This was a prospective study in which 56 consecutive patients with chronic suppurative otitis media, unsafe type cholesteatomas. Every patient has undergone complete clinical evaluation and HRCT. All suspected intracranial complication patients had received intravenous contrast media. Preoperative radiological findings were compared to surgical findings. Results With high rate of occurrence in the 3rd decade. The scutum and the lateral attic wall were the most frequently eroded sites of bony wall in the middle ear (64.3%), while the incus was the most eroded ossicle of those in the middle ear (88.2%). Mastoid air cells sclerosis was identified in 60.7% of the ears, and lateral semicircular canal involvement in 9%, facial canal erosion was found in 21.4%. Complications affecting the temporal bone are more prevalent than intracranial complications. HRCT findings were correlated with operative findings; comparison of the accuracy and sensitivity of HRCT in diagnosis of cholesteatoma (92.8%), location and extension (96.4%) ossicular chain erosion (98%) labyrinthine fistula as well as intracranial disease gave 100% (19).

Aljehani et al in their study tried to find out relationship of Preop temporal bone HRCT findings and Intra-Op findings in COM. This was a retrospective study done in the ORL-HNS Unit, Ohud Hospital, Medina, Saudi Arabia between January and September 2018. All patients with COM were entered into the study and all enrolled participants signed an informed consent. The manifestations on HRCT were correlated with intraoperative findings. The criterium of comparison was subject to be the tympanic membrane, middle ear content and cholesteatoma. In all, 39 patients were subjected to analysis: 14 males and 25 females. Age ranged from 9 to 50 years. After comparing the findings of HRCT with the intraoperative findings, we noted that erosion of incus through CT was also detected in surgical observation at same site in 12 cases (30.8%). One case (2.6%) showed an eroded malleus on CT, but 5 cases were observed

at operation (12.8%). Cholesteatoma on CT and intra-operatively was also found to be related with a strong correlation between HRCT cholesteatoma extension and intra-operative findings (P-value = 0.001, confidence level-95%). The sensitivity, specificity, PPV and NPV were 100% for predicting sigmoid plate erosion, dura exposure, incus erosion, stapes erosion and malleus-incus joint discontinuity using preoperative CT (20).

Mitra et al carried out a prospective observational study to determine the role of HRCT in diagnosing and planning management of patients with COM. A total of 100 patients with COM were recruited for a detailed otorhinolaryngological and otoscopic examination clear etc., pure tone audiometry (PTA), non-contrast HRCT of bilateral temporal bones in addition to being managed medicinally for symptoms and surgically. Statistical Analyses Used: Data were formulated as percentage, mean $\pm$ SD Kolmogorov–Smirnov was used to evaluate linearity of the data. The difference of frequency distribution for the data was compared using either Fischer's exact test or Chi-square test. Onto soft tissue attenuation, H.R.C.T was 100% sensitive as well as specific for the diagnosis of soft tissue lump; it proved to be exact in making diagnoses with cholesteatoma presence and it was found to be sensitive between (83.3%-100%) and specific (87.04% - 100%). In bony erosion, HRCT was reasonably accurate. These comparisons were extremely highly significant with $P < 0.0001$ (21).

Singh R et al performed a study to compare the HRCT temporal bone findings with surgery in unsafe type of CSOM. This was a prospective study of 50 patients (M=28: F=22) with the clinical diagnosis of suspicious unsafe CSOM. All patients had HRCT of the temporal bone followed by surgery. The intra-operative and histopathological results were correlated with HRCT findings. Descriptive statistics, sensitivity, specificity and positive as well as negative predictive value for HRCT were estimated. Student's t-test and χ^2 -test were used. Among 50 patients, left, right and bilateral ear/mastoid were involved in 42% (21/50), 38% (19/50) and 20 % (10/50) cases respectively. The patients' most frequent complaints were ear discharge (100%), and the remaining symptoms were: otalgia in 66%, dizziness in 16% and tinnitus in 14%. Cholesteatoma was observed on HRCT in 82% (49/60) ears and the diagnosis was later confirmed histopathologically and intraoperatively in 40 of these cases. HRCT did not diagnose the cholesteatoma in 18% (11/60) ears, while intraoperative and histopathological findings showed that six patients had cholesteatoma and the remaining had granulation tissue. For the ossicular erosions, tegmen erosions, facial

nerve canal erosions, sigmoid sinus plate and lateral/posterior semicircular canals erosions; HRCT had good sensitivity (86.44%–100%) and specificity (93.33%–100%) (22).

