

A Nursing Report of Primary Tuberculous Otitis Media with Middle Ear Tuberculosis and Mastoiditis Based on the Concept of Precision Nursing: A Case Study

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Abstract: *Objective:* To explore clinical nursing key points and management strategies for patients with primary eustachian tube tuberculosis complicated by middle ear tuberculosis and mastoiditis, providing practical evidence for early identification, precision nursing, and comprehensive management of rare extrapulmonary tuberculosis. *Methods:* A retrospective analysis was conducted on a case presenting with refractory ear fullness, ear pain, and conductive hearing loss, which was initially misdiagnosed as secretory otitis media and later confirmed as primary eustachian tube tuberculosis complicated by middle ear tuberculosis through pathological examination. Nursing interventions included strict isolation protocols, enhanced multidisciplinary team (MDT) specialized nursing procedures, visualized local drug administration, multidimensional intelligent medication management, individualized psychological care, systematic nutritional support, and standardized discharge guidance. *Results:* After 28 days of standardized anti-tuberculosis treatment and comprehensive nursing interventions, the patient exhibited significant improvement in otological symptoms and hearing function, with patent tympanic tubes and no adverse drug reactions or nosocomial cross-infections. Discharge was achieved successfully. Follow-up at 3 months demonstrated good treatment adherence, progressive lesion absorption, and favorable prognosis. *Conclusion:* Primary eustachian tube tuberculosis has an extremely low clinical incidence rate, particularly when complicated by middle ear tuberculosis, with insidious and atypical symptoms prone to misdiagnosis and missed diagnosis. This case innovatively integrates endoscopic techniques, rehabilitation medicine, intelligent management, and multidisciplinary collaboration into clinical nursing workflows. Systematic, individualized, and precision nursing interventions significantly improved treatment outcomes, hearing function, and quality of life, warranting clinical promotion and application.

Keywords: Tuberculosis of the eustachian tube; Tuberculosis of the middle ear; Mastoiditis; Precision nursing; Visualized nursing

1. Introduction

Tuberculosis remains a major global public health issue. The World Health Organization (WHO) 2025 Global Tuberculosis Report indicates that there are approximately 10.7 million new tuberculosis cases worldwide, with China accounting for about 7.1% of these cases ^[1]. The WHO Integrated Guidelines on Tuberculosis explicitly state that *Mycobacterium tuberculosis* can disseminate to various organs in the human body, causing multiple types of tuberculosis, with extrapulmonary tuberculosis accounting for approximately 15–20% of all tuberculosis cases. Primary eustachian tube tuberculosis is an extremely rare type of extrapulmonary tuberculosis, characterized by complex and diverse clinical manifestations, often presenting with ear symptoms as the initial presentation. Due to its anatomical features, it is highly prone to concurrent middle ear tuberculosis, leading to confusion with common otological diseases. The lack of specific symptoms and signs, coupled with insidious onset, results in diagnostic difficulties and a high rate of misdiagnosis ^[2]. If the diagnosis remains undetermined for an extended period, patients not only endure physical suffering but may also experience psychological stress and impaired social functioning due to prolonged illness. In July 2025, our department admitted a patient with primary eustachian tube tuberculosis complicated by middle ear tuberculosis and mastoiditis. The management of this case was complex, involving multidisciplinary collaboration and imposing high demands on nursing care. During the nursing process, we developed a comprehensive and personalized care plan tailored to the patient's condition, aiming to alleviate symptoms, improve treatment adherence, and promote recovery. Through this nursing practice, we have summarized valuable experiences and insights that can serve as references for future care of similar cases. The nursing experience is summarized as follows:

2. Clinical data

2.1. General information

The patient, a 64-year-old male, was admitted to the hospital due to recurrent right-sided ear fullness and discomfort, ear pain for 6 months, and progressive hearing loss for 1 month. Six months prior, he experienced a sudden onset of right-sided ear fullness without obvious cause, occasional discharge of small amounts of yellow fluid from the external auditory canal, and intermittent dull pain, without tinnitus, vertigo, or other symptoms such as fever, cough, or sputum production. He had sought medical attention at multiple hospitals, where he was diagnosed with “septic otitis media” and treated with anti-infective therapy, tympanocentesis, and intranasal corticosteroids. However, his symptoms showed no significant improvement and progressively worsened. Over the past month, he developed marked hearing loss, yellow purulent discharge from the external auditory canal, and right-sided temporal pain and discomfort. He was admitted for further diagnosis and treatment.

