



Dural Prolapse of the Temporal Bone Following Middle Ear Surgery: Diagnostic and Therapeutic Challenges. Case Report



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ABSTRACT:

Introduction: Prolapse of the dura mater and the development of temporal bone meningocele or meningoencephalocele represent rare but potentially life-threatening complications with a heterogeneous pathogenesis. They are most commonly encountered in patients with chronic inflammatory conditions, cholesteatoma, and a history of prior temporal bone surgery, while their diagnosis is often challenging due to a nonspecific clinical presentation.

Aim: This article aims to analyze this rare but clinically significant iatrogenic complication of middle ear surgery through the presentation of a clinical case, with a discussion of its pathogenesis, diagnostic challenges, and contemporary surgical approaches to treatment and prevention.

Materials and Methods: A 42-year-old female patient with a history of multiple surgical interventions on both ears for chronic otitis media and cholesteatoma was evaluated. In the presence of persistent otorrhea and conductive hearing loss, high-resolution

computed tomography imaging was performed, followed by revision surgery of the left ear. Intraoperatively, a defect of the tegmen mastoideum with prolapse of the dura mater and cerebrospinal fluid leakage was identified. A radical trepanation was performed, along with multilayer reconstruction of the osseous defect using autologous cartilage, fascia, hemostatic material, and tissue adhesive.

Conclusion: Dural prolapse following middle ear surgery is a rare but serious complication that requires a high index of clinical suspicion, timely imaging diagnostics, and appropriate surgical management. Multilayer reconstruction of the osseous defect via a transmastoid approach represents an effective and reliable method in appropriately selected cases. Obliteration of the mastoid cavity may be considered an important preventive measure.

Key words: Meningocele of the temporal bone; complications of middle ear surgery; tegmen defect

INTRODUCTION

Surgical interventions of the middle ear represent a standard and widely used treatment approach for chronic inflammatory diseases, cholesteatoma, and other pathological processes of the temporal bone. Despite significant advances in surgical techniques and intraoperative visualization, procedures performed in close proximity to the skull base (tegmen tympani / tegmen mastoideum) remain associated with a risk of iatrogenic defects. These defects may lead to a rare but clinically significant complication—herniation of the dura mater (dural prolapse), and in some cases of the meninges or brain tissue (meningocele or meningoencephalocele) into the operative cavity¹. According to several studies, iatrogenic defects account for a substantial proportion (20–25%) of all cases of temporal bone meningoencephalocele^{2,3}.

Pathophysiologically, this herniation results from two main factors: a bony defect caused or enlarged by surgical intervention, and weakening of the dural structure due to surgical manipulation, chronic inflammation, or elevated intracranial pressure. Several reports^{4,5} describe cases in which herniation occurs following canal-wall-down mastoidectomy or revision procedures in the presence of cholesteatoma, emphasizing the role of previous surgeries as a significant risk factor.

The clinical presentation of herniated brain structures into the temporal bone cavity ranges from incidental detection during revision middle ear surgery to symptoms such as cerebrospinal fluid (CSF) leakage (otorrhea), conductive hearing loss, persistent or recurrent middle ear infections, men-

ingitis, or brain abscesses. Although rare, the presence of herniated brain tissue in the temporal bone may also trigger epilepsy⁶.

Diagnosis requires a high index of clinical suspicion. According to some studies, intraoperative detection of dural prolapse and meningoencephalocele may reach up to 39.5%, particularly in patients with previous surgeries⁷. The presence of a prolapse should be suspected in the context of several nonspecific symptoms, including persistent postoperative otorrhea, suspicious tympanic effusion, treatment-resistant middle ear infections, or unexplained conductive hearing loss.

Early detection using modern imaging techniques and timely surgical management is crucial to prevent the severe complications associated with this condition^{2,3}. High-resolution computed tomography (HRCT) represents the primary diagnostic modality⁸, complemented by magnetic resonance imaging (MRI) when herniated brain tissue is suspected⁹. A contemporary method for confirming the presence of cerebrospinal fluid (otorrhea) is the beta-2 transferrin test, which is widely used in current clinical practice.

