CASE REPORT

doi: 10.5455/medarh.2025.79.71-77
MED ARCH. 2025; 79(1): 71-77
RECEIVED: FEB 11, 2025
ACCEPTED: MAR 21, 2025

Diagnostic Challenges of Tuberculous Meningitis Initially Presenting as Otomastoiditis

Hung Quang Nguyen[1], Hoa Hong Thi Doan[2], Long Hoang Vo[2]

[1]Department of Ear, Nose and Throat, Viet-Tiep Friendship Hospital, Haiphong, Vietnam

[2]University of Medicine and Pharmacy, Vietnam National University, Hanoi, Vietnam

Corresponding author: Long Hoang Vo, M.D. University of Medicine and Pharmacy, Vietnam National University, Hanoi 100000, Vietnam. Address: No 144 Xuan Thuy st, Cau Giay, Hanoi, Vietnam. Email: longmd.306@gmail.com

ABSTRACT

Background: Tuberculosis (TB), caused by Mycobacterium tuberculosis (MTB), remains a major global health problem, with one-third of the world's population infected. **Objective:** This report presents five cases of tuberculous meningitis with a particular emphasis on the symptoms and signs of otitis media that, in various combinations, should raise suspicion for tuberculous meningitis. **Case presentation:** These cases underscore the diagnostic challenges and clinical complexities associated with tuberculous otitis media, particularly when there is concurrent involvement of the central nervous system. It is crucial for physicians to maintain a high index of suspicion for tuberculosis in patients exhibiting chronic otorrhea that does not respond to conventional treatments, especially in endemic regions or in the presence of systemic symptoms. The use of advanced diagnostic tools and a multidisciplinary approach is essential for achieving timely diagnosis and effective management. Early initiation of antituberculous therapy, coupled with surgical interventions when warranted, can lead to favorable clinical outcomes. However, it is important to note that some patients may experience long-term sequelae, which highlights the necessity for prompt diagnosis and treatment to improve prognosis in those presenting with otitis media. ***Conclusion:*** The findings of this case series contribute to a better understanding of the relationship between otitis media and tuberculous meningitis, advocating for increased awareness among healthcare providers to facilitate early recognition and intervention.

Keywords: Tuberculous Meningitis; Otitis media; Chronic Otorrhea; Diagnostic Challenges.

1. BACKGROUND

Tuberculosis (TB), caused by Mycobacterium tuberculosis (MTB), remains a major global health problem, with one-third of the world's population infected (1). Despite being preventable and curable, TB is one of the top 10 causes of death worldwide and the leading cause of death from a single infectious agent (2). Tuberculous meningitis (TBM) is an extrapulmonary form of TB characterized by sub-acute or chronic inflammation of the meninges due to the invasion of the subarachnoid space by M. tuberculosis bacilli (3). TBM is the most severe form of tuberculosis, with a mortality rate ranging from 20% to 67% even with anti-tuberculous treatment, and it is universally fatal without treatment (4). The outcome of treatment largely depends on the stage at which diagnosis is made; mortality exceeds 50% if the Glasgow Coma Scale score is <10/15 at the time treatment begins (5). Early diagnosis is challenging due to the nonspecific nature of TBM symptoms, such as headaches and fever, which can develop over days or weeks, and because mycobacterial tests often lack sensitivity (5).

The pathogenesis of TBM remains debated, and the mechanism by which M. tuberculosis invades the cerebrospinal fluid (CSF) is not fully understood (6). It is possible that a "Trojan horse" mechanism is involved, where M. tuberculosis is transported across the blood-brain barrier by infected macrophages (7). Rich and McCordock (1933) suggested that bacilli reach the oxygen-rich central nervous system through hematogenous spread, either during the bacillemic stage of primary tuberculous infection or following reactivation of TB (1). The Rich focus forms when microglial cells and astrocytes are activated upon bacilli gaining access to the brain. Once established, Rich foci may become activated either rapidly or years later, leading to the release of M. tuberculosis into the subarachnoid space and triggering an inflammatory response. The evolution and manifestation of TBM are variable, depending on the number and virulence of bacilli and the host's immune response.