(1) Admission physical examination

Consciousness was clear, mental status was normal, and vital signs were stable. The right tympanic membrane was retracted and opaque, with loss of light cone distortion and positive tympanic effusion sign. Pure-tone audiometry revealed right-sided conductive hearing loss, with an average speech frequency hearing threshold of 45 dB HL. No significant neoplasms were observed in the nasopharynx, and no cervical lymphadenopathy was palpated. Chest CT showed clear bilateral lung fields without active or old

tuberculosis lesions. Temporal bone CT indicated thickening of soft tissues at the right pharyngeal orifice of the Eustachian tube, increased density in the tympanic cavity and mastoid air cells, and no significant bone destruction.

(2) Laboratory tests

Positive result for tuberculous infection T-cell detection (T-SPOT.TB) and strongly positive PPD test; nasopharyngeal endoscopy-guided tympanic tube mucosal biopsy was performed. Pathological findings revealed caseous necrotizing granulomatous inflammation with positive acid-fast staining. Based on clinical symptoms and imaging findings, the final diagnosis was primary tuberculous otitis media with concurrent middle ear tuberculosis and right mastoiditis.

According to the Declaration of Helsinki, this study was approved by the hospital ethics committee, Batch number: KYYJ-2025-11, and the patient's family members signed the informed consent form.

2.2. Treatment course and outcomes

Upon diagnosis, the patient immediately initiated an anti-tuberculosis treatment regimen using a four-drug combination therapy consisting of isoniazid, rifampicin, pyrazinamide, and ethambutol, with dosage adjustments based on liver and kidney function monitoring results.

The patient was hospitalized for 1–3 days with close monitoring for adverse drug reactions such as nausea, vomiting, and rash. Daily temperature monitoring was performed, along with observation of the volume and nature of purulent discharge from the external auditory canal. Right external auditory canal cleaning and dressing changes were administered once daily to maintain unobstructed drainage. Nasal corticosteroid sprays were administered to reduce edema of the pharyngeal mucosa at the eustachian tube orifice and promote functional recovery of the eustachian tube.

On the 4th day of hospitalization, a right tympanotomy with tube placement was performed under local anesthesia. During the procedure, approximately 3 mL of pale yellow turbid fluid was drained. Postoperatively, the drainage tube was properly secured, and the color, volume, and characteristics of the drainage fluid were monitored. Patients were instructed to avoid forceful nose blowing or ear picking to prevent tube dislodgement or obstruction.

One week after hospitalization, the patient exhibited a significant reduction in purulent discharge from the external auditory canal, alleviation of right temporal region distension pain compared to baseline, and slight improvement in hearing compared to admission.

At 2 weeks of hospitalization, follow-up complete blood count (CBC) and liver/kidney function tests showed no significant abnormalities, and T-SPOT.TB results remained unchanged compared to previous measurements.

The patient was hospitalized for 3 weeks without significant headache or otalgia, and no obvious discharge was observed in the external auditory canal. The tympanostomy tube remained in place and patent. Pure-tone audiometry revealed a reduced right speech frequency average hearing threshold to 35 dB HL.

The patient was hospitalized for 4 weeks with stable condition and was approved for discharge. At discharge, the patient was instructed to continue regular administration of anti-tuberculosis drugs, undergo periodic follow-up examinations including liver and kidney function tests, hearing tests, and temporal bone CT scans, maintain ear cleanliness and dryness, avoid colds and water ingress into the ear, and return to the hospital for re-evaluation of tympanostomy tube placement status after 1 month.