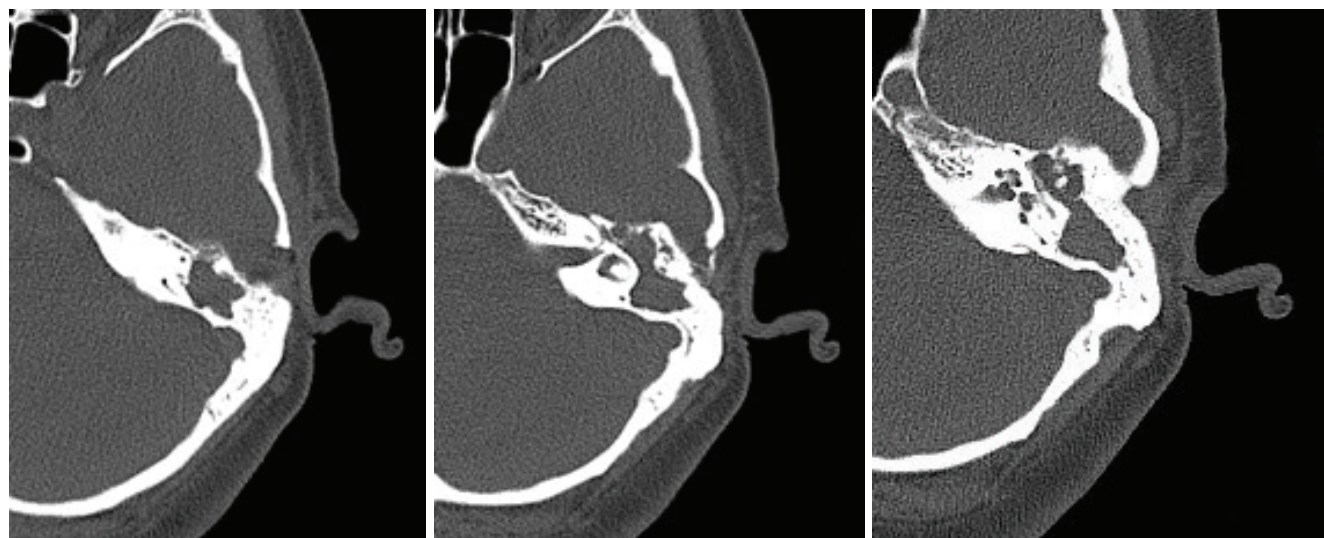
The treatment of dural herniation is surgical and aims both to remove or reposition the herniated tissue and to achieve reliable sealing of the cranial cavity. For better outcomes, a multilayer reconstruction of the bony defect is usually performed. Several surgical techniques are currently used to manage this condition, with the two main approaches being transmastoid and transcranial. Numerous

publications^{2,10} demonstrate the effectiveness of the transmastoid approach for small defects and the need for combined strategies (transmastoid access combined with craniotomy) for larger lesions. The surgical approach depends not only on the size but also on the location of the bony defect, and, importantly, on the surgeon's experience. Surgical success ensures the prevention of recurrence, as well as infectious and neurological complications.

The aim of this article is, through the presentation of a clinical case, to analyze a rare but clinically significant iatrogenic complication in middle ear surgery—dural prolapse, while discussing its pathogenesis, diagnostic challenges, and contemporary surgical approaches for treatment and prevention.

Case report:

We present a clinical case of a 42-year-old woman with a history of bilateral ear surgeries for chronic epitympanic otitis. The right ear underwent radical mastoidectomy in September 2025. The left ear underwent mastoidectomy in 2024, revealing dura closely adjacent to the antrum. A tympanostomy tube was placed and removed three months later. The postoperative period was uneventful until September 2025, when, during surgery on the right ear, middle ear secretions were noted in the left ear, and a tympanostomy tube was reinserted. Since then, the tube has continuously drained seromucous fluid, which later turned purulent. The prescribed antibiotic therapy temporarily stopped the purulent ear discharge, but not the serous secre-



Figs. 1, 2, and 3. Preoperative CT scan of the patient

tion. The patient's main complaints were hearing loss, a feeling of fullness in the ear, and episodes of imbalance.

The performed CT scan shows soft-tissue–equivalent and fluid collections in the residual cells of the left mastoid, as well as in the epitympanum and mesotympanum (Figs. 1–3). Imaging did not reveal the presence of cholesteatoma or any likely postoperative complication from the first surgery.

Given the chronic inflammation unresponsive to conservative treatment and the patient's significant conductive hearing loss (Fig. 4), reoperation of the left ear was decided.

