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Role Of High-Resolution Computed Tomography Of Temporal Bone In Evaluation Of Chronic Suppurative Otitis Media And Its Complications.

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Abstract:
Objective: *To evaluate the role of high-resolution computed tomography (HRCT) in the diagnosis and assessment of chronic suppurative otitis media (CSOM) and its complications.*
Methods: *This prospective observational study included 82 patients with CSOM referred for HRCT evaluation. All patients underwent HRCT scanning of the temporal bone. HRCT findings were analyzed and compared with intraoperative findings where applicable.*
Results: *The study population had a mean age of 35.8 years, with a male predominance (57.3%). The most common presenting symptoms were ear ache (85.4%) and otorrhea (82.9%). HRCT revealed decreased aeration or sclerosis of the middle ear and mastoid air cells in 96.3% of cases. Ossicular chain erosion was observed in 47.6% of patients, while facial canal dehiscence was seen in 25.6%. Cholesteatoma was diagnosed in 26.8% of cases. HRCT showed high sensitivity and specificity in detecting various pathological changes, including scutum erosion, tegmen tympani involvement, and semicircular canal erosion. There was good agreement between HRCT and intraoperative findings for most parameters, although HRCT tended to overestimate soft tissue masses and mastoid air cell involvement.*
Conclusion: *HRCT proves to be a valuable tool in the evaluation of CSOM and its complications. Its high sensitivity and specificity in detecting various pathological changes make it crucial for accurate diagnosis and preoperative planning. However, limitations exist in differentiating between granulation tissue and cholesteatoma. HRCT's role in guiding surgical management and improving patient outcomes warrants further investigation.*
Keywords: *Chronic suppurative otitis media, High-resolution computed tomography, Cholesteatoma, Ossicular erosion, Temporal bone, Mastoid, Middle ear*

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I. Introduction:

Chronic suppurative otitis media (CSOM) is a persistent inflammatory condition of the middle ear and mastoid air cells, characterized by recurrent or continuous otorrhea through a perforated tympanic membrane.[1] CSOM remains a significant global health concern, particularly in developing countries, where it affects up to 2% of the population.[2] The condition can lead to various complications, including hearing loss, vestibular dysfunction, and potentially life-threatening intracranial sequelae.[3] Early and accurate diagnosis of CSOM and its associated complications is crucial for appropriate management and prevention of further complications.

Conventional diagnostic methods, such as otoscopy and audiometry, have limitations in assessing the full extent of disease involvement and identifying complications, particularly in advanced stages.[4] High-resolution computed tomography (HRCT) of the temporal bone has emerged as a valuable imaging modality for the evaluation of CSOM and its complications.[5] HRCT provides detailed visualization of the temporal bone anatomy, allowing for precise localization and characterization of pathological changes.[6] The modality excels in detecting ossicular chain erosion, cholesteatoma formation, and extension of disease into surrounding structures.[7]

This study aimed to investigate the efficacy of HRCT in diagnosing CSOM, assessing its extent, and identifying associated complications. By evaluating the patterns and features visualized on HRCT that correspond to different stages and complications of CSOM, this research seeks to establish standardized criteria for interpretation and determine how HRCT findings can guide optimal patient management. The study will contribute to the existing knowledge and potentially improve clinical practice and patient outcomes in CSOM management.[8]

II. Materials And Methods:

This hospital-based prospective observational study was conducted in the Department of Radio-diagnosis of a tertiary care teaching hospital in western Uttar Pradesh, India, over a period of 18 months from September 2023 to March 2025. The study population consisted of patients referred to the Department of Radio-diagnosis from various departments, including ENT, neurology, and neurosurgery, with middle ear infections and a history of ear discharge.

The sample size was calculated using Cochran's formula, based on a prevalence of 11%, a confidence level of 95%, and a margin of error of 7%. The resulting sample size was 77 patients. Inclusion criteria encompassed patients with a history of middle ear infections manifesting as chronic ear discharge or conductive deafness, as well as those referred for HRCT evaluation due to complications of middle ear infection. Patients with renal insufficiency, those not providing informed consent, and cases where CT was contraindicated (such as pregnancy) were excluded from the study.

After obtaining approval from the institutional ethics committee, eligible participants were enrolled in the study following informed consent. Data collection was carried out using the direct interview method, employing a pre-tested, semi-structured questionnaire. The questionnaire was developed based on a thorough literature review and designed to gather necessary information from the study subjects.

All HRCT scans were performed at the institute using a Toshiba Activion 16-slice MDCT scanner. The scanning protocol began with topograms, followed by helical acquisition in the axial plane. The scan range extended from the lower margin of the external auditory meatus to the arcuate eminence of the superior semicircular canal. Scanning parameters were set at 120 kV, 75 mAs, with slice thicknesses of 1 mm and 0.5 mm at intervals of 1 mm and 0.5 mm, respectively. The pitch was 0.5 x 16. Images were documented using both bone window (WL 350, WW 2700) and soft tissue window (WL 40, WW 100) settings.

Coronal and sagittal reconstructions were generated from the axial images. All images were interpreted on an Apple workstation using source images, multiplanar reformations, and appropriate window settings. The contralateral temporal bone was included for comparison in all cases. Areas of interest examined in the preoperative scans included the status of mastoid air cells, external auditory canal, tegmen plate, sigmoid sinus plate, bony boundaries of the middle ear, ossicular chain status, Fallopian canal, semicircular canals, pathological processes (particularly cholesteatoma and its extension), and any disease outside the middle ear cleft.

