JIDC | THE JOURNAL OF INFECTION IN DEVELOPING COUNTRIES

Case Report

Misdiagnosis of a fungus ball in the middle ear as chronic suppurative otitis media

Yuan-Yuan Yang[1], Lian-Rong Guo[1]

[1] *Department of Otolaryngology, Peking University Shenzhen Hospital, Shenzhen, 518036, China*

Abstract

Background: Middle ear infections caused by fungi are commonly identified through laboratory tests like fungal smears, culture, and DNA detection. There are two types of ear infections caused by fungi: middle ear fungal infections and fungal otitis media. Both fungal otitis media and fungus balls in the middle ear are increasingly rare.

Case Description: A middle-aged immunocompetent woman suffered from long-term recurrent pus formation in the middle ear and associated hearing loss. Physical examination revealed a perforation in the pars tensa of the tympanic membrane; a pure tone audiometry test revealed mild conductive hearing loss. The woman had previously self-medicated with oral antibiotics and/or ear drops multiple times in the past. She did not have a history of diabetes mellitus. She was diagnosed with chronic suppurative otitis media and surgical treatment (tympanoplasty) was advised. Otoscopy-guided tympanoplasty revealed a fungal mass with a cheese-like consistency filling the entire mesotympanum, and important structures such as the ossicular chain and the facial nerve were unharmed. Lesions were meticulously excised from the tympanic cavity of the affected ear. The patient no longer experienced pus formation in the middle ear and loss of hearing was restored after the surgery. After tympanoplasty, the patient did not experience any symptom recurrence during the 10-month follow-up period.

Conclusions: If a patient has good immune function and no history of diabetes mellitus, despite repeated antibiotic use resulting in a diagnosis of chronic otitis media, doctors should consider the possibility of a fungal infection in the middle ear.

Key words: Fungus ball; fungal infection; middle ear; *Aspergillus flavus.*

J Infect Dev Ctries 2024; 18(11):1793-1797. doi:10.3855/jidc.19395

(Received 13 October 2023 – Accepted 12 January 2024)

Introduction

Fungal infections in the middle ear are rare. However, research advances in the pathogenesis of middle ear diseases have revealed a role for fungi in the development of these conditions [1,2]. Fungal infections in the middle ear reported in medical research literature are mainly categorized into middle ear fungal infections and fungal otitis media. Current reported fungal otitis media infections are allergic fungal mastoiditis, invasive fungal otitis media, and fungus balls in the middle ear. There are few reports of fungus balls detected in the middle ear.

Although local or systemic antifungal drugs are commonly used to treat fungal infections, similar to the treatment of fungus balls in the paranasal air sinuses, the primary treatment approach with a favorable outcome is the surgical removal of fungus balls in the middle ear.

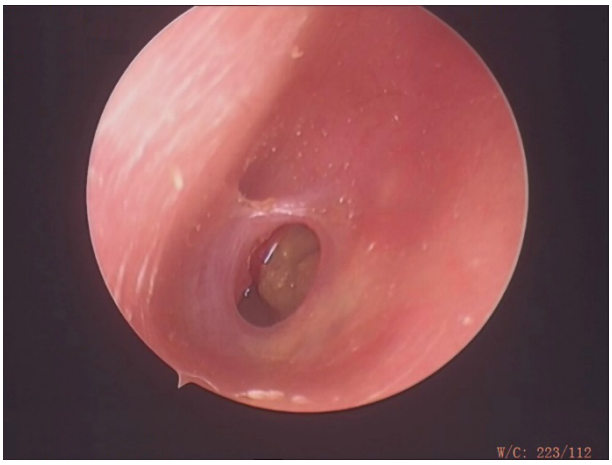
The patient presented in this case report had a fungus ball in the middle ear but was incorrectly diagnosed with chronic suppurative otitis media. We highlight the significance of doctors considering fungal infections in the middle ear in patients with chronic suppurative otitis media infection who have been repeatedly prescribed antibiotics. We also analyzed previous literature on fungal infection in the middle ear and discussed the significance of these infections in this case report.