Kumar SR et al in a study carried out to analyze the role of preoperative HRCT temporal bone in establishing the diagnosis, extent and complications of the disease and also in planning for surgery. The specificity of the structures involved and of Intraoperative findings by the surgeon to age and sex, in ascertaining outcome is compared to increase precision in diagnosis. It is useful in early detection of intracranial complications of CSOM and helps surgical planning. Patients presenting/Suspected to have CSOM that were posted for mastoid exploration surgery in our Department (ENT) in a span of 2 years-Considering from February 2019 till September 2020, were selected and taken up for the study. The patient will be subjected to HRCT TB with Aquilon 160 slice CT scanner with sub millimetric thick AXIAL CUTS Regions of Interests were Searched in Preoperative Scans In our preoperative scans, we looked for the following areas. DOMASTOID. RAND TTE. FCE. TE. OSSICLSOME ccD and E LPESCOD Out of total 30 CPROW patients, there was a male predominance (52%) with 26 patients being males. Seventy percent of the patients were aged 11 to 30 years. The left ear was affected in 40% of patients. Symptoms: The most common symptom reported was otorrhoea (80%). External Auditory Canal (EAC) was found to be normal in most of the (82%) patient's radiologically as well as per operatively in this study. HRCT scanning was very sensitive (100%) for diagnosis of cholesteatoma. CT scan had sensitivity and specificity of 100% for detecting erosion of malleus, whereas sensitivity and specificity of CT scan was 91% and 100%, respectively, for the detection of erosion of incus (23). Balakrishnan et al presented results of a study assessing The Utilization of HRCT imaging to determine extent of disease versus SPECT/CT scan. This study included patients with a clinical diagnosis of MEO who received both types of imaging in skull base. We compared the stage of disease extent between the imaging modalities in patients. Symptom relief and survival were evaluated between SPECT/CT stages of MEO. Seventy-two percent of the 28 patients studied had SPECT/CTssns with a higher stage than HRCT diagrams. Four (18%) patients demonstrated mild uptake (stage 1), 15 (68%) disease limited to the mastoid and temporal bone not crossing midline, stage II. All stage 1 and 2 patients were alive, with good symptom control. Five patients presentation involved midline (stage 3 with petrous bone involvement)

remained symptomatic whereas all four presentations with sphenoid and crossmidline-involvement on SPECT/CT (stage 4) died within a year of diagnosis (24).

Dubey R and et al performed a study to evaluate the HRCT findings of temporal bone involvement in various inflammatory, traumatic, and neoplastic diseases of the surrounding structures and correlated specific HRCT findings with surgery/histopathology as applicable. A 100 patients were selected after them getting local examination, clinical examination and from them obtaining the proper consent then subsequently analysed in the study for HRCT and relevant statistical analysis were computed. All the patients who underwent HRCT temporal bone..... presented with clinical features of disease or conditions affecting external middle and inner ear, congenital anomalies and trauma. The exclusion criteria were Patients aged 80 years and patients with cochlear implants. In our series of 100 patients, 60 cases were inflammatory, 20 traumatic, 12 neoplastic and 4 congenital malformations. Among cases of infective etiology 60, (otomastoiditis/CSOM-30 (50%), cholesteatoma-25 (42%) and otitis externa-5(8%). Specificity, sensitivity, Positive predictive values (PPV) and negative predictive values (NPV) were determined for each etiology and structure involved in separate disease processes (25).

Chatterjee P et al in their study to determine the role of HRCT in diagnosing and investigating /assessing / managing cases of CSOM. All the patients with CSOM selected for mastoid exploration surgery in department of ENT, Gauhati Medical College and Hospital during a period of 2 years, from 1st january 2013 to 31th december 2014 were included in the study. Such HRCT mastoids performed as a routine before the cholesteatoma surgery to give more details of all middle ear structures and disease complications prior of surgical exploration, may help lead as road map for the surgeon during the mastoid drilling for unsafe CSOM. The diagnostic role of HRCT is in early detection of the cholesteatoma, thus less invasive surgical techniques can be adopted to get rid of disease (26).