Occasionally, the infection may spread to the CNS from distant sites of TB, such as tuberculous otitis, osteogenic tuberculous foci in the spine, or the cranial vault (1, 8, 9).

Despite extensive research on the classical symptoms of TBM, there remains a significant gap in understanding the relevance of atypical symptoms, such as otitis media, which may indicate the presence of TBM. Existing studies often overlook the potential link between these non-specific signs and the development of TBM, which can lead to delayed diagnosis and suboptimal treatment outcomes. Consequently, there is a pressing need to enhance awareness regarding the possible association between otitis media and TBM, and to refine diagnostic approaches to facilitate early detection and improve patient prognosis. This study, conducted in Vietnam, addresses this critical gap by providing detailed insights into TBM cases where atypical symptoms were present, thereby contributing valuable data to the global understanding of TBM diagnostics in diverse clinical settings. The findings underscore the importance of considering a broader range of symptoms in TBM diagnosis, particularly in settings where traditional indicators may be less prominent.

2. OBJECTIVE

In this report, we present and discuss five cases of TBM, focusing on symptoms and signs of otitis media that, in their various combinations, should raise suspicion of TBM. We emphasize the importance of performing neuroimaging, as well as appropriate histological and bacteriological testing for accurate diagnosis.

3. CASE PRESENTATION

Case 1

A 23-year-old female patient with no significant medical history presented in February 2014 with intermittent right otalgia. Otoscopic examination revealed a translucent right tympanic membrane with yellowish fluid behind it. The left ear, as well as the nose and throat examinations, were unremarkable. The patient was initially treated with intranasal corticosteroids and systemic antibiotics, but her otalgia did not improve.

One month later, in March 2014, the tympanic membrane appeared normal, and there were no signs of post-auricular tenderness or erythema. However, the patient experienced pain upon palpation of the mastoid process, particularly along the posterior margin. A computed tomography (CT) scan of the temporal bone demonstrated complete opacification of the mastoid air cells, with erosion of both the lateral and medial walls of the mastoid. Brain MRI showed right sigmoid sinus and temporal meninge enhancement.

Mastoidectomy was performed for biopsy and drainage. Histological examination revealed inflammatory tissue, and CSF analysis from an initial lumbar puncture was normal. The patient was treated with intravenous ceftriaxone and quinolones, resulting in temporary symptomatic relief.

In December 2014, the patient's earache and headache worsened, accompanied by vomiting. A repeat brain magnetic resonance imaging (MRI) scan showed an infarction extending from the lateral sinus to the superior sagittal sinus. A second lumbar puncture revealed findings suggestive of suppurative meningitis, with protein levels of 0.9 g/L. The patient was started on intravenous ceftriaxone and metronidazole, but no clinical improvement was noted after five days of treatment. A third lumbar puncture showed elevated protein (1.3 g/L), 85 cells/μL (70% lymphocytes), raising suspicion of TBM. An interferon-gamma release assay (IGRA) test was positive, though a lung CT scan appeared normal.

Upon further questioning, the patient disclosed that her husband had been receiving antituberculosis therapy for pulmonary tuberculosis for five months prior. Anti-tuberculosis treatment was promptly initiated, consisting of isoniazid, rifampicin, ethambutol, and pyrazinamide, combined with dexamethasone. Within ten days of starting the treatment, the patient's headache resolved, and her general condition significantly improved.

In June 2016, the patient developed epilepsy with recurrent seizures over the subsequent two years. In March 2018, she was diagnosed with a pulmonary abscess, experienced prolonged fever, and developed deep vein thrombosis. Her platelet count ranged from 700,000 to 1,300,000 cells/μL. During this period, the patient experienced significant weight loss (15 kg) and joint pain. As of four months prior to this report, the patient has remained stable.