At 3-month follow-up after discharge, the patient reported no ear discomfort symptoms, with dryness in the external auditory canal. The tympanostomy tube had spontaneously fallen out, and the tympanic membrane healed well. Pure-tone audiometry showed that the average speech frequency hearing threshold on the right side recovered to 25 dB HL, meeting the clinical cure criteria.

3. Nursing

3.1. Precision infection control and isolation nursing

Based on the characteristics of the patient's lesion and transmission risk, a three-tier protective strategy of standard precautions + droplet isolation + contact isolation was implemented ^[3]. The patient was placed in a single isolation ward, with air circulation maintained in the room. Natural ventilation was performed at least three times daily for 30 minutes each session. Ultraviolet air disinfection was conducted twice daily for 30 minutes each time. Floors, bed units, and surface objects were disinfected daily using a 1000 mg/L chlorine-containing disinfectant for wiping.

Medical staff strictly adhere to hand hygiene protocols, wearing surgical masks, work caps, and disposable gloves upon entering isolation wards. Patients are required to wear disposable surgical masks throughout their stay, with restricted movement ranges and prohibited from leaving or moving between wards ^[4]. Nasopharyngeal secretions and external auditory canal secretions are collected in dedicated covered containers and disposed of according to infectious medical waste regulations. Patients are instructed to cover their mouth and nose with tissues when coughing or sneezing, with used tissues directly discarded into medical waste bags to interrupt transmission routes effectively. No nosocomial cross-infection incidents occurred during hospitalization.

3.2. Specialized nursing care based on the MDT model

Based on the patient's ear condition and tuberculosis status, a multidisciplinary nursing team composed of otolaryngologists and surgeons was assembled to develop an individualized comprehensive nursing plan. The assigned nurse is responsible for the specific implementation and dynamic adjustment of the plan, with otolaryngology nurses leading specialized ear care, focusing on tympanic membrane catheter placement status and middle ear drainage. Daily observation of the color, consistency, and volume of external auditory canal secretions is conducted, along with strict adherence to local cleaning and dressing changes under aseptic techniques. Surgical nurses assist in addressing potential surgical-related nursing needs, such as postoperative wound monitoring, pain assessment, and complication prevention. The team achieves real-time information sharing through daily morning joint ward rounds, midday nursing discussions, and evening condition summaries, enabling timely adjustments to nursing measures for symptoms such as hearing loss, tinnitus, and vertigo. This ensures the professionalism and dynamic adaptability of the nursing plan.

3.2.1. Care for tympanic membrane cannulation and middle ear drainage

Maintain patency and proper positioning of the tympanic membrane ventilation tube to avoid compression, twisting, or dislodgement. Daily observation of the color, volume, and consistency of external auditory canal secretions is required. Gently clean the skin at the external auditory canal orifice using sterile cotton swabs. Strictly prohibit ear digging, irrigation of the external auditory canal, or introduction of contaminated water into the ear. Instruct patients to use waterproof ear muffs during hair washing and bathing to provide tight

protection for the affected ear, preventing secondary bacterial infections that may exacerbate the condition.

Perform daily inspections of the tympanic membrane ventilation tube's position and condition to ensure proper functionality. Provide patients with detailed explanations regarding the importance of maintaining ear dryness and recommend appropriate protective measures in daily life. If abnormal external auditory canal discharge or ear discomfort is observed, promptly notify the physician for intervention. After one week of hospitalization, the volume of external auditory canal discharge has significantly decreased compared to admission, with the color transitioning from initial yellow purulent discharge to pale yellow mucoid consistency, and the texture becoming thinner. During examination of the ventilation tube, it was observed that the tube remained centrally positioned with a patent lumen, showing no signs of obstruction or displacement.