Khan MI et al 8 Prospectively evaluated the role of high resolution computed tomography (HRCT) temporal bone in active squamous COM. Correlation between HRCT and surgical findings. One hundred and four clinically diagnosed COM patients were involved in a prospective study. All patients were clinically evaluated and HRCT of the temporal bone was performed. Measurement The HRCT findings were compared with the surgical finding. The sensitivity of HRCT temporal bone in diagnosing cholesteatoma was 91.81%. However it could not differentiate cholesteatoma from

other soft tissue density such as granulation or hypertrophic mucosa or discharge while soft tissue attenuation content with bone erosion were considered as sine qua non of cholesteatoma. The sensitivity-specificity of HRCT in detecting erosion of malleus, incus and stapes were 71.5-88.5%, 86.3-95% and 53.1 -64.7% respectively. The sensitivity and specificity for finding erosion of the LSCC was 77.78 and 98.2%. The sensitivity and specificity for the facial canal were 80 and 100% (27).

Chapter 3

METHODOLOGY

3.1. 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

3.2. Clinical setting:

The study was conducted in radiology department of Sir Ganga Raam Hospital, Lahore and data was collected in form of questionnaire

3.3. Sample Size:

The formula for sample size calculation is:

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

N= 45

(14)

3.4. Sampling Technique:

Convenient sampling technique was used.

3.5. Duration of Study:

This descriptive study lasted for almost 6 months .

3.6. Selection Criteria:

3.6.1. Inclusion Criteria:

- Patienta with Sudden onset of ear infection.
- Patients who present with sudden onset of pain in ea
- Patients with vertigo
- Patients with persistent Ear Infection for more than 3 weeks
- Patients with Hear loss secondary to ear infection.

3.6.2. 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.

3.7. Equipment:

"Toshiba Aquillon 64 Slicer CT "

3.8. Ethical Consideration:

- The study followed the guidelines provided by moral committee Superior University Lahore and all rights of research participants will be taken into consideration.
- Informed written consent was obtained from all subjects.
- Confidentiality All information/data collection will be treated as confidential.
- Subjects will be anonymous at all times during the study.
- Subjects have been informed that there are no detrimental effects or risks upon the conduction of the study.
- They also were told that they will be able to drop out at anytime during the study.
- There were no harms to this research.
- We will take all reasonable precautions to ensure that the information you share with us is protected. You won't be identified in any report that comes out of this study.
- Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate anytime. You will not be punished in any way if you choose to discontinue we are Arbor requirements or offer anita study.

3.9. Data Collection Procedure

After performing the scan, all the required variables like age, gender, clinical findings history and the radiological features of patients' scan was noted in the questionnaire. All the data was recorded after taking consent from the patient.

3.10. Data Analysis Procedure

Data was evaluated and analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. All variables were analyzed 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) were calculated for continuous variables.

Chapter 4

RESULTS

Out of 45 patients that were included in this study, 27 were females while remaining 18 were males. All the patients presented with symptoms like fever, otalgia and hearing loss. After performing HRCT, it was found that out of these 45 patients, 30 had acute while 15 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.

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 45 patients, with the youngest being a 10 years old patient while the eldest being a 70 years old man. Around 50% of the patients were aged between 10-25 years.

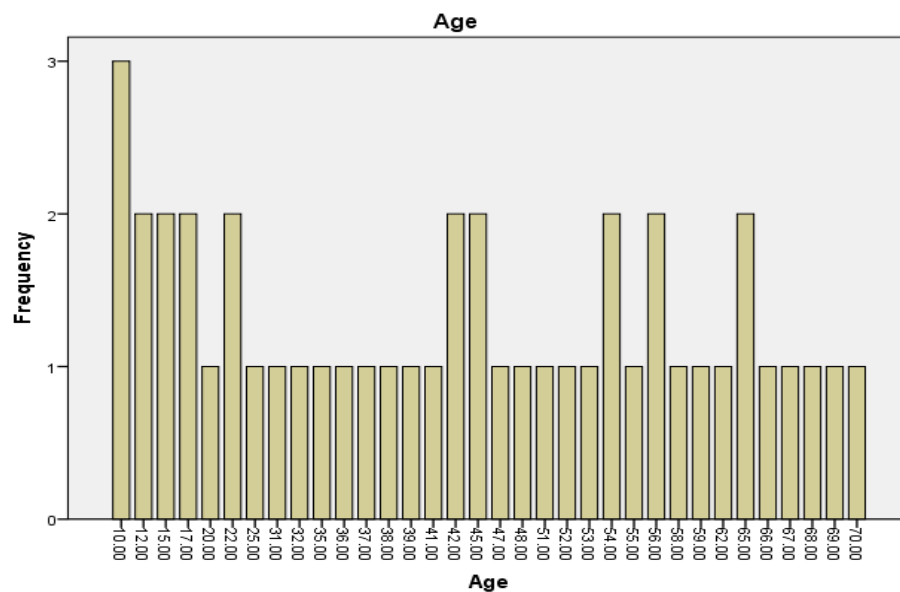


Figure 4.1: Histogram representing the frequency distribution of different age groups of patients

GENDER:

Gender of a patient was very important factor in determining the different aspects of the study. Many conditions were gender specific and situations develop differently based on the gender. It was very important to correctly analyze the data and determine the gender ratio. 27 Females and 18 males were included in this study.