III. Results:

The study included 82 patients with CSOM. Table 1 shows that the majority of patients (32.9%) were in the 41-60 age group, followed by those under 20 (29.3%). Males (57.3%) outnumbered females (42.7%). The most common presenting complaints were ear ache (85.4%) and otorrhea (82.9%), followed by tinnitus (56.1%). Bilateral involvement was seen in 35.4% of cases, with a slight predominance of left-sided (36.6%) over right-sided (28%) involvement.

Table 1: Demographic and Clinical Characteristics of Patients (N=82)

		Frequency	Percentage
Age (in years)	**<20**	24	29.3%
	20-40	23	28%
	41-60	27	32.9%
	>60	8	9.8%
Gender	**Female**	35	42.7%
	Male	47	57.3%
Presenting complaints	**Otorrhea**	68	82.9%
	Ear ache	70	85.4%
	Tinnitus	46	56.1%
	Hearing loss	12	14.6%
	Vomiting	5	6.1%
	Fever	1	1.2%
	Vertigo	4	4.9%
Laterality	**Left**	30	36.6%
	Right	23	28%
	Bilateral	29	35.4%

Table 2 presents the HRCT findings in CSOM patients. The most common findings were decreased aeration or sclerosis of the middle ear and mastoid air cells (96.3% each). Ossicular chain integrity was lost in 47.6% of cases. Facial canal dehiscence was observed in 25.6% of patients, while semicircular canal erosion was seen in 14.6%. Scutum erosion was present in 30.5% of cases.

Table 2: HRCT Findings in Patients with CSOM (N=82)

HRCT findings		Frequency (%)
Middle ear	Decreased aeration/sclerosed	79 (96.3%)
	Lost ossicular integrity	39 (47.6%)
Facial canal	Dehiscence of tympanic part	21 (25.6%)
Semi-circular canals	Erosion	12 (14.6%)
	Fistula communication	2 (2.4%)
Mastoid air cells	Soft tissue density/sclerosed	79 (96.3%)
EAC involvement		6 (7.3%)
Scutum erosion		25 (30.5%)

Table 3 shows that cholesteatoma was diagnosed in 26.8% of patients. Other notable findings included auto mastoidectomy (7.3%) and previous surgical intervention (6%).

Table 3: Diagnosis and Other Findings (N=82)

Characteristic		Frequency	Percentage
Diagnosis	**Cholesteatoma**	22	26.8%
	CSOM with petrous osteomyelitis	2	2.4%
	CSOM with mastoid osteomyelitis	1	1.2%
Other findings	**Auto mastoidectomy**	6	7.3%
	Destruction of mastoid and temporal bone	2	2.4%
	Focal bony erosions	1	1.2%
	Previous operated case	5	6 %
	Thinning of tegmen tympani	1	1.2%
	Cerebral abscess	1	1.2%
	Dehiscence of semicircular canal	1	1.2%
	Destruction of mastoid	1	1.2%
	Enlarged and bulbous vestibule	1	1.2%
	Mastoid abscess	1	1.2%
	Petrous osteomyelitis	1	1.2%
	Post-operative changes	1	1.2%

Table 4 compares HRCT findings with intraoperative observations. There was good agreement between HRCT and surgical findings for most parameters, including ossicular involvement, external auditory canal involvement, scutum erosion, tegmen tympani involvement, facial canal erosion, and semicircular canal erosion. However, HRCT appeared to overestimate the presence of soft tissue masses and mastoid air cell involvement compared to intraoperative findings.

Table 4: Comparison of HRCT Findings with Intra-operative Findings

Finding	HRCT (n)	Intra-operative (n)	P value
Soft tissue masses	22	12	>0.05
Ossicular involvement	39	34	>0.05

External auditory canal	6	6	>0.05
Scutum involvement	25	25	>0.05
Tegmen tympani involvement	12	12	>0.05
Facial canal erosion	21	21	>0.05
Semicircular canal erosion	12	12	>0.05
Mastoid air cells involved	79	19	>0.05

IV. Discussion:

This study demonstrates the effectiveness of HRCT in evaluating CSOM and its complications. The demographic profile of patients in our study, with a mean age of 35.8 years and a male predominance, aligns with previous research by Harshul et al.[9], Dhulipalla et al.[10], and others. The most frequent presenting symptoms of otorrhea and earache are consistent with findings by Harshul et al[9], Yorgancilar et al.[11] and Lyngwa et al.[12]

HRCT proved highly sensitive in detecting various pathological changes associated with CSOM. The high prevalence of sclerosed mastoids (96.34%) in our study corroborates findings by Jadia et al.[13] The detection of soft tissue masses, indicative of cholesteatoma, showed high sensitivity and specificity, consistent with studies by Chatterjee et al.[14] and Chidambaram et al.[15]

Ossicular erosion, observed in 47.6% of our cases, is comparable to findings by Harshul et al[9], Mandal P et al.[16] and Gul et al.[17] The high sensitivity and specificity of HRCT in detecting scutum erosion, tegmen tympani erosion, and facial canal involvement align with studies by Harshul et al[9], Rocher et al.[18] and Tak et al.[19]

The study revealed HRCT's limitations in differentiating between granulation tissue and cholesteatoma, a challenge noted in previous research. However, HRCT's ability to accurately assess disease extent, as observed by Donoghue et al.[20] and Mafee et al.[21] underscores its value in preoperative planning.

V. Conclusion:

In conclusion, this study affirms HRCT's crucial role in the evaluation of CSOM and its complications. Its high sensitivity and specificity in detecting various pathological changes make it an indispensable tool for accurate diagnosis and surgical planning. Future research could focus on improving HRCT's ability to differentiate soft tissue pathologies and on long-term follow-up studies to assess the impact of HRCT-guided management on patient outcomes.

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