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COMPARISON OF CONVENTIONAL HRCT EVALUATION AND HRCT-BASED SCORING SYSTEM IN THE DIAGNOSIS AND ASSESSMENT OF OTOMASTOIDITIS

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Abstract

Background: *Otomastoiditis is an infection involving the middle ear and mastoid air cells, commonly developing as a complication of acute or chronic otitis media when inflammation extends into the mastoid process. Symptoms include ear pain, fever, otorrhea, hearing loss, and mastoid tenderness or swelling. Frequent causative organisms include Streptococcus pneumoniae and Pseudomonas aeruginosa. Diagnosis relies on clinical evaluation and CT imaging. Prompt antibiotic therapy and, when required, surgical intervention are essential to avoid serious complications.*

Objective: *To assess HRCT and HRCT-based scoring in diagnosing otomastoiditis and quantifying disease extent for improved clinical and surgical management.*

Methods: *In this research, descriptive study was adopted. convenient sampling technique was used. Duration of study was 4 months and it was take place at the Radiology Department of Mayo hospital Lahore.50 patients' data was collected.*

Results: *A total of 50 patients were included in the study. Otalgia was the most common presenting symptom, observed in 40 (80%) patients, followed by nasal discharge in 11 (22%) and tenderness in 13 (26%) patients. Most patients presented in the subacute to chronic stage, with 19 (38%) having symptoms for one month and 17 (34%) for up to one year. HRCT showed posterior involvement as the most frequent anatomical site (14, 28%), followed by lateral (13, 26%) and anterior (11, 22%) regions. Mild and moderate otomastoiditis were equally common (21, 42% each), while severe cases were less frequent (8, 16%). Intermittent disease pattern (28, 56%) was more common than constant (20, 40%), and acute cases (27, 54%) were more frequent than chronic (17, 34%). HRCT findings revealed bony erosion in 21 (42%) patients, coalescent otomastoiditis in 15 (30%), middle ear cavity opacification in 15 (30%), and mastoid air cell opacification in 14 (28%). HRCT demonstrated higher detection rates than conventional CT across all parameters, particularly for bony erosion (24% vs 42%) and middle ear opacification (84% vs 96%). Statistical analysis*

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showed a significant difference for bony erosion (p = 0.045) and middle ear opacification (p = 0.029), while coalescent mastoiditis was not statistically significant (p = 0.180).

Conclusion: *In conclusion, this study demonstrates that HRCT is superior to conventional CT in the diagnosis and assessment of otomastoiditis. HRCT showed higher detection rates for key pathological findings, particularly bony erosion and middle ear opacification, with statistically significant differences. Additionally, HRCT-based scoring proved effective in evaluating disease severity, with most cases categorized as mild to moderate. These findings highlight the importance of HRCT in early detection, accurate assessment, and improved clinical management of otomastoiditis. Therefore, HRCT should be considered the preferred imaging modality for comprehensive evaluation of this condition.*

INTRODUCTION

Otomastoiditis is an infection involving both the middle ear and the mastoid air cells of the temporal bone. It most often develops as a complication of acute or chronic otitis media when inflammation spreads into the mastoid process. Typical symptoms include ear pain, fever, otorrhea, hearing reduction, and tenderness or swelling over the mastoid region. Common causative organisms include *Streptococcus pneumoniae* and *Pseudomonas aeruginosa*. Diagnosis usually relies on clinical evaluation supported by imaging such as CT scans. Prompt treatment with appropriate antibiotics and, when necessary, surgical intervention is essential to prevent potentially serious complications such as abscess formation or intracranial spread [1].

The condition primarily affects young children, particularly those under two years of age, with a global incidence ranging from 0.99 to 38.3 cases per 100,000 children annually. Males are affected more frequently than females. Several risk factors contribute to its development, including young age, exposure to parental smoking, and a history of recurrent ear infections or ear surgery. Although relatively uncommon, otomastoiditis can lead to serious complications such as meningitis, facial nerve paralysis, and intracranial abscesses, making early diagnosis and timely management essential [2].

Otomastoiditis is caused by the spread of infection from the middle ear into the mastoid air cells. The most common causative organisms include *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Haemophilus influenzae*, and *Pseudomonas aeruginosa*, particularly in chronic or post-surgical cases. It commonly arises due to untreated or inadequately managed otitis media, with higher risk observed in children, immunocompromised individuals, and patients with recurrent infections [3].

Imaging plays a central role in the diagnosis and assessment of otomastoiditis. High-resolution computed tomography (HRCT) is considered the modality of choice due to its ability to provide detailed visualization of bony structures, mastoid air cells, and soft tissue involvement [4]. Compared to conventional radiography, HRCT offers superior spatial resolution and allows early detection of subtle bony erosion and disease extent, which is crucial for treatment planning and prevention of complications [5].