Case 2

A 65-year-old man presented with bilateral severe hearing loss and intermittent earache. On September 7, 2015, he was referred to the ENT department at the National Hospital, Vietnam, due to these symptoms, which had begun approximately two weeks prior. He had no history of TB or family history of TB. Otoscopic examination revealed bilateral bulging and thickened tympanic membranes, particularly in the posterior half. Audiometry indicated mixed hearing loss of 70 dB in the right ear and sensorineural hearing loss of 87 dB in the left ear. Despite two weeks of treatment with oral antibiotics (clarithromycin combined with amoxicillin-clavulanic acid) and steroids for otitis media with effusion, his symptoms did not improve.

Intermittent headaches, vomiting, and weight loss developed, and on October 25, 2015, brain MRI revealed bilateral mastoid opacification, with no other abnormalities. The patient was initially treated for trigeminal neuralgia with Trileptal, Lyrica, Gabax, and Lopior, prescribed by a neurologist. However, five days after treatment, the patient developed high fever, vomiting, severe headaches, bilateral facial nerve paralysis, and loss of appetite. On November 10, 2015, he was admitted to the National Lung Hospital with meningeal signs. Lumbar puncture analysis revealed 60 cells/μL with 80% lymphocytes. Pulmonary CT scan showed nodular opacities in the right upper lobe, and while the sputum smear for acid-fast bacilli (AFB) was negative, a positive culture for MTB was obtained using BACTEC. Brain MRI

revealed basal meningeal enhancement, and HIV serology was negative.

The patient was diagnosed with TBM and associated pulmonary TB. Treatment was initiated with standard anti-tubercular therapy (isoniazid, rifampicin, pyrazinamide, ethambutol) and continued with ciprofloxacin for 12 months. At follow-up, the patient had persistent severe hearing loss and imbalance, though the right-sided facial paralysis had fully recovered and the left-sided paralysis showed incomplete recovery.

Case 3

A 9-year-old girl presented with intermittent fever ranging from 39°C to 40°C, accompanied by otalgia. Otoscopic examination revealed a bulging and erythematous left tympanic membrane. She was diagnosed with acute otitis media and treated with a broad-spectrum antibiotic for one week, but her condition did not improve, and she continued to experience high fever and headaches. A second course of antibiotics was prescribed, but her symptoms persisted, and otorrhea developed. She was admitted to the National ENT Hospital on January 19, 2019.

Upon admission, otoscopic examination showed a small anterior perforation of the tympanic membrane with thickening, pallor, and bulging in the remaining part. Audiometry revealed a 60 dB conductive hearing loss. A temporal bone CT scan demonstrated osteomyelitis of the petrous bone and mastoid opacification. Brain MRI revealed extensive soft tissue filling the middle ear cavity, destruction of the petrous apex, and left temporal meningeal enhancement. The patient had no prior history of TB, no family history of TB, and had received the BCG vaccine. A mastoidectomy was performed on January 24, 2019, for biopsy, which revealed typical tuberculous lesions.

The patient was transferred to the National Pulmonary Hospital on January 29, 2019, with suspected meningeal involvement. The following day, she became lethargic, with vomiting and worsening headaches. Neurological examination revealed positive meningeal signs and left-sided hemiplegia. Brain MRI findings were suggestive of TBM, though chest X-ray findings were normal. Lumbar puncture revealed 350 cells/mm^3 with 56% lymphocytes, positive Pandy's test, protein 0.9 g/L, chloride 115.3 mmol/L, and glucose 2 mmol/L. An IGRA test was positive. The diagnosis of aural tuberculosis with TBM was suspected. On February 26, 2019, TBM was confirmed by the presence of MTB in the CSF via BACTEC culture.

Anti-tubercular therapy was initiated the day after admission with HRZE (isoniazid, rifampicin, pyrazinamide, ethambutol) combined with Bacsutan, followed by streptomycin. After 10 days of treatment, the patient showed significant improvement, with the resolution of fever, headaches, and hemiplegia. She was discharged on day 20 and continued treatment following a 2-month HRZE regimen, followed by 10 months of RH (rifampicin, isoniazid). At a 3-month follow-up after completing treatment, she had fully recovered clinically, though she declined repeat cranial imaging.

