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The Role of Radiological Assessment in the Management of Chronic Cholesteatomatous Otitis Media: A Retrospective Study at Avicenna Military Hospital, Marrakech

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Abstract: **Original Research**

Objective: To assess the clinical utility of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) in both the initial staging and the post-surgical follow-up of chronic cholesteatomatous otitis media (CCOM). ***Methods:*** Our team conducted a retrospective study of 51 patients treated at the Avicenna Military Hospital in Marrakech between 2020 and 2024. Preoperative high-resolution CT was the baseline for all cases. For surveillance and complex cases, MRI—specifically non-echo-planar diffusion-weighted imaging (non-EPI DWI)—was utilized. Results: The study population (mean age 40 years) showed a significant prevalence of bony destruction on preoperative CT, including scutum erosion (82.35%) and ossicular chain involvement (60.78%). Postoperatively, MRI was performed in 19 cases, accurately identifying 6 recurrences and 10 residual "pearls," effectively distinguishing them from inflammatory granulation tissue. ***Conclusion:*** While CT remains the "roadmap" for surgical safety, non-EPI DWI MRI has become the cornerstone of postoperative monitoring. This dual-modality strategy has significantly reduced the need for invasive "second-look" surgeries in our department.

Keywords: Cholesteatoma, Computed Tomography, Mastoidectomy, MRI.

1. INTRODUCTION

Chronic cholesteatomatous otitis media (CCOM) is essentially a skin-in-the-wrong-place problem, where keratinized squamous epithelium invades the middle ear. Its locally aggressive behavior leads to the relentless destruction of bony structures, which can open the door to catastrophic complications like meningitis, brain abscesses, or facial nerve palsy [1, 2]. Historically, the only way to ensure complete eradication was through a "second-look" surgery 6 to 12 months after the initial procedure.

However, the diagnostic landscape has been reshaped by the advent of high-resolution Computed Tomography (CT) and non-echo-planar Diffusion-Weighted MRI (non-EPI DWI). These tools allow us to transition from systematic re-operation to targeted radiological surveillance [3]. In this study, we review our 5-year experience at the Avicenna Military Hospital to evaluate how these imaging techniques have optimized our patient management.

2. Materials and Methods

We reviewed 51 cases of confirmed CCOM managed between January 2020 and May 2024. Our inclusion criteria required a complete radiological file and a minimum postoperative follow-up of 18 months.

Imaging Protocols:

- **CT:** All patients underwent high-resolution petrous bone CT with 0.6 mm slices. We focused on identifying opacification patterns and specific bony dehiscences.
- **MRI:** We reserved MRI for cases with suspected intracranial extension or for postoperative screening. Our protocol prioritized non-EPI DWI sequences (such as HASTE or PROPELLER) because they are less prone to the magnetic susceptibility artifacts typically found at the bone-air interface of the ear.

3. RESULTS

3.1. Clinical Presentation

The mean age of our cohort was 40 years. Clinically, every patient presented with some degree of hearing loss, and 90.19% reported foul-smelling otorrhea. More severe complications, such as mastoiditis (21.56%) or peripheral facial paralysis (1.96%), were also noted at the time of admission.

3.2. Preoperative CT Mapping

CT imaging proved invaluable for surgical planning. The most common site of involvement was the mastoid cells (62.74%) **(Figures 1, 2 & 3)**. Bony erosions were frequent, with the scutum (the "mur de logette") being the most fragile point, involved in over 82% of cases **(Table 1)**.