Case Description

A 45-year-old female visited the hospital with a history of recurrent pus formation and progressive hearing loss in the left ear for 40 years. She occasionally experienced symptoms of tinnitus, pain, fullness, and itching in the left ear without dizziness. After a week of treatment with ofloxacin ear drops and (or) orally administered cephalosporin antibiotics, the symptoms were relieved. Neither the patient nor the family had any medical history of diabetes mellitus.

A perforation measuring 3 mm × 3 mm was discovered in the middle of the pars tensa of the tympanic membrane in the left ear during otoscopy. There were some yellowish pus plugs on the surface of the granulation tissue, and the tympanic cavity was

Figure 1. Clinical findings under otoscopy: perforation at the center of the pars tensa of the left side of the tympanic membrane. Edema of the mucous membrane in the tympanic cavity. Yellow-colored secretions in localized areas of the tympanic cavity.



filled with a cheese-like secretion and pale red granulation-like hyperplastic tissue (Figure 1).

In a pure tone audiometry test, the patient exhibited conductive hearing loss in the left ear, with an average hearing threshold of 35 dB (Figure 2). No bacteria were detected in the culture of external auditory canal secretion. Computed tomography scans of the middle ear revealed no destruction or absorption of bone, and a uniform soft tissue density shadow was seen (Figure 3).

The patient was diagnosed with chronic suppurative otitis media and otoscopy-guided type-I tympanoplasty was performed. During the procedure, doctors discovered a blockage in the pharyngotympanic tube and saw a large amount of a brown, cheese-like substance in the mesotympanum (Figure 4). The cheese-like substance in the tympanic cavity was completely excised and was sent for histopathological analysis and culture. Removal of the cheese-like substance from the tympanic cavity resulted in normal functioning of the ossicular chain and facial nerve canal. The perforated tympanic membrane was repaired using tragal cartilage and cartilage membrane.

No postoperative complications were reported. Histopathological examination of the fungus ball and a few inflammatory cells revealed that *Aspergillus flavus* was the most prevalent fungus, with *Aspergillus oryzae* and *Corynebacterium* also present in low numbers (Figure 5). In addition, to confirm and identify fungal species, this study adopted the second generation of high-throughput sequencing technology, namely DNA-pathogenic microbial metagenomic detection project (Guangzhou Jinyu Medical Laboratory Center), to detect and analyze the nucleic acid sequences of

Figure 2. Mild conductive hearing loss in the left ear based on the tested threshold using the pure tone audiometry test (average hearing threshold at 35 dB).

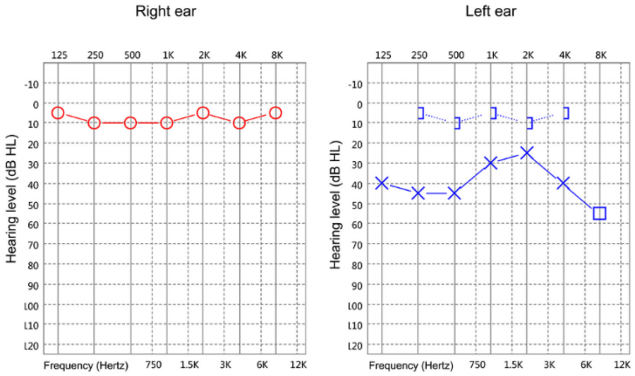
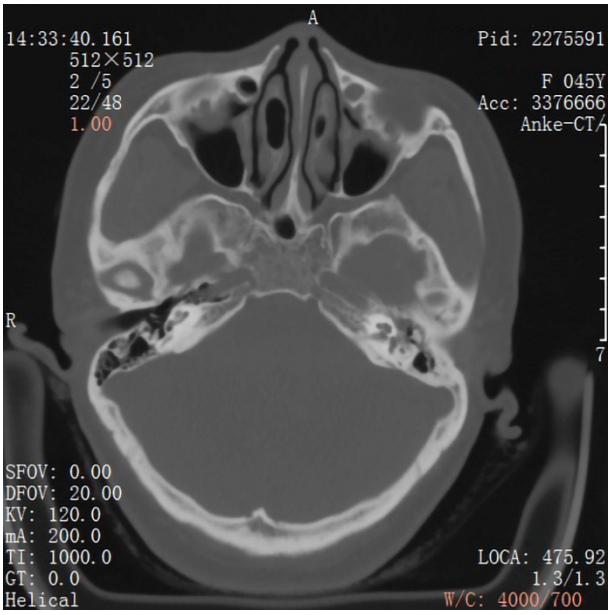