Case 4

A 26-month-old girl was referred to the National Pulmonary Hospital on June 22, 2017, for generalized spasticity and drowsiness after 50 days of anti-tuberculosis treatment for TBM. In February 2017, she developed fever, vomiting, and left-sided otorrhea. Despite multiple courses of antibiotics, including intravenous treatment, she showed no improvement and was diagnosed with acute otitis media. By April 2017, she experienced persistent high fever, delirium, vomiting, and weight loss, prompting admission to the National Pediatric Hospital on April 18, 2017. Family history revealed that her father had recently completed anti-tuberculosis therapy for pulmonary TB with positive sputum AFB, and her mother was undergoing a 4-drug anti-TB regimen for pulmonary TB with negative AFB.

Upon admission, the physical examination revealed high fever (39°C), confusion (Glasgow Coma Scale score of 12), right-sided hemiplegia, left otorrhea, and positive meningeal signs. Chest X-ray showed calcified nodules (10 mm) in the right upper lung zone. Brain CT scan demonstrated ventricular dilation with reduced brain parenchyma. An urgent ventriculoperitoneal shunt was placed. CSF analysis revealed 6 cells/μL, protein 0.79 g/L, glucose 1.25 mmol/L, chloride 119.2 mmol/L, and a positive Pandy test, though PCR for H. influenzae, tuberculosis, EBV, herpes, and CMV were negative. A diagnosis of TBM was made.

Initial treatment included meropenem and levofloxacin, followed by a regimen of RHZE (isoniazid, rifampicin, pyrazinamide, and ethambutol) for 50 days, combined with streptomycin for 20 days and dexamethasone. However, her condition worsened, prompting transfer to the National Pulmonary Hospital. Physical examination revealed poor coordination and generalized spasticity, necessitating nasogastric tube placement. Otoscopy showed left-sided abundant otorrhea with bilateral large tympanic membrane perforations and granulation. Xpert testing of the otorrhea remained positive. Repeat lumbar puncture revealed protein 0.336 g/L, glucose 2.76 mmol/L, and a negative Pandy test.

On July 3, 2017, a brain MRI showed significant ventricular dilation, suggesting blockage of the ventriculoperitoneal shunt, along with brain parenchymal abnormalities consistent with severe TBM. A shunt revision was performed on July 10, 2017. CSF analysis at that time revealed protein 0.56 g/L, glucose 4.12 mmol/L, and a positive Pandy test, with negative BACTEC and Xpert results. The patient continued anti-tuberculosis treatment with a 2-month SHRZE/10-month RH protocol. Prior to discharge, lumbar puncture results showed protein 0.336 g/L, glucose 2.76 mmol/L, and a negative Pandy test.

Case 5

A 20-year-old male, residing on a boat at sea with no known history of TB contact, initially presented with bilateral persistent otorrhea for one year, intermittently treated with antibiotics (Augmentin). Two months prior to admission at the National ENT Hospital, his hearing loss worsened, accompanied by earache and swelling behind the left ear. One week before admission, he

developed headache, vomiting, and vertigo, though he denied cough or fever.

On physical examination, the patient was conscious with bilateral cophosis (complete hearing loss), left-sided facial paralysis (House-Brackmann grade II), large perforations of the tympanic membranes with white exudate, and a fistula in the posterior area of the left ear. Meningeal signs were negative. Chest X-ray revealed nodular opacities across all lung zones, particularly in the upper lobes, suggestive of miliary tuberculosis. Temporal bone computed tomography (CT) demonstrated bone lysis with opacification of the mastoid and middle ear cavities. The patient was referred to the National Pulmonary Hospital for further tuberculosis evaluation.

Laboratory results showed a C-reactive protein (CRP) level of 132 mg/L, white blood cell count of 14.2 g/L with 80.2% neutrophils. TB LAMP testing of sputum confirmed MTB complex, and MTB TRC testing of otorrhea, as well as Quantiferon testing, were positive. A culture of otorrhea on September 16, 2019, grew Acinetobacter baumannii, sensitive to imipenem, meropenem, ceftazidime, ticarcillin/clavulanic acid, piperacillin/tazobactam, ciprofloxacin, tobramycin, and amikacin. A subsequent culture on September 21, 2019, grew Escherichia coli.