Conventional HRCT evaluation is largely qualitative and depends on the radiologist's subjective interpretation of imaging findings such as mucosal thickening, opacification, ossicular erosion, and bone destruction. This may lead to interobserver variability and inconsistency in disease assessment [6]. In contrast, HRCT-based scoring systems provide a structured and quantitative approach by assigning numerical values to specific radiological findings. This method enhances objectivity, improves reproducibility, reduces observer bias, and allows better correlation with clinical severity and surgical outcomes [7].

This study seeks to improve the diagnostic precision and objectivity of high-resolution computed tomography (HRCT) in the assessment of temporal bone pathologies, with particular emphasis on otomastoiditis. It aims to compare

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traditional qualitative HRCT interpretation with a structured HRCT-based scoring system, while correlating radiological findings with intraoperative and histopathological results. Through this approach, the study endeavors to develop a more standardized, quantitative, and clinically relevant method for diagnosing and evaluating temporal bone disorders.

METHODS

An analytical cross-sectional study was conducted at Mayo Hospital, Lahore, over a period of four months following approval of the research synopsis. A total sample size of 50 patients was calculated based on a prevalence rate of 0.04%, a 5% margin of error, and a 95% confidence level using the standard sample size formula. Participants were selected using a non-probability convenience sampling technique. Patients presenting with acute or chronic otomastoiditis, symptoms of middle ear infection, and involvement of one or both sides of the middle ear and mastoid were included in the study. Patients with contraindications to CT scanning, claustrophobia, or those diagnosed with cholesteatoma unrelated to the current infection were excluded. Imaging was performed using a 128-slice Toshiba computed tomography (CT) scanner. For HRCT evaluation, patients were positioned supine with the head immobilized, and thin axial slices (0.5–1 mm) were obtained through the temporal bone. Images were reconstructed using a bone algorithm, with additional coronal and sagittal views generated using bone windows to assess ossicles, mastoid air cells, and bony erosions. Both conventional HRCT evaluation and an HRCT-based scoring system were applied for disease assessment. Data were analyzed using SPSS version 27.0 and Microsoft Excel 2016. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages.

RESULTS

A total of 50 patients were included in the study. Otalgia was the most common presenting symptom, observed in 40 (80%) patients, followed by nasal discharge in 11 (22%) and tenderness in 13 (26%) patients. Most patients presented in the subacute to chronic stage, with 19 (38%) having symptoms for one month and 17 (34%) for up to one year.

HRCT showed posterior involvement as the most frequent anatomical site (14, 28%), followed by lateral (13, 26%) and anterior (11, 22%) regions. Mild and moderate otomastoiditis were equally common (21, 42% each), while severe cases were less frequent (8, 16%). Intermittent disease pattern (28, 56%) was more common than constant (20, 40%), and acute cases (27, 54%) were more frequent than chronic (17, 34%).

HRCT findings revealed bony erosion in 21 (42%) patients, coalescent otomastoiditis in 15 (30%), middle ear cavity opacification in 15 (30%), and mastoid air cell opacification in 14 (28%). HRCT demonstrated higher detection rates than conventional CT across all parameters, particularly for bony erosion (24% vs 42%) and middle ear opacification (84% vs 96%).

Statistical analysis showed a significant difference for bony erosion ($p = 0.045$) and middle ear opacification ($p = 0.029$), while coalescent mastoiditis was not statistically significant ($p = 0.180$).

Table 1: Representing the frequency distribution of clinical symptoms

Clinical Symptom	Yes n (%)	No n (%)
Otalgia	40 (80%)	10 (20%)
Nasal Discharge	11 (22%)	39 (78%)
Tenderness	13 (26%)	37 (74%)

Table 2: Representing the frequency distribution of disease duration

Disease Duration	Frequency (n)	Percentage (%)
1 Week	13	26%

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1 Month	19	38%
1 Year	17	34%

Table 3: Representing the frequency distribution of anatomical location

Anatomical Location	Frequency (n)	Percentage (%)
Anterior	11	22%
Lateral	13	26%
Posterior	14	28%

Table 4: Representing the frequency distribution of Severity Grading of Otomastoiditis (HRCT Scoring)

Severity Level	Frequency (n)	Percentage (%)
Mild	21	42%
Moderate	21	42%
Severe	8	16%
Total	50	100%

Table 5: Representing the frequency distribution of disease pattern

Disease Pattern	Frequency (n)	Percentage (%)
Constant	20	40%
Intermittent	28	56%

Table 6: Representing the frequency distribution of disease type of Otomastoiditis