Table 1: Preoperative CT Findings of Bony Erosions and Opacification (n=51)

Anatomical Structure	No. of Cases	%
Bony Erosions		
Scutum (Mur de logette)	42	82.35
Ossicular Chain	31	60.78
Tegmen Tympani	13	25.49
Tegmen Antri	6	11.76
Facial Canal	3	5.88
Opacification Site		
Mastoid Cells	32	62.74
Epitympanum	23	45.09
Mesotympanum	17	33.33

CT: Computed Tomography

Figure 1: Axial CT: Petrous bone opacification with scutum erosion

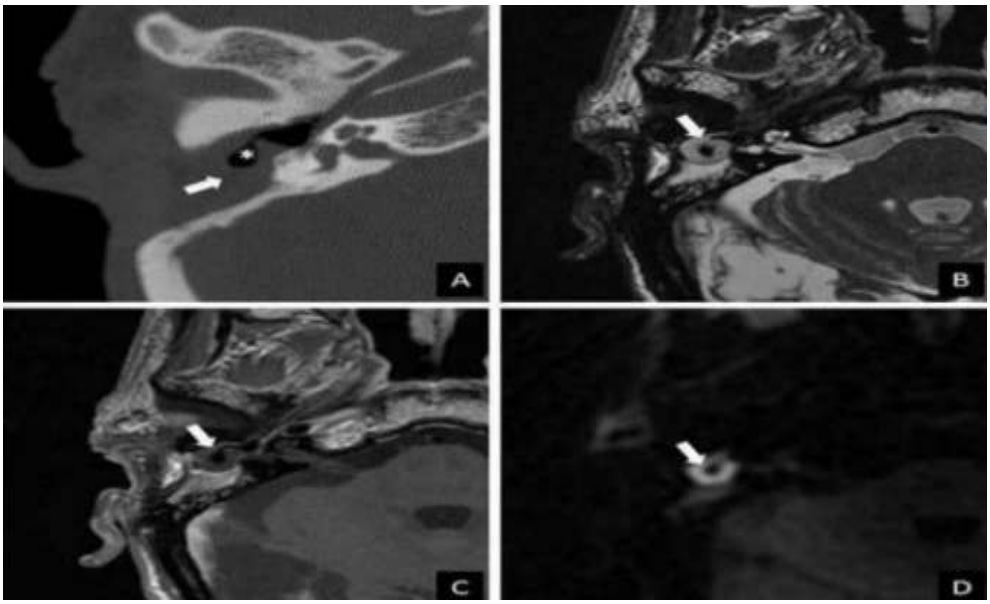

Figure 2: Multi-modal imaging (A: CT, B-D: MRI sequences including DWI) showing the complementary role of imaging in identifying cholesteatoma

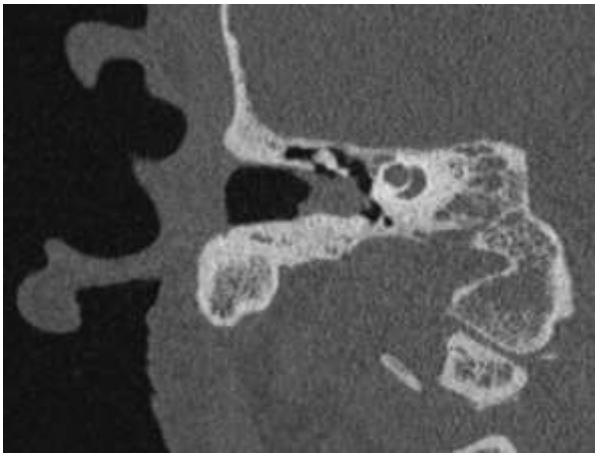

Figure 3: CT scan of the right petrous bone demonstrating a globular, focal soft-tissue mass bulging into the tympanic cavity, with associated scutum erosion and displacement of the ossicular chain

3.3. Postoperative Surveillance

Out of the 19 patients who underwent postoperative MRI after canal-wall-up (CWU) surgery **(Figures 4, 5)**, the imaging was decisive. We identified 6 recurrences and 10 residual cholesteatomas **(Figures 6, 7)**. Crucially, the MRI signal allowed us to differentiate these percholesteatomatous "pearls" from simple postoperative fibrosis, which does not show diffusion restriction.

