


The Role of Stepwise Imaging in the Diagnosis and Management of Cholesteatoma in a Resource-Limited Setting: A Case Report

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Background: Cholesteatoma is a non-neoplastic but destructive lesion of the temporal bone that can lead to significant complications if not accurately diagnosed and managed. While computed tomography (CT) is the standard for assessing bony erosion, its ability to differentiate cholesteatoma from inflammatory tissue is limited. Non-echo planar diffusion-weighted magnetic resonance imaging (non-EPI DWI MRI) offers high specificity for diagnosing cholesteatoma. In resource-limited settings, access to MRI is often restricted, making a stepwise, evidence-based imaging approach crucial.

Case Presentation: A 26-year-old male presented with a decade-long history of chronic, foul-smelling left ear discharge and progressive hearing loss. Clinical examination was suspicious for a left-sided cholesteatoma. An initial non-contrast CT scan revealed a soft tissue mass with significant erosion of the scutum and ossicular chain. To confirm the diagnosis, a subsequent non-EPI DWI MRI was performed, which demonstrated a well-defined lesion with restricted diffusion, characteristic of cholesteatoma. The MRI also identified contralateral otomastoiditis in the right ear without evidence of cholesteatoma. Based on this definitive diagnosis, the patient underwent a left-sided canal wall down mastoidectomy.

Conclusion: This case highlights the pivotal role of a stepwise imaging strategy in a resource-limited environment. While CT identified the extent of bony destruction, the selective use of non-EPI DWI MRI provided a definitive diagnosis, confidently guiding the surgical plan towards an eradicated procedure. This approach ensures appropriate management, prevents potential complications, and underscores the value of integrating advanced diagnostics judiciously when resources are scarce.

Keywords: cholesteatoma, mastoidectomy, diffusion-weighted imaging, resource-limited setting, stepwise diagnostics, case report

Introduction

Cholesteatoma is an expansile lesion of keratinizing squamous epithelium within the middle ear and mastoid.^{1,2} Its aggressive nature stems from the production of proteolytic enzymes that cause local bone destruction, leading to complications such as permanent conductive hearing loss, facial nerve palsy, labyrinthine fistula, and life-threatening intracranial infections.^{3,4} The definitive treatment for cholesteatoma is surgical, with the primary goals being complete eradication of the disease, creation of a safe and dry ear, and, when possible, restoration of hearing.^{5,6}

The diagnostic pathway for cholesteatoma typically involves clinical otoscopy and high-resolution computed tomography (HRCT) of the temporal bones.^{7,8} CT is unparalleled in delineating the bony anatomy and assessing the extent of erosion.^{9,10} However, a diagnostic dilemma often arises as CT cannot reliably distinguish cholesteatoma from other soft tissue pathologies like granulation tissue, cholesterol granuloma, or chronic inflammation.¹¹ In recent years, non-echo planar diffusion-weighted magnetic resonance imaging (non-EPI DWI MRI) has emerged as a highly specific tool for this purpose. Cholesteatoma, as a dense matrix of keratin, restricts the diffusion of water molecules, making it appear

hyperintense on DWI and hypointense on corresponding ADC maps—an imaging signature that is virtually pathognomonic.^{12,13}

Non-echo-planar diffusion-weighted MRI (non-EPI DWI) has shown superior diagnostic accuracy compared to echo-planar imaging (EPI DWI) in detecting middle ear cholesteatoma. According to Piekarek et al (2022), non-EPI DWI achieved 100% sensitivity and 83.3% specificity, with excellent interobserver agreement, while EPI DWI demonstrated lower sensitivity and reproducibility.¹⁴

In resource-limited settings, patients often present with advanced disease, and access to advanced imaging like MRI is not routine. Clinicians must employ a judicious, stepwise approach to diagnostics. This case report describes the management of a young male with advanced cholesteatoma where an initial CT was supplemented by a non-EPI DWI MRI, leading to a definitive diagnosis that guided successful surgical management in Mogadishu, Somalia.

Case Presentation

A 26-year-old male presented to the otolaryngology clinic with a chief complaint of persistent, foul-smelling discharge (otorrhea) from his left ear, which had been ongoing for more than ten years. He reported a gradual but profound hearing loss in the same ear. He also noted a feeling of fullness and intermittent fluid sensation in his right ear. His clinical history was negative for vertigo, facial weakness, or headache.

On clinical examination, the left external auditory canal contained purulent debris. After meticulous cleaning, otoscopy revealed a perforation in the attic (pars flaccida) of the tympanic membrane, with a pearly white, keratinous mass visible in the middle ear space. The right tympanic membrane was dull and retracted, suggestive of middle ear effusion. Facial nerve function was normal and symmetric bilaterally.

An initial non-contrast computed tomography (CT) scan of the temporal bones was performed to assess the extent of the suspected cholesteatoma. The scan demonstrated a soft tissue density mass occupying the left Prussak's space and epitympanum, causing erosion of the scutum and the ossicular chain (Figure 1). MRI was subsequently performed on a Neosoft 1.5T scanner, including T1-, T2-, and diffusion-weighted imaging (DWI) with both EPI and non-EPI sequences (slice thickness 3 mm; b-values 0 and 1000 s/mm²). Non-EPI DWI provided a definitive diagnosis (Figure 2), showing a well-defined 22×9 mm lesion with marked hyperintensity on DWI and hypointensity on ADC maps, consistent with cholesteatoma. Further detailed views of the MRI findings are presented in Figure 3. The right ear showed fluid signal and mucosal thickening consistent with otomastoiditis, with no evidence of restricted diffusion (Figure 2).