Table 4.1: Descriptive statistics of genders of patients in this study

Gender

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

FEVER :

This study included total 45 patients in which 10 patients presented with mild fever, 15 with severe while 20 patients didn't present with fever. Which was graphically described below

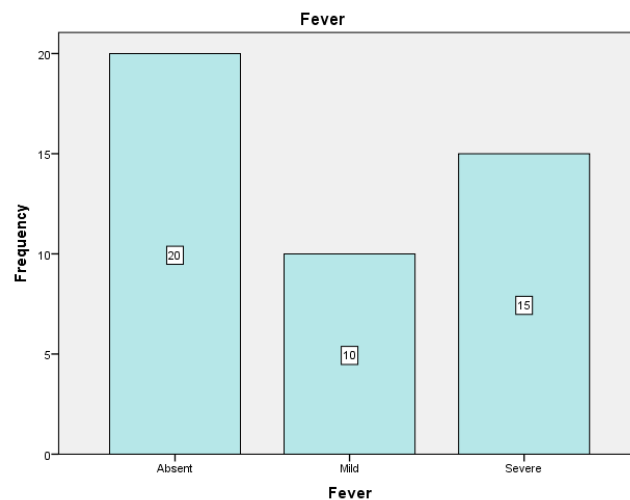


Figure 4.2: otitis media linked with fever

MIDDLE EAR OPACIFICATION:

Middle ear opacification is ought to be very common in patients with acute and chronic otitis media, but it was really important for this study to determine whether the opacification was complete or partial. In this study, middle ear opacification was not seen in 2 patients, while 25 patients had complete middle ear opacification and 18 had partial opacification of their middle ear.

Table 4.2: Classification of patients based on the extent of middle ear opacification
Middle Ear Opacification

Middle Ear Opacification		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	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	

Middle ear opacification was not seen in 2 patients, while 25 patients had complete middle ear opacification and 18 had partial opacification of their middle ear

OSECLAR 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 10 patients , while they were partially eroded in 24 patients. Extensive erosion of middle ear osecles was seen in 11 patients out of total 45 patients