Surgical intervention: Under general endotracheal anesthesia and after thorough preparation of the surgical field, a left retroauricular incision was performed in the area of the previous surgical scar. The skin and subcutaneous tissue were dissected, exposing the mastoid bone, and the mastoid cavity formed during the previous surgical intervention was identified. The cavity was found to be partially obliterated by dura mater prolapsing through a defect in the bony wall, alongside which clear fluid was visibly leaking (most likely cerebrospinal fluid). Due to the proximity of the prolapsed dura, removal and thinning of the bony bridge were performed from the tympanic cavity after reconstruction of the external auditory canal skin. The bridge was transected using a diamond burr, and a cavity typical of a radical mastoidectomy was created. Multiple granulations were removed from the mastoid and the tympanic cavity. The ossicular chain, which was enveloped in granulation tissue, was also removed. A cholesteatoma mass was encountered in the antrum and was completely excised. The prolapsed dura mater was gently repositioned through the defect. Cartilage was harvested from the patient's tragus and shaped according to the size and configuration of the bony defect. The cartilage was inserted through the defect and positioned on its inner side (underlay), completely covering it (Fig. 5A and 5B). A layer of fascia was placed (overlay) (Fig. 6), followed by Surgicel (Fig. 7), and the defect was sealed with tissue adhesive (Fig. 8). Layered closure of the operative wound was performed. The operative cavity was packed with a gauze roll, and a sterile “turban-type” dressing was applied.

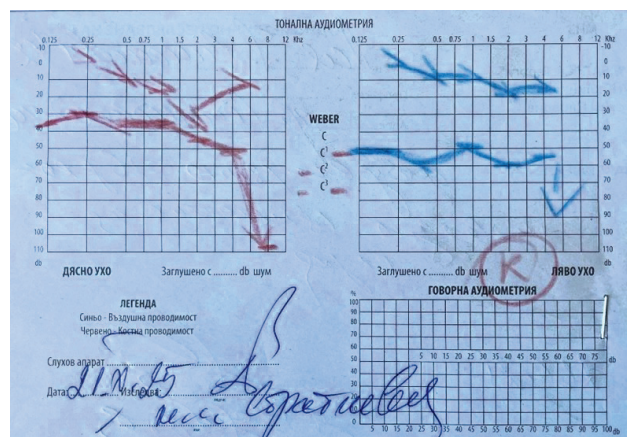


Fig. 4. Patient's audiogram

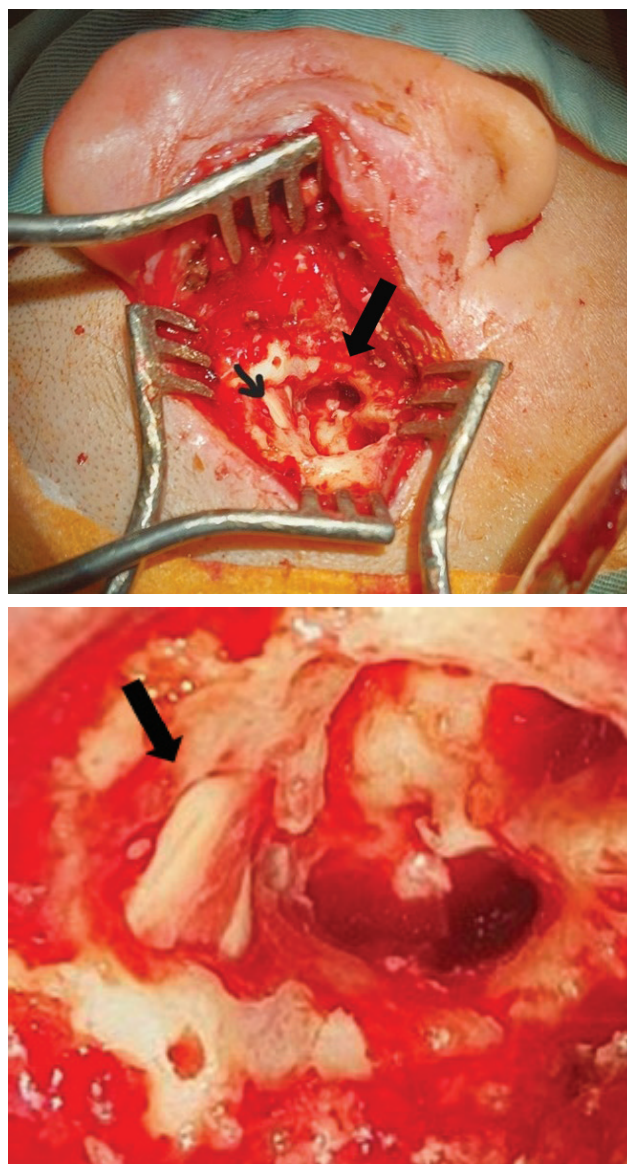


Fig. 5A and 5B. Cartilage placed into the bony defect of the tegmen mastoideum (underlay)