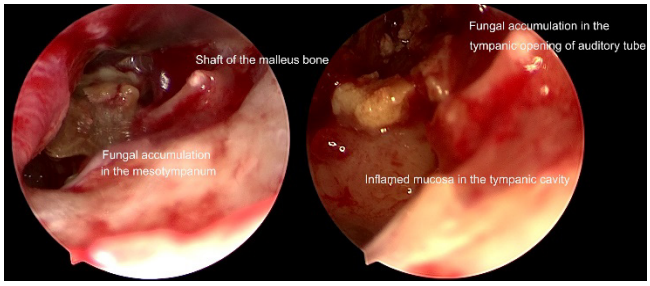
Figure 3. Computed tomography findings: the soft tissue density shadow in the left middle ear cavity is even. No damage is observed in the ossicular chain and mastoid bone.



microbial populations in specific specimens. By comparing with the nucleic acid sequences of microorganisms in the database, the pathogenic microorganisms in the specimen can be identified. The results showed that the sequence number of *A. flavus* was 113046, *A. oryzae* 27596 and *Corynebacterium* crowded 29248.

Postoperatively, the patient received itraconazole 100 mg po q.d. for two weeks. The patient was followed up regularly for ten months when the tympanic membrane healed, and the patient's left ear remained dry. The patient's hearing was fully functional at this time.

Figure 4. Findings during surgery: a substantial quantity of cheese-like secretion accumulated in the mesotympanum and in the mouth of the tympanic cavity of the pharyngotympanic tube.