CSF analysis revealed glucose of 1.9 mmol/L, protein of 1.07 g/L, chloride of 113 mmol/L, a positive Pandy test, and 57 cells/mm^3 with 60% neutrophils and 14% lymphocytes. CSF culture was negative. Brain magnetic resonance imaging (MRI) revealed parenchymal abnormalities with mass lesions, the largest measuring 34 mm, surrounded by edema.

The patient was promptly started on anti-tuberculosis therapy with isoniazid, rifampicin, ethambutol, and pyrazinamide, along with meropenem and dexamethasone. Mastoidectomy and drainage of 3 ml of purulent material from the left cerebellar area were performed. One month after initiating treatment, the patient showed significant improvement, with resolution of headache.

4. DISCUSSION

Tuberculous otitis media is a rare manifestation of extrapulmonary tuberculosis, comprising less than 1% of all tuberculosis cases. Its rarity is a significant factor contributing to its diagnostic challenges (10, 11). Tuberculous otitis media frequently presents with non-specific symptoms, primarily chronic otorrhea, which can easily be mistaken for more common ear conditions such as chronic suppurative otitis media. This misdiagnosis is compounded by the fact that tuberculous otitis media often does not respond to conventional antibiotic treatments, which are typically effective for chronic suppurative otitis media (12, 13). The indolent nature of tuberculous otitis media, characterized by persistent and often insidious progression, further complicates the diagnosis, as symptoms may be attributed to more prevalent and less serious conditions. In contrast to tuberculous otitis media, chronic suppurative otitis media is a well-recognized condition with a more typical presentation and established treatment protocols. Chronic suppurative otitis media usually presents with a history of recurrent ear infections, purulent discharge, and sometimes associated hearing loss. However, tuberculous otitis media's presentation of chronic ear discharge that is unresponsive to standard antibiotics, coupled with its subtle onset, makes it less immediately recognizable. This often leads to a diagnostic delay as tuberculous otitis media is not initially considered, especially in regions where tuberculosis is not commonly suspected. Furthermore, the low index of suspicion for tuberculosis in non-endemic areas or among patients without obvious risk factors exacerbates the problem. This lack of initial suspicion means that tuberculous otitis media is frequently misdiagnosed as chronic suppurative otitis media, leading to inappropriate treatment and prolonged suffering. The five cases presented underscore the critical need for heightened clinical awareness and vigilance when dealing with persistent or atypical ear infections, particularly in regions with a higher prevalence of tuberculosis. Healthcare professionals must consider the possibility of tuberculous otitis media in patients with chronic otorrhea that fails to respond to standard treatments. This is particularly important for patients with risk factors for tuberculosis or those who have had previous contact with individuals with active TB. Enhanced diagnostic practices should include a thorough evaluation for tuberculosis, including specific tests for MTB when conventional treatments for ear infections are ineffective. Advanced diagnostic modalities such as acid-fast bacilli smear, culture, and molecular assays can be instrumental in identifying tuberculous otitis media. The delay in diagnosing tuberculous otitis media highlights a broader issue in clinical practice where rare and atypical presentations of common infections are often overlooked. There is a pressing need for increased education among healthcare providers about the potential for tuberculous otitis media and similar rare conditions. Implementing routine screening for tuberculosis in patients with chronic or unusual ear infections could significantly improve early detection and treatment outcomes. Additionally, clinical guidelines should be updated to reflect the need for considering tuberculosis in the differential diagnosis of persistent otologic symptoms, especially in areas with a significant burden of the disease.