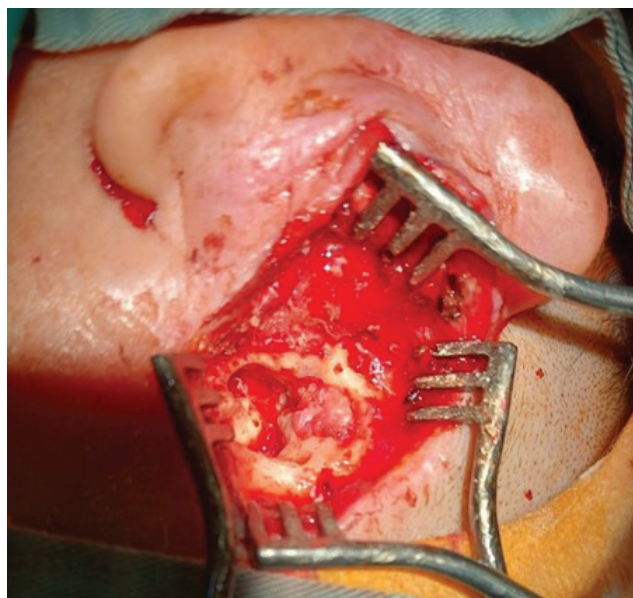


Fig. 6. Placed (overlay) fascial layer

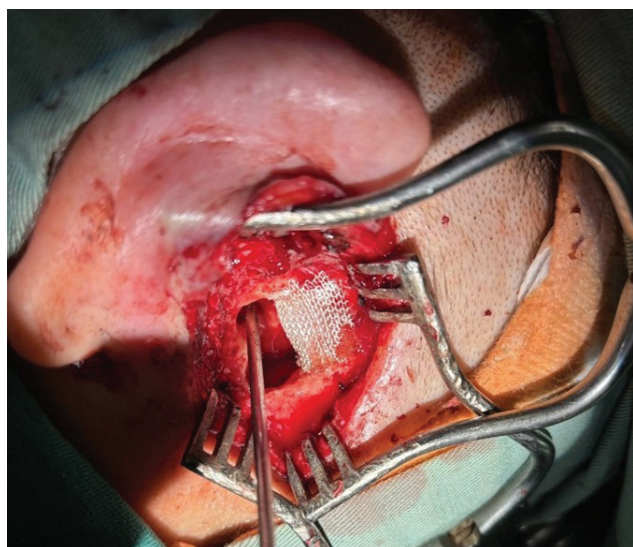


Fig. 7. Coverage of the fascia with Surgicel

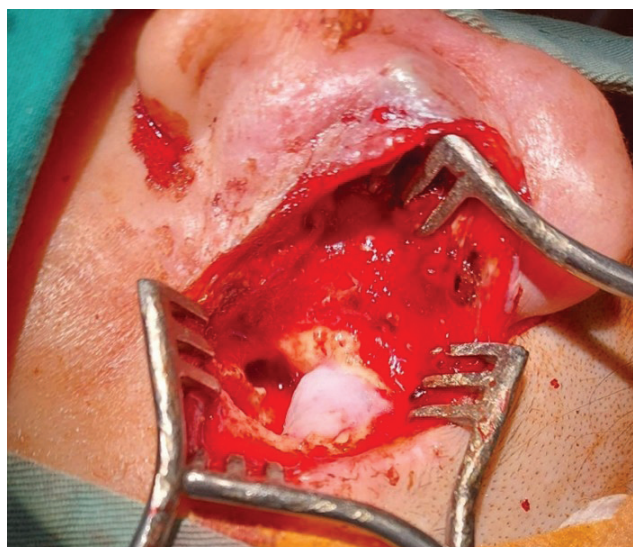


Fig. 8. Sealing of the reconstruction with tissue adhesive

The histological analysis of the material taken from the antrum confirmed the presence of cholesteatoma.

The postoperative period was uneventful, with the patient's vestibular symptoms gradually resolving. Daily examinations of the surgical cavity showed no cerebrospinal fluid leakage. The patient was discharged on the 10th postoperative day.