Figure 1 Axial Non-Contrast CT scan Demonstrating Left-Sided Cholesteatoma. The scan reveals a soft tissue mass completely opacifying the left middle ear cavity and mastoid antrum, with associated erosion of the ossicular chain. Sclerosis of the surrounding mastoid air cells indicates a chronic inflammatory process. The right middle ear and mastoid are well-aerated and serve as a normal comparison.



Figure 2 Coronal T1-weighted MRI demonstrating the anatomical location of the cholesteatoma. A soft tissue lesion of intermediate signal intensity is seen filling the left middle ear cavity and extending superiorly into the epitympanum.

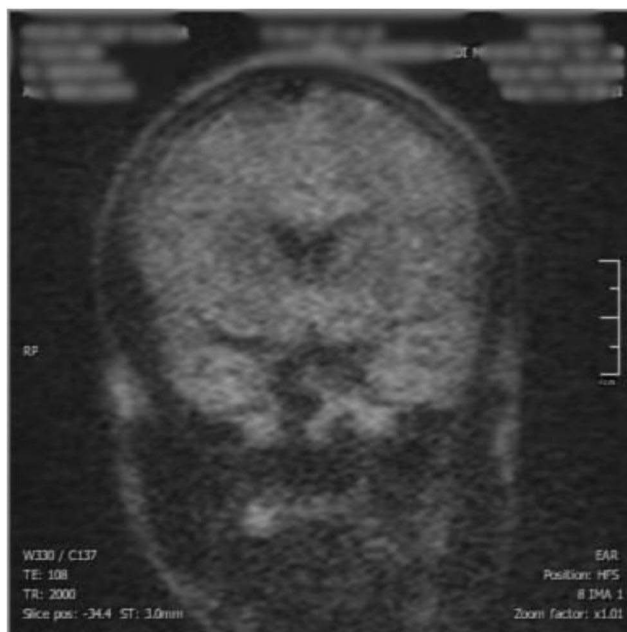


Figure 3 Coronal diffusion-weighted image (DWI) confirming the diagnosis. The lesion demonstrates marked hyperintensity (high signal), indicating restricted diffusion. This finding is highly characteristic of cholesteatoma and is crucial for differentiating it from other inflammatory conditions.

The patient underwent a left-sided canal wall down mastoidectomy. Intraoperative findings confirmed the presence of a pearly white keratinous mass filling the mastoid antrum and epitympanum, consistent with the imaging diagnosis. The cholesteatoma was meticulously removed. The right ear was scheduled for medical management with antibiotics and nasal steroids, followed by observation.

The patient had an uneventful postoperative course. At the six-week follow-up, the left mastoid cavity was healing well and was dry. His right-sided symptoms had resolved with medical therapy.

Discussion

This case illustrates the critical importance of accurate diagnosis in the management of cholesteatoma, particularly in a setting where resources must be used efficiently. The patient's long-standing history and clinical signs were highly suggestive of cholesteatoma, but the definitive diagnosis provided by a stepwise imaging approach was instrumental in formulating the correct management plan for both ears.

Our findings align with previous research demonstrating the advantages of non-echo-planar diffusion-weighted MRI (non-EPI DWI) over conventional echo-planar imaging (EPI DWI).¹⁴ Non-EPI DWI provides higher spatial resolution and fewer artifacts, allowing more accurate detection of cholesteatoma, including small or postoperative lesions. Its superior image quality and diagnostic reliability make it a valuable tool in both preoperative assessment and postoperative follow-up.

While CT scanning remains the first-line imaging modality for suspected cholesteatoma due to its superb bony detail, its limitation is its low specificity for soft tissue characterization.^{15–17} In our case, the CT confirmed the destructive nature of the disease on the left side but could not have definitively distinguished the cholesteatoma from extensive granulation tissue. More importantly, it could not have accurately characterized the pathology in the symptomatic right ear.

The decision to proceed with a non-EPI DWI MRI was a crucial second step. Its ability to confirm cholesteatoma with high specificity (reported to be over 90%) provided the diagnostic certainty needed to commit to major surgery.^{18,19} This is especially important in a resource-limited setting, as it prevents unnecessary surgical exploration for what might be simple inflammation and, conversely, ensures that a destructive disease is not undertreated. For this patient, it confirmed the need for aggressive surgical eradication on the left while simultaneously confirming that the right ear required only medical management, sparing him an unnecessary bilateral procedure.

The surgical choice of a canal wall down (CWD) mastoidectomy was dictated by both the advanced stage of the disease and the socioeconomic context. The CWD procedure creates a “safe ear” by exteriorizing the disease, which minimizes the risk of recurrence and eliminates the need for a second-look surgery.^{20,21} This is a paramount consideration when long-term patient follow-up cannot be guaranteed.

This study is limited by its single-case nature, which restricts the generalizability of the findings. Additionally, the absence of long-term follow-up data limits the ability to assess postoperative outcomes or recurrence over time. Future studies with larger sample sizes and extended follow-up are recommended to validate these observations and further establish the clinical utility of non-EPI DWI MRI in cholesteatoma diagnosis and management.

Conclusion

This case report demonstrates a successful and resource-appropriate pathway for the diagnosis and management of cholesteatoma. The synergistic use of CT to evaluate bony destruction and selective non-EPI DWI MRI for definitive tissue characterization represents an ideal model for a stepwise diagnostic approach in a resource-limited setting. This strategy allows for precise surgical planning, optimizes patient outcomes, and prevents the severe complications of mismanaged cholesteatoma.

Ethical Considerations

This case report was conducted with ethical approval obtained from the Ethics Committee of Jamhuriya University of Science and Technology.

Consent for Publication

Informed consent was obtained from the patient for the publication of this case report and the accompanying images.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or all these areas; took part in drafting, revising or critically

reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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