The clinical manifestations of tuberculous otitis media in the cases presented exhibited considerable variability, highlighting the complex and multifaceted nature of this disease. Persistent otorrhea was a common symptom across all cases, reflecting its role as a prominent feature of tuberculous otitis media. This symptom, while also characteristic of chronic suppurative otitis media, was often accompanied by additional clinical signs that are less typical for chronic suppurative otitis media but more indicative of tuberculous otitis media. These included hearing loss, which varied from moderate to severe in the patients, and facial paralysis, notably observed in Cases 1 and 5. The presence of facial paralysis in tuberculous otitis media is particularly concerning and suggests extensive disease involvement that may impact the facial nerve, a complication less commonly seen in

more straightforward cases of otitis media. In addition to otorrhea and hearing loss, several patients presented with systemic symptoms such as fever, weight loss, and neurological deficits, which further complicated the clinical picture. For instance, Case 4 exhibited hemiplegia, while Cases 2 and 4 demonstrated meningeal signs. These systemic symptoms, coupled with the local manifestations, should serve as a red flag for clinicians to consider tuberculosis as a potential underlying cause, especially in regions where tuberculosis is prevalent or among patients with known exposure or contact with individuals suffering from TB. The presence of such systemic symptoms in patients with ear infections is atypical and warrants a thorough investigation into possible underlying systemic conditions like tuberculosis. Audiological assessments revealed findings consistent with the destructive nature of tuberculous otitis media. All patients demonstrated varying degrees of conductive or mixed hearing loss on audiometric testing, indicative of significant involvement of the middle ear and ossicular chain damage—hallmarks of tuberculous otitis media. The reported bilateral hearing loss in Cases 1 and 5, while unusual for common middle ear infections, aligns with the more extensive infectious processes typically associated with tuberculosis. This bilateral presentation suggests a more diffuse involvement of the middle ear structures, which is characteristic of tuberculous otitis media and distinguishes it from localized middle ear infections.

Imaging studies provided further insight into the extent of disease progression. CT and MRI findings revealed advanced disease in several patients, including notable bony erosion of the temporal bone and the presence of intracranial complications. For example, Case 5 exhibited petrous bone osteomyelitis and a cerebellar abscess, illustrating the aggressive nature of tuberculous otitis media when left untreated. Such findings underscore the potential for tuberculous otitis media to progress rapidly and cause severe complications if not diagnosed and managed promptly. The presence of these advanced complications highlights the critical need for early recognition and intervention to prevent further deterioration and achieve better clinical outcomes.

Histopathological confirmation of TB was successfully achieved in all cases, either through biopsy or culture, underscoring the critical role of tissue analysis in diagnosing tuberculous otitis media. For instance, in Case 3, histopathological examination of the biopsy specimens revealed typical tuberculous lesions, providing definitive evidence of TB. In Case 2, culture methods confirmed the presence of MTB, further validating the diagnosis. These methods are essential for confirming TB when the clinical and radiological presentations suggest the disease but are not yet definitively proven by other means. The utilization of advanced molecular diagnostic tools significantly enhanced the diagnostic yield in the remaining cases. Tools such as TB LAMP (Loop-mediated Isothermal Amplification), Xpert MTB/RIF, and BACTEC culture were pivotal in identifying MTB in the samples from Cases 1, 2, and 5. These molecular techniques offer several advantages over traditional culture methods, including faster turnaround times and greater sensitivity, which is particularly valuable in cases where the clinical suspicion of TB is high but traditional culture results may be inconclusive (14, 15). The use of these advanced microbiological techniques highlights the necessity of incorporating modern diagnostic tools into clinical practice to improve the accuracy and timeliness of TB diagnosis. Despite the overall high diagnostic yield from molecular techniques, some cases, particularly Cases 4 and 5, exhibited negative culture results from CSF samples. In these instances, the lack of growth in cultures did not preclude the diagnosis of TB meningitis. Instead, the overall clinical presentation, combined with radiological findings and the results from molecular diagnostics, strongly suggested TB meningitis. Molecular diagnostic tools, such as the Xpert MTB/RIF assay and BACTEC culture, eventually confirmed the presence of MTB in the CSF of these cases, aligning with the clinical and radiological evidence. This underscores the importance of a comprehensive diagnostic approach, incorporating a range of diagnostic modalities to achieve an accurate diagnosis. These findings are consistent with the existing literature, which emphasizes the need for a multidisciplinary approach in diagnosing tuberculous otitis media and its complications. Integrating clinical evaluations, radiological imaging, histopathological analysis, and molecular diagnostics provides a robust framework for confirming the presence of tuberculosis and ensuring appropriate management. Such a comprehensive approach is critical in addressing the diagnostic challenges posed by tuberculous otitis media and improving patient outcomes through timely and accurate diagnosis.