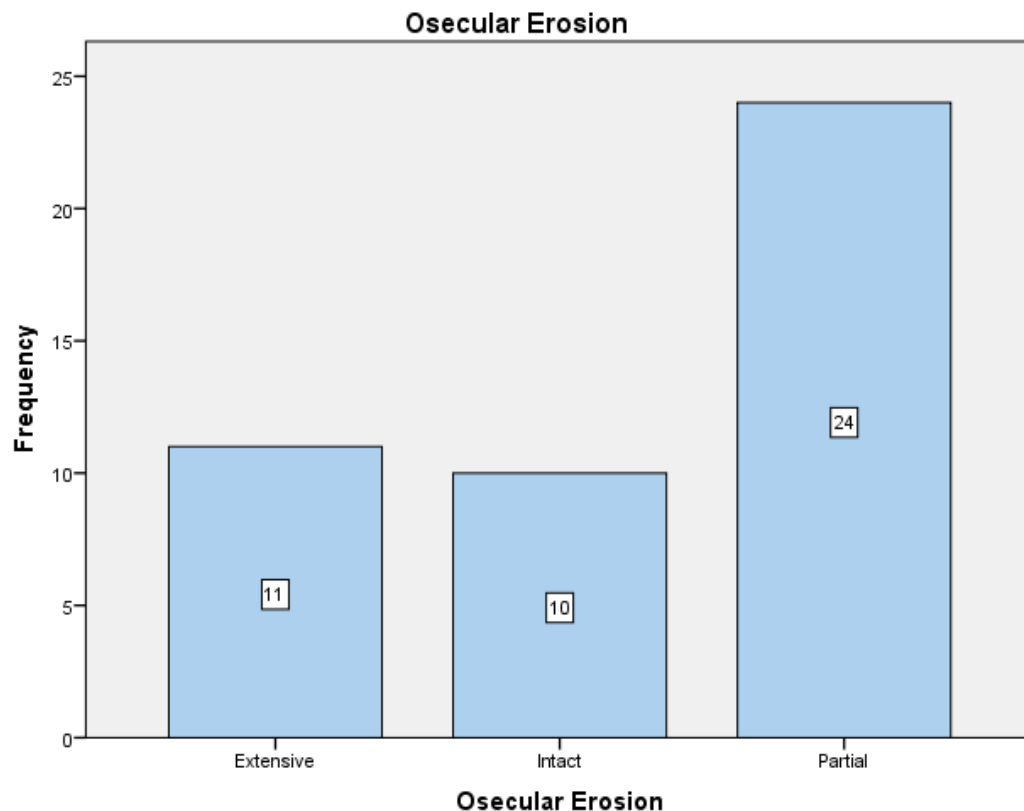


Figure 4.3: Frequency Statistics of patients with different types of erosions.

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 29 patients, while 9 patients had advanced sclerotic mastoid cells. Only 7 patients had normal mastoid cells.

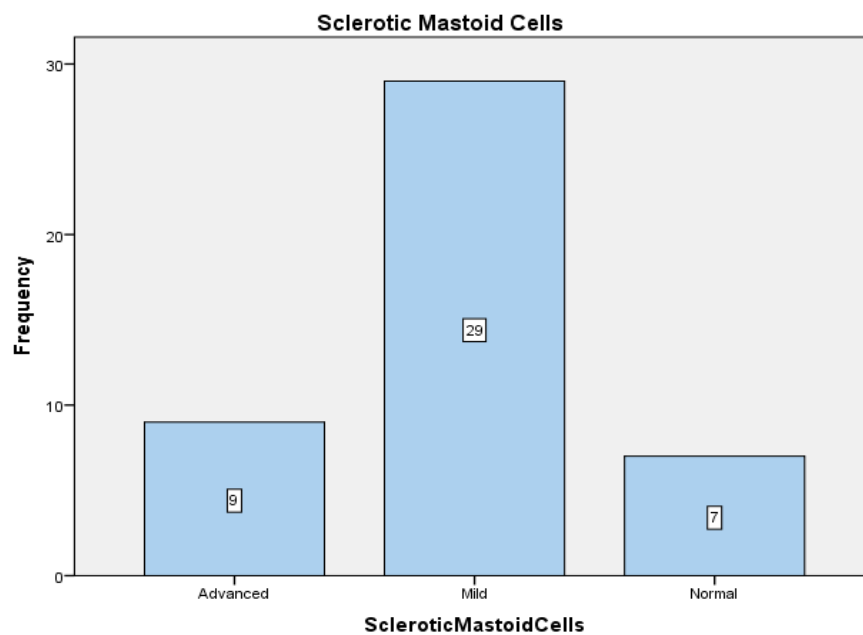


Figure 4.4: Frequency distribution table for patients based on sclerosis in their mastoid air cell

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 10 patients. Mild effusion was seen in 27 patients while only 8 patients were found to have severe effusion

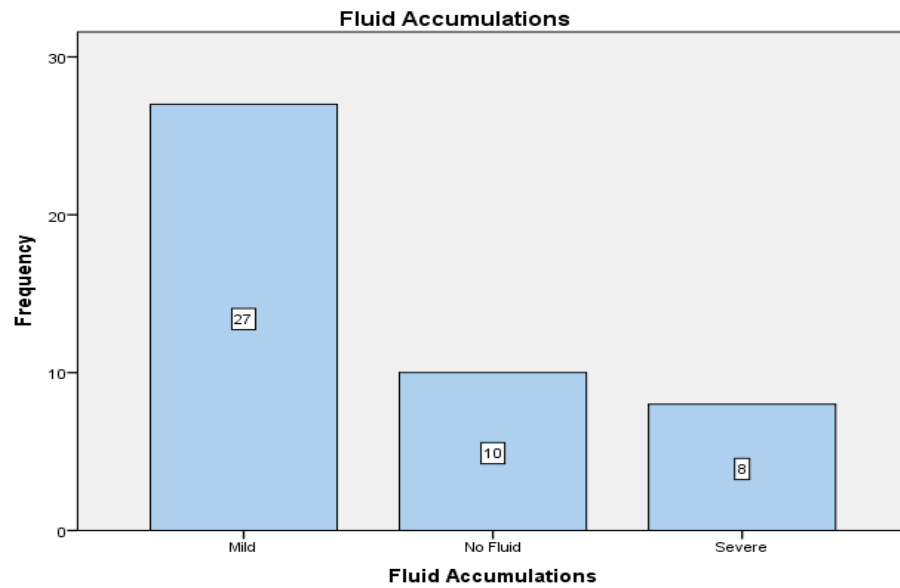


Figure 4.5: Descriptive analysis of patients with fluid accumulation in ear cavity.