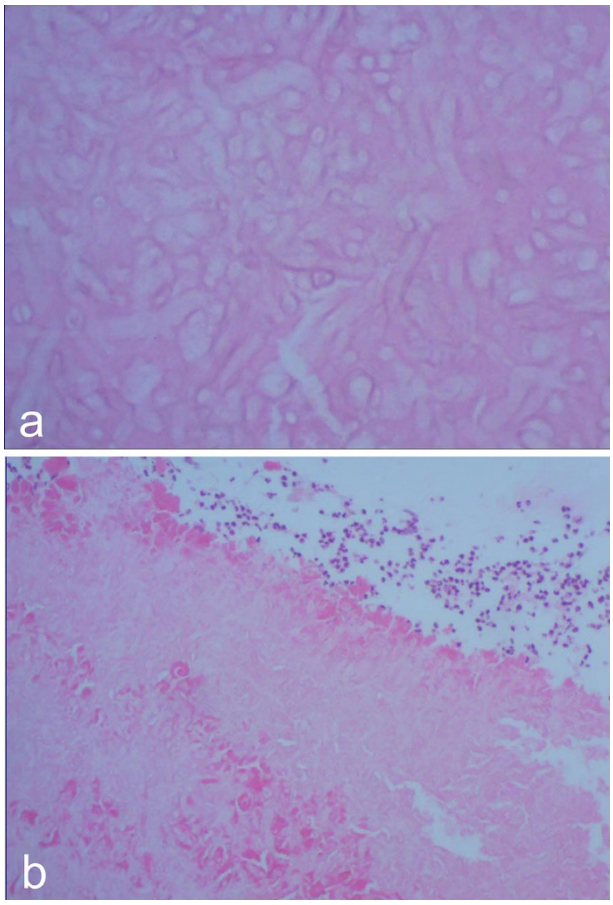
Discussion

The accumulation of non-invasive fungal hyphae in the sinus cavity leads to the formation of fungus balls. They are commonly found in the maxillary sinuses [3]. The pathogenesis of fungus balls has not yet been determined. Its etiological factors include weather shifts, increased humidity, sinus and ear surgery, suppressed immune system, and long-term use of broad-spectrum antibiotics and steroids. Middle ear fungus balls are a distinct form of fungal infection with similarities to fungus balls in the paranasal sinuses in terms of their clinical presentation. Symptoms include formation of pus and loss of hearing in the ear, similar to the symptoms of chronic otitis media, they are rarely seen in clinical practice [4,5]. They are characterized by a cheese-like exudate in the middle ear, which presents as a fungus ball based on post-operative histopathology investigation. Infections can enter the middle ear-mastoid bone or cavity through various entry points, including the nasopharynx and pharyngotympanic tube, or the perforation in the tympanic membrane.

Common symptoms of fungal infections in ears include itching, pain, fullness, discharge in the ear, tinnitus, loss of hearing, and headache, among others. The most common fungal pathogens involved are *Aspergillus* and *Candida* [6-8]. Fungal infections of the external auditory canal are commonly seen in the otolaryngology specialty department. Fungal infections of the middle ear, which account for more than 10% of external ear infections, have also been frequently reported [8-16]. The detection of fungi has been greatly aided by the progress of histopathological investigations, particularly the development of molecular techniques.

Fungal infections of the ears are well documented in medical literature, suggesting fungi may contribute to developing ear diseases. Fungi were detected in most of the specimens of mastoid cholesteatoma infection obtained from the mastoidectomy procedure performed

Figure 5. Microscopic images based on histopathology. A, fungal spores and hyphal conglomeration can be observed under 400× magnification (H&E staining [hematoxylin and eosin staining]); B, a significant amount of exudate can be observed under 100× magnification, with neutrophils present on the surface of the exudate (H&E staining).



on patients diagnosed with cholesteatoma in the middle ear [8-11]. However, after comparing the mucosal specimens in the middle ear between patients with cholesteatoma infection and those undergoing cochlear implant surgeries, some scholars reported that both patient groups had fungi in middle ear mucosa. When the middle ear effusion was subjected to fungal DNA testing for exudates [12] and fungal spectrum gene analysis [13], patients with secretory types of otitis media were found to have fungi in their ear lesions. Fungi have been found to exist in recurrent acute otitis media [12], eosinophilic otitis media [13], chronic suppurative otitis media [8,14,15], and the inflammatory petrous portion of the temporal bone [17,18]. Since these fungi were found in areas of the middle ear that manifested as primary diseases, it is important to consider the possibility that these conditions are superimposed upon or associated with fungal infections. It is currently unknown whether fungi

play a role in the onset of middle ear infections, as fungal colonization also exists in the normal functional middle ear [1,2].

If an immunocompetent patient has inadequate anti-inflammatory response to standard treatment, persistent pus discharge, tympanic membrane perforation, or even post-tympanoplasty headache and fever, fungal otitis media should be considered a provisional diagnosis. In cases of allergic fungal mastoiditis, a large number of characteristic yellow mucin fungal masses were found in the surgical cavity [19,20]. Surgery to remove the lesions and effective antifungal treatment would be necessary for patients diagnosed with fungal masses to recover fully. An invasive form of fungal otitis media may develop in a patient with systemic diabetes mellitus if the otitis media infection progresses rapidly [21,22].

Fungus balls in the paranasal sinuses are typically treated through endoscopic functional paranasal sinus surgery, while drug therapy (especially antifungal treatment) should only be prescribed in exceptional circumstances [23]. Surgery is also the recommended treatment for middle ear fungus balls [4,5]. Antifungal drugs should not be used in patients with superimposed middle ear infections or associated with non-invasive fungal infections [4,5,10,11]. However, systemic administration of antifungal drugs is recommended for the treatment of fungal otitis media, allergic fungal mastoiditis [19,20], inflammation with fungal infection in the petrous portion of the temporal bone [17,18], and invasive fungal otitis media [21,22].