The management of tuberculous otitis media necessitates a multi-faceted approach that includes both antituberculous therapy and surgical intervention when indicated. Prompt initiation of antituberculous therapy is crucial to address the underlying MTB infection and prevent disease progression. In the cases presented, antituberculous therapy was initiated as soon as tuberculosis was confirmed, following standard protocols that included a regimen of isoniazid, rifampicin, ethambutol, and pyrazinamide. This combination therapy is effective in targeting the various stages of mycobacterial growth and ensuring comprehensive treatment of the infection. In some cases, particularly those involving central nervous system complications (Cases 2 and 4), prolonged courses of antituberculous therapy were required. This extended treatment regimen is necessary to adequately address the more complex and severe manifestations of tuberculosis, such as meningitis and brain abscesses. The extended therapy helps to ensure the eradication of mycobacterial infection from the CNS and reduces the risk of relapse or persistent disease. Surgical intervention played a critical role in the management of tuberculous otitis media, particularly in cases where there was significant local disease burden. Mastoidectomy was performed in Cases 1, 3, and 5, which was essential for draining purulent collections and obtain-

ing tissue samples for histopathological examination. This surgical approach not only alleviates symptoms by removing infected material but also provides vital diagnostic information that aids in confirming the presence of tuberculosis. The ability to obtain and analyze biopsy specimens is invaluable for accurate diagnosis and tailored treatment planning. In addition to antituberculous therapy and surgical management, the use of corticosteroids was an important component of the treatment regimen, especially in cases with CNS involvement. Corticosteroids, such as dexamethasone, were utilized to mitigate inflammatory responses and reduce neurological damage. This was particularly evident in Cases 2 and 4, where corticosteroid therapy contributed to improved neurological outcomes and reduced inflammation within the CNS. The inclusion of steroids in the treatment plan helped in managing severe symptoms and promoting recovery by controlling the body's inflammatory response to the infection.

The outcomes of patients with tuberculous otitis media varied significantly, underscoring the complex nature of the disease and the impact of timely intervention on clinical results. In some cases, such as Cases 2, 3, and 5, patients demonstrated considerable clinical improvement following treatment. These individuals showed resolution of symptoms such as fever, headache, and neurological deficits, highlighting the effectiveness of comprehensive treatment strategies when initiated promptly. In these cases, the integration of antituberculous therapy with surgical intervention and supportive care contributed to a favorable recovery trajectory, with substantial relief from acute symptoms and overall enhancement in quality of life. However, the clinical outcomes were not uniformly positive across all cases. The child in Case 4, for instance, experienced persistent neurological sequelae despite receiving appropriate treatment. This patient's ongoing issues, including generalized spasticity and delayed recovery of neurological functions, reflect the potential for long-term complications associated with tuberculous otitis media, particularly in the context of TBM. Such persistent neurological deficits serve as a stark reminder of the disease's potential severity, especially in pediatric populations, where TB meningitis can lead to significant and enduring impairment. The variable outcomes among these patients highlight several critical factors that influence prognosis. Early diagnosis and timely initiation of antituberculous therapy are crucial in improving clinical outcomes and preventing long-term damage. Prompt treatment can significantly reduce the risk of severe complications and irreversible damage, which is particularly important in managing tuberculous otitis media. In cases where treatment is delayed or inadequate, the risk of persistent symptoms and complications, such as irreversible hearing loss, increases. For instance, in Case 5, the patient suffered from permanent hearing loss despite the comprehensive treatment provided, emphasizing the potential for long-lasting effects even with aggressive management. The prognosis of tuberculous otitis media is intricately linked to several key factors: early recognition of the disease, prompt initiation of antituberculous therapy, and effective management of complications. Early diagnosis allows for timely intervention, which is essential for mitigating the disease's impact and reducing the likelihood of severe outcomes. Furthermore, addressing complications such as hearing loss and neurological deficits is integral to optimizing patient outcomes and enhancing quality of life. The variability in outcomes observed across the cases underscores the need for continued vigilance and a proactive approach in managing tuberculous otitis media, particularly to minimize the risk of irreversible damage and ensure comprehensive care for affected individuals.