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 7 patients, mildly thickened in 31 patients while 7 patients had quite marked tympanic membrane thickness

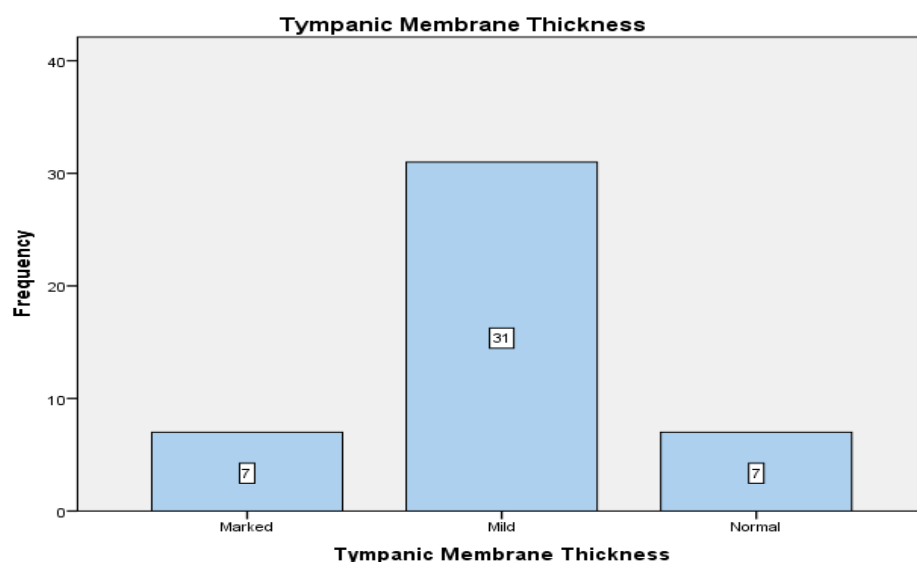


Figure 4.6: Histogram representing the patients with different extents of tympanic membrane thickness.

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, 30 patients had acute, while 15 patients had chronic otitis media.

Table 4.3: Frequency of Acute vs Chronic Otitis Media in this study

OtitisMedia				
	Frequency	Percent	Valid Percent	Cumulative Percent
Acute	30	66.7	66.7	66.7
Valid Chronic	15	33.3	33.3	100.0
Total	45	100.0	100.0	

Of all the patients with Otitis Media in our study, 30 patients had acute while 15 patients had chronic otitis media.

Chapter 5

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.²⁸

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.²⁹ In our study, the most prevalent complaint was ear discharge, reported by 86% 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.³⁰ In addition, 56% of patients reported hearing loss, 31% reported tinnitus, 16% reported fever, 15% reported ear pain, 12% reported dizziness, and 2% 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.^{31,32} Our examination of the mastoid region using HRCT of the temporal bone revealed that 64% of mastoid cells displayed mild sclerosis, while 20% showed advanced sclerosis, and 16% were classified as normal. This contrasts with Rai's study, which recorded 44% as well-pneumatized and 50% with sclerotic mastoid appearances.³³ On the temporal bone HRCT, 40% 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 30% of cases and a slightly higher rate with bony erosion at 66.6%.³⁴ In 64% 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.³⁵ 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 78% of cases, slightly less than the 92% reported by Gaurano and Joharjy.^{36,37} Mozumder et al. found that absent malleus was present in 5% of cases and absent incus in 43% of cases, while absent ossicles were found in 24% of cases. Albera et al. reported similar outcomes.³⁸ It was discovered during surgery that those who showed bony erosion suggestive of cholesteatoma on HRCT actually had cholesteatoma. Therefore, HRCT proved to be 100% accurate in identifying cholesteatoma. HRCT is highly sensitive and specific for identifying soft tissue masses, as shown by Mafee et al. and O'Reilly et al., but Jackler et al. and Garber et al. reported that its sensitivity and specificity were lower.^{39,40,41} O'Donoghue et al. observed bony erosion associated with cholesteatoma in 80% of cases.⁴² However, HRCT failed to differentiate between granulation tissue and polyps. In terms of identifying ossicular erosion, HRCT showed a sensitivity of 100% and a specificity of 87.04%, revealing 10 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.^{35,38,40} With a specificity of 100% and sensitivities ranging from 87.04% to 100%, HRCT demonstrated a high degree of accuracy in identifying bony erosions of the temporal bone. HRCT showed 100% specificity and 87.04% 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.²⁹ Additionally, HRCT exhibited 100% sensitivity and specificity in identifying lateral semicircular canal erosion in 9 patients, which mirrored the results of Mafee et al., Rocher P et al., and Chee NW et al. The incidence matched the 9% of LSCC fistulas identified by SuatKeskin et al.⁴² 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.