Discussion:

Herniation of the dura mater within the temporal bone represents a dural prolapse, with or without associated brain parenchymal tissue (temporal bone meningocele or meningoencephalocele), through a defect in the skull base (tegmen tympani / tegmen mastoideum) into the tympanic cavity or the mastoid cavity. This potentially life-threatening complication⁶ may be associated with chronic middle ear infections with or without cholesteatoma, temporal bone trauma, spontaneous (congenital) defects¹¹, and, last but perhaps most importantly, iatrogenic causes following middle ear surgery²⁻⁵.

Several pathogenetic mechanisms lead to dural herniation after middle ear surgery. A frequent factor is preoperative temporal bone vulnerability, such as a thin or eroded tegmen due to chronic otitis or cholesteatoma. However, the primary and most significant factor is intraoperative (iatrogenic) – excessive mastoidectomy or radical trepanation causing overexposure or defects of the tegmen tympani/mastoideum, with wide dural exposure and subsequent prolapse into the surgical cavity, with or without brain parenchyma. In the presence of chronic inflammation, the dura may be thickened or pathologically adherent to cholesteatoma matrix, which often alters and significantly complicates surgical management, particularly in revision procedures. It should also be noted that several postoperative factors predispose to prolapse - absent or incomplete cavity reconstruction, chronic inflammation of the surgical cavity with subsequent bone resorption and enlargement of the defect, and elevated intracranial pressure facilitating extrusion of intracranial structures through the defect. As a result, herniation of the dura mater may occur, with or without associated brain parenchyma.



The clinical presentation of that surgical complication ranges from asymptomatic or mild nonspecific symptoms—such as hearing loss, vestibular changes, or persistent inflammation of the operated ear, to severe intracranial complications like arachnoiditis, meningitis, or brain abscess, often accompanied by significant neurological injuries.

Detection of dural herniation in a surgical defect after middle ear surgery is often challenging, as the condition is frequently masked by symptoms of the pathology that prompted the previous surgery¹² and is sometimes only diagnosed during revision surgery^{7,13}. Suspicion of this serious complication arises from intermittent or persistent clear fluid discharge from the operated ear (cerebrospinal fluid in the mastoid or tympanic cavity)⁶, the presence of a pulsatile mass in the surgical cavity, or unexplained vestibular symptoms and/or hearing loss.

Modern imaging plays a crucial role in the rapid and accurate diagnosis of this condition. High-resolution CT (HRCT) of the temporal bone is particularly valuable for identifying bony defects, typically using slice thicknesses of 0.4–0.6 mm. Despite its high diagnostic utility, CT findings can sometimes be indistinguishable from cholesteatoma, granuloma, or other soft tissue masses within the temporal bone⁸. In such cases, contrast-enhanced T2-weighted MRI with fluid suppression (T2/FLAIR/contrast)⁹ is effectively used to differentiate brain tissue from other soft tissues.

The treatment of prolapsed dura mater in the temporal bone surgical cavity, with or without brain tissue (meningoencephalocele), is surgical. The procedure can be performed by an experienced ENT surgeon, a neurosurgeon, or a multidisciplinary team, depending on the chosen technique and surgical approach. These choices are determined by the size and location of the defect, cerebrospinal fluid leakage, presence of inflammation, and the patient's hearing status. Small defects without brain herniation or with minimal prolapse are typically repaired via a transmastoid approach⁶, whereas large defects with significant meningoencephalocele usually require a combined approach—transmastoid and transcranial (minicraniotomy). The presence of infection combined with postoperative prolapse

of brain tissue into the temporal cavity requires a reliable multilayer reconstruction, which can be performed in a single-stage or two-stage procedure.

Conclusions:

Prolapse of the dura mater into the operative cavity during middle ear surgery is a rare complication that should not be underestimated.

The diverse causes of this condition further complicate accurate diagnosis, and a history of previous surgical interventions should be considered as a major risk factor.

Early diagnosis, the use of modern imaging techniques to assess the severity of the complication, and timely surgical intervention are critical for success.

The preferred surgical technique for treating dural prolapse with or without meningocele/meningoencephalocele involves staged, multilayer closure of the bony defect and sealing of the cranial cavity, which can be achieved via a transmastoid, transcranial, or combined approach.

Herniation of the meninges and brain tissue requires the presence of a cavity in the temporal bone; therefore, obliteration of the mastoid cavity following middle ear reconstructive surgery can be used to prevent this complication.

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