3.2.2. Auditory-vestibular functional rehabilitation nursing

In view of the characteristic that middle ear tuberculosis is prone to invade the ossicular chain and labyrinth, we invited otolaryngology nurses to provide professional knowledge lectures and implement integrated auditory-vestibular rehabilitation nursing care.

(1) Dynamic monitoring, precise evaluation

Perform daily pure-tone audiometry, acoustic impedance testing, and vestibular function examinations. Dynamically monitor changes in the patient's hearing threshold, promptly record fluctuations in the audiogram, and closely observe for episodes of vertigo and nystagmus characteristics.

(2) Personalized training to promote functional recovery

Develop a personalized auditory training program for the patient, consisting of two parts:

Auditory function exercises: Guide patients daily to perform 15–20 minutes of sound localization, speech recognition, and pure tone listening exercises to maximize residual hearing protection. Vestibular balance training: For balance dysfunction, perform balance function training including single-leg standing with open and closed eyes, linear walking exercises, etc. Initially supervised by nurses at bedside, gradually increase training difficulty and duration. Prior to all examinations and training sessions, it is imperative to thoroughly explain the purpose and procedures to the patient to alleviate their anxiety. During training, closely monitor the patient's facial complexion and chief complaints. If symptoms such as dizziness or nausea occur, immediately cease training and implement appropriate measures. We have incorporated hearing protection into the core nursing pathway to reflect the principles of precision medicine.

3.2.3. Maintenance of nasal cavity and eustachian tube function

To improve ventilation and drainage of the Eustachian tube and prevent retrograde infection, the following nursing measures are prioritized:

(1) Standardize local care and improve ventilation

Perform nasal irrigation with normal saline twice daily, combined with nasal corticosteroid spray to reduce congestion and edema of the nasopharyngeal mucosa. Simultaneously, instruct patients to master unilateral alternating gentle nose blowing techniques, strictly prohibiting bilateral forceful nose blowing, coughing, or sneezing to prevent the spread of tuberculosis lesions.

(2) Dynamic assessment, targeted rehabilitation

Closely monitor the color of the patient's nasal mucosa and the characteristics of secretions. Evaluate the eustachian tube function daily during shift handover by observing the patient's swallowing movements

or performing the Valsalva maneuver. After achieving stable control of the tuberculosis lesion, initiate an individualized targeted rehabilitation program for eustachian tube function, including Bollinger bulb inflation training and tensor veli palatini muscle exercises, and develop a tuberculosis-specific eustachian tube rehabilitation scale.

(3) Early warning reporting to eliminate risks

Closely monitor patients for abnormal signs such as nasal congestion, rhinorrhea, or foreign body sensation in the nasopharynx. Immediately report to the physician upon observing increased nasal secretions or significant mucosal swelling, and conduct further examinations and laboratory tests if necessary. No retrograde infection occurred during the patient's hospitalization.

3.2.4. Pain management nursing

The NRS pain scale was used for dynamic pain assessment. At admission, the patient's pain score was 7, indicating moderate to severe pain. The nursing team immediately initiated a stepwise analgesia regimen, providing physical analgesia measures such as local warm compresses when ear pain was pronounced, avoiding pressure on the affected ear, and guiding the patient to assume a comfortable semi-recumbent position. Distraction techniques including listening to soothing music and deep breathing relaxation training were employed to alleviate pain perception. Nonsteroidal anti-inflammatory drugs (NSAIDs) were administered when necessary, with monitoring of therapeutic efficacy and adverse reactions recorded promptly. Daily NRS score re-evaluations were conducted at morning awakening, post-lunch, bedtime, and during pain exacerbations to adjust the analgesia regimen dynamically. On day 3 of hospitalization, the patient's pain score decreased to 4, indicating mild pain, and the combined physical analgesia and pharmacological intervention regimen was continued with reduced NSAID dosage. Emphasis was placed on enhanced relaxation training guidance to assist patients in alleviating tension through progressive muscle relaxation techniques. By day 5, the pain score further declined to 2, with patients reporting significant improvement in ear pain and only occasional mild discomfort during chewing or swallowing. Analgesic medications were discontinued, with focus on auricular acupoint massage (e.g., Tinggong and Yifeng points) and personalized music therapy. Patients were advised to avoid hard or irritating foods to minimize traction on the ears during mastication. One day prior to discharge, the patient's pain score remained within the 0-1 range, meeting clinical pain-free criteria. No drug-related adverse reactions were observed throughout the nursing care process.