CONCLUSIONS

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.

Limitation

- Limited Research Resources
- Sample Size

Recommendations

- More studies should be done in this topic

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APPENDICES

ENGLISH CONSENT FORM

The study you are about to participate is a randomized control trial survey titled as;

“TITLE”

The study has no potential harm to participants. All data collected from you will be coded in order to protect your identity, and should not be disclosed to anyone. Following the study there will be no way to connect your name with your data. Your answers to the questions will not affect the quality of education given to you. Any additional information about the study results will be provided to you at its conclusion, upon your request.

You are free to withdraw from the study at any time. You agree to participate, indicating that you have read and understood the nature of the study, and that all your inquiries concerning the activities have been answered to your satisfaction.

NAME _____

SIGNATURE_____

DATE_____

URDU CONSENT FORM

نے اپنی (YOUR NAME IN URDU) محترمہ تصدیق کرتا/ کرتی ہوں کہ _____ میں
اس تحقیق

“YOU TITLE ”

زیرنگرانی (YOUR SUPERVISOR NAME) کے متعلق بتا دیا ہے۔ مجھے اس تحقیق کی
نوعیت، مقاصد، احداث، توقعات، فوائد اور خطرات کے متعلق ، ساری معلومات فراہم کر دی گئی
ہیں

اس تحقیق کے دوران ساری معلومات صیغہ راز میں رہیں گی اور مریض کا نام اور دیگر معلومات
صرف تحقیق کے لیے استعمال ہوں گی۔ مجھے یہ بھی بتا دیا گیا ہے کہ میں اس تحقیق سے متعلق ہر
قسم کے سوال پوچھنے کا مجاز ہوں اور یہ تحقیق صرف ایک شخص کا مفاد میں نہیں ہے بلکہ
بحسنیت مجموعی انسانیت کا مفاد اس سے وابستہ ہے۔ تمام تفصیلات جاننے کے بعد میں تحقیق میں
شامل ہونے یا نہ ہونے پر کسی کا قائل نہیں ہوں۔ اس تحقیق سے کسی بھی وقت علیحدہ ہونے پر مجھ
پر کوئی پابندی نہیں ہو گی۔ میں بذاتِ خود بقائمی حوش و حواس
اور رضا مندی سے اس تحقیقاتی عمل میں شامل ہوتی/ ہوتا ہوں

دستخط محقق _____

دستخط شرکت کار _____

تاریخ _____

DEMOGRAPHICS FORM & QUESTIONNAIRES

Patient ID # _____

Age	
Gender	

Clinical Findings:

Ear Infection	Acute/Chronic
Fluid drainage	Absent/Mild/Severe
Fever	Present/Absent
Otalgia	Primary/Secondary
Hearing loss	Partial/Complete

HRCT Findings:

Middle Ear Opacification	Clear/Partial/Complete Opacification
Thickened tympanic membrane	Normal/Mild/Marked Thickness
Bulging of tympanic membrane	Normal/Mild/Contour Bulging
Fluid accumulation in middle ear	No Fluid/Minimal/Significant Effusion
Septations or compartmentalization in middle ear	Absent/Several Septations
Ossicular Erosion	Intact Ossicles/Partial erosion/Extensive Erosion
Inflamed/Infected Mastoid air cells	Normal/Mild/Severe Inflammation
Sclerotic Mastoid cells.	Normal/Mild Sclerotic changes/Advanced Sclerosis

Data collection sheet (10 patients)

Sr. No	Age	Gender	Clinical Findings			HRCT Findings						Diagnosis
			Otalgia	Hearing Loss	Fever	Middle ear Opacification	Osecular Erosion	Sclerotic MastoidCells	Fluid Accumulation	Septations	Tympanic Membrane Thickness	
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