Review of the case in this study: the patient was misdiagnosed with chronic suppurative otitis media based on her clinical symptoms, vital signs, and radiographic imaging before surgery, but a fungus ball was detected in her middle ear. There were limitations to the diagnostic analysis, which led to the misdiagnosis. Firstly, the secreted yellow pus plugs in the mesotympanum detected under otoscopy in the outpatient department were difficult to surgically remove and this finding was overlooked. Secondly, no bacterial growth was detected when the secretion was subjected to a bacterial culture test; thus, the secretion was not subjected to further fungal pathological tests. Therefore, the possibility of fungal infection should be considered in cases diagnosed with chronic otitis media and undergoing long-term antifungal treatments. This should be emphasized for treating patients diagnosed with chronic otitis media in outpatient departments.

Conclusions

The possibility of fungal infection should be considered in patients who have been repeatedly prescribed antibiotics for a diagnosis of chronic otitis media. An accurate diagnosis is essential for timely and optimal treatment for fungal otitis media, to avoid poor treatment results.

Acknowledgements

We are particularly grateful to all the people who have given us help with our article.

Funding

This study was supported by the Research Foundation of Peking University Shenzhen Hospital (JCYJ2021001, JCYJ2017011).

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. The study was approved by the Ethics Committee of the Peking University Shenzhen Hospital. The written, informed consent was obtained from the participant for the publication of this case report (including all data and images).

Availability of data and material

All data generated or analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author.

References

1. Durmaz R, Durmaz B, Ar O, Abdulmajed O, Çelik S, Kalcıoğlu MT (2021) Mycobiome in the middle ear cavity with and without otitis media with effusion. Turk Arch Otorhinolaryngol 59: 261–270. doi: 10.4274/tao.2021.2021-10-4.
2. Weiss JP, Antonelli PJ, Dirain CO (2019) Microbiome analysis of cholesteatoma by gene sequencing. Otol Neurotol 40: 1186–1193. doi: 10.1097/MAO.0000000000002355.
3. Li H, Wu YX, Wang M, Xing ZM, Han L (2022) Comparison between multiple and solitary fungus balls: a retrospective analysis. Ear Nose Throat J 101: NP459–NP467. doi: 10.1177/0145561320982188.
4. Bois E, Boucenna M, Sain-Oulhen C, Lecanu JB (2017) Fungus ball of the middle ear: a case study. OTO Open 1: 2473974X17746582. doi: 10.1177/2473974X17746582.
5. Kim SG, Lee EJ, Yoo JS, Yeo CD (2020) A case of fungal ball with cholesterol granuloma in the middle ear cavity. J Audiol Otol 24: 210–213. doi: 10.7874/jao.2019.00339.
6. Mahdavi Omran S, Yousefzade Z, Khafri S, Taghizadeh-Armaki M, Kiakojuri K (2018) Effect of combination therapy with ceftizoxime and clotrimazole in the treatment of otomycosis. Curr Med Mycol 4: 18–23. doi: 10.18502/cmm.4.1.30.
7. Kamali Sarvestani H, Seifi A, Falahatinejad M, Mahmoudi S (2022) Black aspergilli as causes of otomycosis in the era of