3.3. Visualization of local drug administration nursing pathways and multidimensional intelligent medication adherence management

This study strictly adheres to the principles of early initiation, combination therapy, appropriate dosage, regularity, and full-course anti-tuberculosis treatment, implementing a closed-loop management model that ensures medication delivery to patients and oral administration in person. Patients and their families are provided with detailed explanations regarding the treatment regimen, duration, administration methods, and significance, with emphasis on the total treatment course lasting 12 months. Unauthorized discontinuation, dose reduction, missed doses, or arbitrary regimen changes are strictly prohibited. A three-dimensional linkage monitoring system integrating "aural symptom feedback, medication adherence tracking, and biochemical indicators" has been established. Utilizing endoscopic ear technology, we perform

tympanoplasty combined with precise perfusion of anti-tuberculosis drugs into the eustachian tube.

Under endoscopic monitoring, accurately administer a mixture of rifampin ear drops and isoniazid solution to ensure drug concentration reaches the lesion site. Closely observe patient tolerance reactions such as dizziness and ear pain, establish a dressing change record form, and dynamically assess granulation tissue regression.

3.4. Individualized psychological nursing and emotional intervention

To address anxiety caused by prolonged misdiagnosis, hearing loss, and uncertain prognosis in patients, we adhere to empathy as the core principle, establishing a trusting nurse-patient relationship. We use accessible language to explain the etiology, treatment regimens, and prognostic outcomes of primary eustachian tube and middle ear tuberculosis. Special emphasis is placed on clarifying that this condition is not pulmonary tuberculosis, has extremely low infectivity, and that standardized treatment can restore hearing function and achieve complete lesion absorption. This approach aims to correct misconceptions and alleviate fear and anxiety.

This study prioritized the establishment of family and social support networks, encouraging comprehensive participation from relatives to alleviate patients' loneliness through companionship and support. Tailored emotional intervention plans are developed based on patients' distinct psychological characteristics: For patients with low mood, we guide them to engage in relaxing and enjoyable activities such as reading and painting to divert attention. For patients exhibiting social withdrawal due to hearing impairment, we actively encourage them to strengthen emotional bonds with grandchildren through written communication or video interactions to fill psychological voids. Additionally, we regularly organize sharing sessions for patients with similar conditions, where recovered individuals share their experiences to enhance further patients' confidence in overcoming the disease. During hospitalization, patients actively cooperate with treatment, proactively raise treatment-related questions to nurses, and share the joy of their recovery progress.

3.5. Systematic nutrition and rest care

In terms of nutritional support, patients are advised to consume a diet high in protein, calories, vitamins, and easy to digest, such as lean meat, eggs, milk, soy products, and fresh vegetables and fruits, with the aim of rapidly replenishing physical energy and repairing damaged tissues. At the same time, spicy and irritating foods must be strictly avoided to minimize irritation to the nasopharyngeal mucosa.

In terms of rest and activity management, we implement refined regulation strategies. Patients are advised to maintain regular sleep schedules and create a quiet, comfortable sleep environment. For sleep management, it is essential to avoid caffeinated beverages and excessively stimulating activities. Nursing staff should monitor patients' weight fluctuations and mental status daily to promptly identify signs of inadequate nutrition intake or poor sleep quality, while maintaining timely communication with family members to provide collaborative support. Additionally, based on recovery progress, patients may gradually engage in moderate low-intensity activities such as indoor walking or simple stretching exercises to promote blood circulation and accelerate physical recovery. Prior to discharge, patients exhibited a 2kg weight gain compared to admission levels, with significant physical strength recovery and the ability to tolerate daily rehabilitation training.