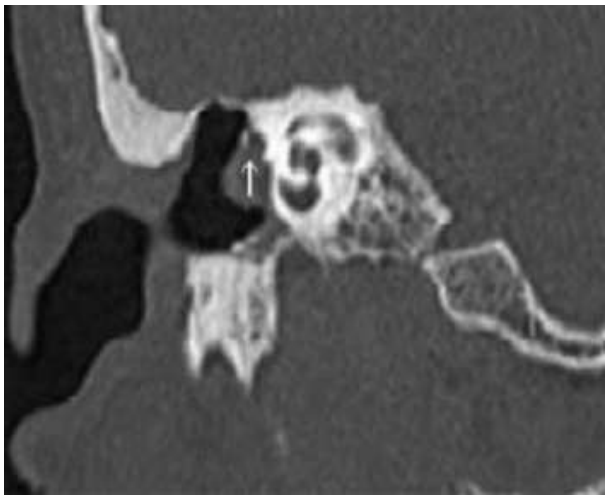

Figure 4: Axial CT scan of the right petrous bone showing erosion of the facial nerve canal (arrow) at its second (tympanic) segment, related to soft-tissue opacification suggestive of a cholesteatoma

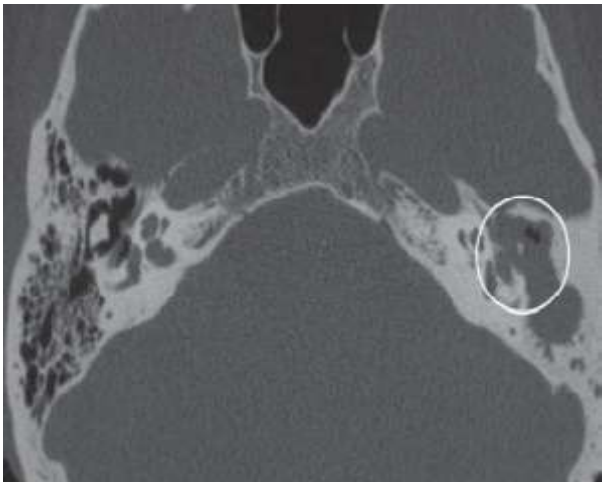

Figure 5: Axial CT scan of the petrous bones showing a left middle ear cholesteatoma causing ossicular chain lysis (circle)

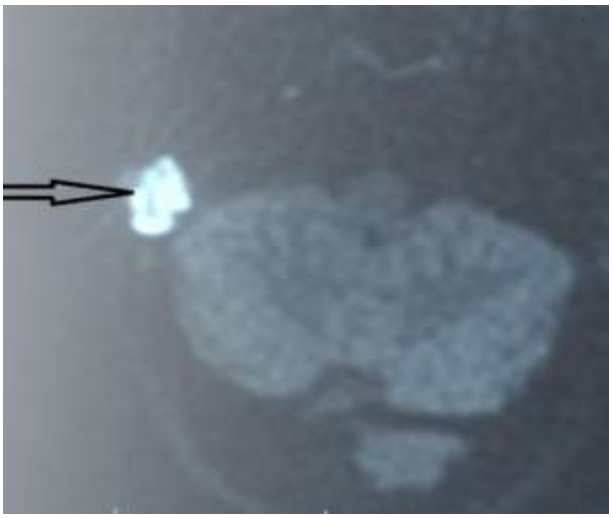

Figure 6: Non-EPI DWI: Hyperintense "bright spot" indicating recurrence

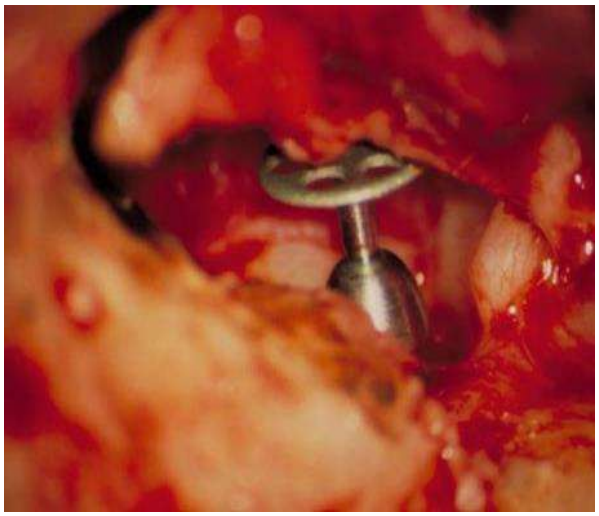

Figure 7: Intraoperative view: Confirmation of the radiological findings during surgery