molecular diagnostics, a mini-review. J Mycol Med 32: 101240. doi: 10.1016/j.mycmed.2021.101240.
8. Vennewald I, Schönlebe J, Klemm E (2003) Mycological and histological investigations in humans with middle ear infections. Mycoses 46: 12–18. doi: 10.1046/j.1439-0507.2003.00835.x.
9. Gluth MB, Tan BY, Santa Maria PL, Atlas MD (2013) Unique microbiology of chronically unstable canal wall down tympanomastoid cavities: considerations for surgical revision. J Laryngol Otol 127: 458–462. doi: 10.1017/S0022215113000583.
10. Singh GB, Solo M, Kaur R, Arora R, Kumar S (2018) Mycology of chronic suppurative otitis media-cholesteatoma disease: An evaluative study. Am J Otolaryngol 39: 157–161. doi: 10.1016/j.amjoto.2017.12.001.
11. Effat KG, Madany NM (2014) Mycological study on cholesteatoma keratin obtained during primary mastoid surgery. J Laryngol Otol 128: 881–884. doi: 10.1017/S0022215114002059.
12. Kim EJ, Catten MD, Lalwani AK (2002) Detection of fungal DNA in effusion associated with acute and serous otitis media. Laryngoscope 112: 2037–2041. doi: 10.1097/00005537-200211000-00023.
13. Murakami A, Tutumi T, Watanabe K (2012) Middle ear effusion and fungi. Ann Otol Rhinol Laryngol 121: 609–614. doi: 10.1177/000348941212100908.
14. Punia RS, Singhal SK, Kundu R, Das A, Chander J (2019) Fungal suppurative otitis media (histopathology) among patients in north India. Head Neck Pathol 13: 149–153. doi: 10.1007/s12105-018-0918-2.
15. Ahn JH, Kim MN, Suk YA, Moon BJ (2012) Preoperative, intraoperative, and postoperative results of bacterial culture from patients with chronic suppurative otitis media. Otol Neurotol 33: 54–59. doi: 10.1097/MAO.0b013e31823dbc70.
16. Gharaghani M, Seifi Z, Zarei Mahmoudabadi A (2015) Otomycosis in Iran: a review. Mycopathologia 179: 415–424. doi: 10.1007/s11046-015-9864-7.
17. Jin L, Liu S, Tan S, Wang Y, Zhao Y, Yu S (2022) Petrositis caused by fluconazole-resistant candida: case report and literature review. BMC Infect Dis 22: 649. doi: 10.1186/s12879-022-07637-3.
18. Rushton P, Battcock T, Denning A, Herbetko J, Hillier C, Nicholas D (2004) Aspergillosis of the petrous apex. Age Ageing 33: 317–319. doi: 10.1093/ageing/afh092.
19. Singh A, Subash A, Kumari N, Virk RS (2022) Allergic fungal otomastoiditis: a case report and review of literature. Indian J Otolaryngol Head Neck Surg 74: 3687–3691. doi: 10.1007/s12070-020-02318-6.
20. Salamah MA, Al-Shamani M (2019) Allergic fungal otomastoiditis in a patient without allergic fungal rhinosinusitis: a case report. Am J Case Rep 20: 877–881. doi: 10.12659/AJCR.915292.
21. Liu Y, Han L, Cao J (2023) Invasive fungal ptitis media in diabetic patients: a case-based review. J Int Adv Otol 19: 55–60. doi: 10.5152/iao.2023.22743.
22. Okada M, Hato N, Okada Y, Sato E, Yamada H, Hakuba N, Gyo K (2015) A case of hypertrophic cranial pachymeningitis associated with invasive Aspergillus mastoiditis. Auris Nasus Larynx 42: 488–491. doi: 10.1016/j.anl.2015.04.009.
23. Saibene AM, Allevi F, Calvo-Henriquez C, Dauby N, Dondossola D, Hervochon R, Lechien JR, Lobo-Duro D, Locatello LG, Maniaci A, Mannelli G, Mayo-Yáñez M, Maza-Solano J, Radulesco T, Tan N, Tincati C, Tucciarone M, Vaira LA, Sowerby L (2023) Comprehensive management of paranasal sinus fungus balls: a young-IFOS consensus statement. Int Forum Allergy Rhinol 13: 877–885. doi: 10.1002/alr.23093.

Corresponding author

Lian-Rong Guo
Department of Otolaryngology,
Peking University Shenzhen Hospital,
No. 1120 of Lianhua Road, Futian District,
Shenzhen 518036, China
Tel: 0755-8392333-5636
E-mail: guolianrong@126.com

Conflict of interests: No conflict of interests is declared.