3.6. Standardized discharge guidance and continuity of care

3.6.1. Medication continuation management

Emphasizes the importance of a 12-month treatment course, provides personalized medication records, guides daily scheduled medication intake and accurate documentation, and mandates regular hospital visits for follow-up assessments of liver function, renal function, hearing, and temporal bone CT scans ^[5].

3.6.2. Home-based continuous care with otoscopic visualization

Introduce a portable otoscopic home follow-up system. Guide patients and their families to master otoscopic examination techniques. During each follow-up visit and home visit, upload photos of the tympanic membrane and middle ear cavity to cloud-based archives.

3.6.3. Infection prevention education

Avoid crowded places for 3 months after discharge, wear masks when going out, do not share towels, tableware, or toiletries with family members, and ensure regular ventilation and disinfection at home.

3.6.4. Self-monitoring of disease condition

Educate patients on recognizing signs of recurrence and abnormal manifestations, such as recurrence of symptoms including ear fullness, ear pain, hearing loss, fever, cough, or night sweats, and seek immediate medical consultation for follow-up evaluation.

3.6.5. Comprehensive follow-up plan

Establish individualized follow-up records, with regular outpatient follow-ups at 1, 3, 6, and 12 months post-discharge, managed by specialized nurses throughout the process to ensure continuity of treatment and nursing care.

4. Discussion

Tuberculosis of the eustachian tube complicated with middle ear tuberculosis represents an extremely rare extrapulmonary tuberculosis subtype in clinical practice, often secondary to pulmonary tuberculosis. Primary tuberculous eustachian tube infection without primary pulmonary lesions has been reported only sporadically in domestic and international literature. The clinical manifestations of this condition lack specificity, primarily presenting with ear fullness, ear pain, hearing loss, and purulent discharge from the external auditory canal, which closely resemble those of common secretory otitis media. This similarity frequently leads to prolonged misdiagnosis and missed diagnosis, resulting in delayed optimal treatment timing.

The nursing care for this disease is characterized by high specialization, stringent isolation requirements, prolonged treatment cycles, and rigorous follow-up management, imposing stringent demands on the professional competence of nursing staff. Key nursing priorities include: enhancing early detection capabilities for rare extrapulmonary tuberculosis, implementing precise isolation protocols based on transmission risks, and rigorously preventing nosocomial cross-infections ^[6]; reinforcing specialized nursing interventions such as middle ear drainage and eustachian tube function maintenance to maximize auditory function preservation. Innovations include: a novel nursing intervention integrating precision medication administration, visualized follow-up monitoring, functional rehabilitation, and intelligent management

systems, which resulted in no occurrence of otogenic complications during hospitalization. Three-month post-discharge follow-up revealed complete resolution of granulation tissue, significant improvement in hearing acuity, and stable vestibular function.

5. Conclusion

This case study demonstrates that conventional nursing practices are insufficient to meet therapeutic requirements for primary eustachian tube tuberculosis complicated by middle ear tuberculosis, a rare and complex condition. The innovative approach integrates endoscopic techniques, rehabilitation medicine, smart management, and multidisciplinary collaboration into clinical nursing workflows. Through systematic, individualized, and precision nursing interventions, clinical symptoms can be effectively alleviated, lesion absorption promoted, hearing function preserved, and risks of complications and recurrence reduced. This not only enhances specialized nursing quality but also provides a novel nursing pathway for managing similar rare tuberculosis cases, significantly improving treatment success rates and patient quality of life. It further underscores the importance of clinical nursing staff strengthening learning and research on extrapulmonary tuberculosis, continuously elevating specialized nursing standards, and delivering higher-quality, more efficient care for patients with rare diseases.

Disclosure statement

The authors declare no conflict of interest.

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