Disease Type	Frequency (n)	Percentage (%)
Acute	27	54%
Chronic	17	34%

Table 7: Representing the frequency distribution of Specific HRCT Findings in Otomastoiditis

HRCT Finding	Frequency (n)	Percentage (%)
Bony Erosion	21	42%
Coalescent Otomastoiditis	15	30%
Mastoid Air Cell Opacification	14	28%
Middle Ear Cavity Opacification	15	30%

Table 8: Representing the comparison between Conventional CT and HRCT

Diagnostic Finding	Conventional CT n (%)	HRCT n (%)	Increase in Detection (%)
Middle ear opacification	42 (84%)	48 (96%)	+12%
Bony erosion	12 (24%)	21 (42%)	+18%
Coalescent mastoiditis	5 (10%)	9 (18%)	+8%
Middle ear cavity opacification	3 (6%)	7 (14%)	+8%
Mastoid air cell opacification	8 (16%)	14 (28%)	+12%

Table 9: Representing the Chi square test for Bony Erosion

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.020[a]	1	0.045

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Likelihood Ratio	4.080	1	0.043
N of Valid Cases	50		

Table 10: Representing the Chi square test for Middle Ear Opacification

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.760[a]	1	0.029
Likelihood Ratio	4.820	1	0.028
N of Valid Cases	50		

Table 11: Representing the Chi square test for Coalescent Mastoiditis

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.800[a]	1	0.180
Likelihood Ratio	1.850	1	0.174
N of Valid Cases	50		

DISCUSSION

In this study, 50 patients were evaluated to compare the role of conventional CT and HRCT in diagnosing otomastoiditis. It was observed that otalgia was the most common symptom, present in the majority of patients, which is expected because ear pain is usually the main complaint in middle ear infections. Many patients presented after some delay, mostly in the subacute or chronic stage, which may be due to late diagnosis or lack of early medical attention. A similar pattern has also been reported by Cristina Popescu (2024), where patients, especially from less accessible areas, presented with more advanced disease.

On imaging, HRCT showed that the posterior region of the mastoid was more commonly involved compared to anterior and lateral areas. This suggests that as the disease progresses, it tends to involve deeper mastoid air cells. Similar structural involvement has been described in studies like K. Buch et al. (2016), where different parts of the temporal bone were affected depending on disease progression.

Regarding severity, most of the cases in this study were mild to moderate, while severe cases were fewer. This indicates that many patients were still within a manageable stage of the disease at the time of diagnosis. Comparable findings were reported by Showkat et al. (2021), who also found that inflammatory conditions were the most common and HRCT was helpful in identifying them early.

Among the HRCT findings, bony erosion was the most frequent, followed by coalescent otomastoiditis and middle ear opacification. Bony erosion is particularly important because it indicates disease progression and possible complications. Similar observations were made by Mariana Coman et al. (2022), who highlighted the importance of CT in detecting bone destruction and serious complications in ear infections.

The main focus of this study was to compare conventional CT with HRCT. The results clearly showed that HRCT detected more abnormalities, especially bony erosion and middle ear opacification, and this difference was statistically significant. This means HRCT is more sensitive and can pick up subtle changes that conventional CT might miss. These findings are in line with Showkat et al. (2021), who also reported high accuracy of HRCT in temporal bone evaluation. However, for coalescent mastoiditis, the difference between CT and HRCT was not statistically significant, which suggests that both methods may perform similarly in more advanced disease.

Other studies, such as Camilla Russo et al. (2025), have also emphasized that early imaging plays an important role in detecting complications and guiding treatment. Similarly, G. Sonmez et al. (2019) pointed out that otomastoiditis can

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sometimes be associated with serious conditions like meningitis, which further highlights the importance of accurate and timely diagnosis.

Overall, the findings of this study suggest that HRCT is more reliable than conventional CT in diagnosing and assessing otomastoiditis. It helps in detecting early changes, evaluating disease severity and identifying complications, which can improve patient management and outcomes.

CONCLUSION

In conclusion, this study demonstrates that HRCT is superior to conventional CT in the diagnosis and assessment of otomastoiditis. HRCT showed higher detection rates for key pathological findings, particularly bony erosion and middle ear opacification, with statistically significant differences. Additionally, HRCT-based scoring proved effective in evaluating disease severity, with most cases categorized as mild to moderate. These findings highlight the importance of HRCT in early detection, accurate assessment, and improved clinical management of otomastoiditis. Therefore, HRCT should be considered the preferred imaging modality for comprehensive evaluation of this condition.

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