5. CONCLUSION

These cases highlight the diagnostic challenges and clinical complexity of tuberculous otitis media, especially when associated with central nervous system involvement. Physicians should maintain a high index of suspicion for TB in patients with chronic otorrhea unresponsive to conventional treatment, particularly in endemic areas or in the presence of systemic symptoms. Advanced diagnostic tools and a multidisciplinary approach are essential for timely diagnosis and appropriate management. Early treatment with antituberculous therapy, combined with surgical intervention when necessary, can lead to favorable outcomes, although some patients may suffer from long-term sequelae, underscoring the need for early diagnosis and treatment.

- **Author's contribution**: The all authors were involved in all steps of preparation this article. Final proofreading was made by the first author.
- **Conflict of interest**: None to declare.
- **Financial support and sponsorship**: None.

REFERENCES

1. Getahun H, Matteelli A, Chaisson RE, Raviglione M. Latent Mycobacterium tuberculosis infection. N Engl J Med. 2015; 372(22): 2127-2135.
2. WHO G. Global tuberculosis report 2020. Glob Tuberc Rep. 2020;2020.
3. Slane VH, Unakal CG. Tuberculous Meningitis. StatPearls. Treasure Island (FL): StatPearls Publishing
4. Copyright © 2024, StatPearls Publishing LLC.; 2024.
5. Lee SA, Kim SW, Chang HH, Jung H, Kim Y, Hwang S, et al. A New Scoring System for the Differential Diagnosis between Tuberculous Meningitis and Viral Meningitis. J Korean Med Sci. 2018; 33(31): e201.
6. Thwaites G. Tuberculous meningitis. Medicine. 2017; 45(11): 670-673.
7. Davis AG, Rohlwink UK, Proust A, Figaji AA, Wilkinson RJ. The pathogenesis of tuberculous meningitis. J Leukoc Biol. 2019; 105(2): 267-280.
8. Nguyen L, Pieters J. The Trojan horse: survival tactics of pathogenic mycobacteria in macrophages. Trends Cell Biol. 2005; 15(5): 269-276.
9. Ahluwalia VV, Sagar GD, Singh T, Arora N, Narayan S, Singh M. MRI spectrum of CNS tuberculosis. J Indian Acad Clin Med. 2013; 14(1): 83-90.

10. Bernaerts A, Vanhoenacker F, Parizel P, Van Goethem J, Van Altena R, Laridon A, et al. Tuberculosis of the central nervous system: overview of neuroradiological findings. European radiology. 2003; 13: 1876-1890.
11. Awan MS, Salahuddin I. Tuberculous otitis media: two case reports and literature review. Ear, nose & throat journal. 2002; 81(11): 792-794.
12. Ravi Kumar A, Senthil K, Prasanna Kumar S, Gopinath GB. Primary tubercular mastoiditis-a rare presentation. Sri Ramachandra J Medicine. 2007; 4: 129-131.
13. Vaamonde P, Castro C, García-Soto N, Labella T, Lozano A. Tuberculous otitis media: a significant diagnostic challenge. Otolaryngology--Head and Neck Surgery. 2004; 130(6): 759-766.
14. Araújo MF, Pinheiro TG, Raymundo IT, Soares VYR, Araújo PIM, de Melo Martins RL, et al. Tuberculous otitis media. The Journal of International Advanced Otology. 2011; 7(3): 413.
15. Bartolomeu-Gonçalves G, Souza JMd, Fernandes BT, Spoladori LFA, Correia GF, Castro IMd, et al. Tuberculosis Diagnosis: Current, Ongoing, and Future Approaches. Diseases. 2024; 12(9): 202.
16. García-Elorriaga G, del Rey-Pineda G. Practical and laboratory diagnosis of tuberculosis: from sputum smear to molecular biology: Springer; 2015.