SUPPLEMENTARY TABLE

Sr.No	Age	Gender	Clinical Findings			HRCT Findings						Diagnosis
			Otalgia	Hearing Loss	Fever	Middle ear Opacification	Ossicular Erosion	Sclerotic Mastoid Cells	Fluid Accumulation	Septations	Tympanic Membrane Thickness	
1	54	F	Secondary	Complete	Severe	Partial	Extensive	Advanced	Severe	No Septations	Marked	Chronic
2	37	F	Primary	Partial	Absent	Partial	Partial	Mild	Mild	Septated	Mild	Acute
3	10	F	Primary	Partial	Absent	Partial	Partial	Mild	Mild	Septated	Mild	Acute
4	20	F	Secondary	Complete	Severe	Absent	Extensive	Advanced	Severe	No Septations	Marked	Chronic
5	65	F	Secondary	Complete	Severe	Partial	Extensive	Mild	Mild	No Septations	Mild	Chronic
6	53	F	Secondary	Complete	Severe	Partial	Extensive	Advanced	Severe	No Septations	Marked	Chronic
7	15	F	Primary	Partial	Mild	Complete	Intact	Normal	No Fluid	Septated	Normal	Acute
8	47	M	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
9	65	F	Primary	Partial	Mild	Complete	Intact	Mild	No Fluid	Septated	Mild	Acute
10	51	M	Primary	Partial	Mild	Complete	Intact	Normal	No Fluid	Septated	Normal	Acute
11	59	M	Primary	Partial	Mild	Complete	Intact	Normal	No Fluid	Septated	Normal	Acute
12	48	F	Primary	Partial	Absent	Partial	Partial	Mild	Mild	Septated	Mild	Acute
13	70	F	Secondary	Complete	Severe	Partial	Partial	Mild	Mild	No Septations	Mild	Chronic
14	36	F	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
15	62	M	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
16	55	M	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
17	10	F	Secondary	Complete	Severe	Absent	Extensive	Advanced	Severe	No Septations	Marked	Chronic
18	45	F	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
19	56	M	Primary	Partial	Mild	Complete	Intact	Mild	No Fluid	Septated	Mild	Acute
20	69	F	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
21	67	M	Secondary	Complete	Severe	Partial	Extensive	Advanced	Severe	No Septations	Mild	Chronic
22	68	M	Secondary	Complete	Severe	Partial	Partial	Mild	Mild	Septated	Mild	Chronic
23	45	F	Secondary	Partial	Absent	Partial	Partial	Mild	Mild	Septated	Mild	Acute
24	58	M	Primary	Partial	Mild	Complete	Intact	Normal	No Fluid	No Septations	Normal	Acute
25	42	F	Secondary	Complete	Severe	Partial	Partial	Mild	Mild	Septated	Mild	Chronic
26	12	F	Secondary	Complete	Absent	Partial	Partial	Mild	Mild	Septated	Mild	Acute
27	22	F	Primary	Partial	Mild	Complete	Intact	Normal	No Fluid	Septated	Normal	Acute
28	31	M	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
29	10	M	Secondary	Complete	Severe	Partial	Partial	Mild	Mild	No Septations	Mild	Chronic
30	41	F	Primary	Partial	Mild	Complete	Intact	Normal	No Fluid	Septated	Normal	Acute
31	52	M	Secondary	Complete	Severe	Partial	Extensive	Advanced	Severe	No Septations	Marked	Chronic
32	25	F	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
33	38	F	Primary	Partial	Mild	Complete	Intact	Normal	No Fluid	Septated	Normal	Acute
34	56	F	Secondary	Complete	Severe	Partial	Extensive	Mild	Mild	No Septations	Mild	Chronic
35	12	M	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
36	39	F	Secondary	Complete	Severe	Partial	Extensive	Advanced	Mild	No Septations	Mild	Chronic
37	32	F	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
38	54	F	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
39	17	F	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
40	66	M	Secondary	Complete	Severe	Complete	Extensive	Advanced	Severe	No Septations	Marked	Chronic
41	22	M	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
42	42	F	Primary	Partial	Mild	Complete	Intact	Mild	No Fluid	Septated	Mild	Acute
43	15	M	Primary	Partial	Absent	Complete	Partial	Mild	Mild	Septated	Mild	Acute
44	35	M	Secondary	Partial	Absent	Partial	Partial	Mild	Mild	Septated	Mild	Acute
45	17	M	Secondary	Complete	Severe	Partial	Extensive	Advanced	Severe	No Septations	Marked	Chronic