4. DISCUSSION

4.1. Preoperative CT: The Essential Mapping for Surgical Safety

Our findings confirm that high-resolution Computed Tomography (CT) remains the indispensable architectural blueprint for the initial management of CCOM. In our cohort, the high prevalence of scutum erosion (82.35%) and ossicular chain destruction (60.78%) underscores the locally aggressive nature of this pathology. From a surgical standpoint, CT acts as a vital safety net. By identifying dehiscences of the tegmen tympani or the facial nerve canal, the radiologist provides the surgeon with a "roadmap" to navigate the complex anatomy of the petrous bone and avoid catastrophic intraoperative injuries [4, 5].

However, we must acknowledge that CT has a major inherent limitation: its lack of tissue specificity. Within a crowded middle ear, CT cannot reliably differentiate a cholesteatoma from simple inflammatory granulation tissue or fluid retention, as all these entities appear as non-specific soft-tissue opacifications. This "gray zone" often led, in the past, to exploratory surgeries that could have been avoided with better tissue characterization [6].

4.2. The Shift Toward Non-EPI Diffusion-Weighted MRI

The management of CCOM has been revolutionized by the introduction of Magnetic Resonance Imaging (MRI), particularly non-echo-planar diffusion-weighted imaging (non-EPI DWI). Unlike traditional EPI sequences, which are highly sensitive to magnetic susceptibility artifacts caused by the bone-air interface of the petrous bone, non-EPI DWI sequences (such as PROPELLER or HASTE) offer superior spatial resolution [7, 8].

In our study, postoperative MRI (n=19) demonstrated high diagnostic accuracy in identifying 6 recurrences and 10 residual diseases. This sequence is characterized by the "bright spot" sign, reflecting the restricted diffusion of keratin within the cholesteatoma. Literature suggests that non-EPI DWI achieves a sensitivity of up to 97% for detecting lesions larger than 2-3 mm. This specific radiological signature allows for a clear distinction from postoperative fibrosis or inflammatory tissue, which do not show diffusion restriction.

4.3. Challenging the "Second-Look" Surgery Dogma

Historically, a "second-look" surgery was a mandatory step in the treatment journey, usually performed 6 to 12 months after a canal-wall-up mastoidectomy. Our study supports the modern international trend toward a more selective, imaging-guided approach. By using non-EPI DWI as a primary surveillance tool, we have moved away from systematic re-operation [3, 9].

In a military healthcare setting, where resource optimization and rapid patient recovery are essential, this shift has significant implications. Avoiding an unnecessary second surgery reduces the risks associated with general anesthesia, decreases the psychological burden on the patient, and lowers the overall cost of care [10]. We now reserve the "second-look" primarily for cases where MRI is positive or when there is a strong clinical or otoscopic suspicion despite equivocal imaging.

4.4. Recognizing the Limits of Modern Imaging

Despite these advancements, we must remain cautious. Our study indicates that very small residual lesions (less than 2-3 mm) can still evade detection due to partial volume effects. Furthermore, certain anatomical areas like the sinus tympani or the facial recess remain difficult to assess. Therefore, a negative radiological report must never replace rigorous clinical follow-up. The synergy between high-resolution CT and advanced MRI protocols has narrowed the diagnostic gap, but the final decision-making process must remain a multidisciplinary dialogue between the radiologist and the ENT surgeon [10].

5. CONCLUSION

Modern management of CCOM at Avicenna Military Hospital is now built on the synergy of CT and MRI. While CT provides the anatomical blueprint for the surgery, non-EPI DWI MRI offers a non-invasive "virtual second-look." This integrated approach ensures surgical precision while sparing a large number of patients from unnecessary repeat operations.

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