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RADIOLOGICAL METHODS FOR DIAGNOSING FUNGAL DISEASES OF THE MIDDLE EAR AND THEIR CLINICAL SIGNIFICANCE

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Abstract. Although fungal infections of the middle ear are uncommon, they may lead to mastoiditis, osseous destruction, facial nerve involvement, and skull base osteomyelitis, particularly in patients with impaired immunity, diabetes mellitus, or a history of prolonged antibacterial therapy. Their clinical and otomicroscopic manifestations often resemble bacterial chronic otitis media, cholesteatoma, or a neoplastic process. Radiological examinations are therefore essential for determining the anatomical extent of disease and detecting complications. High-resolution computed tomography of the temporal bone demonstrates opacification of the middle ear and mastoid air cells and permits assessment of destructive changes involving the auditory ossicles, tegmen, petrous apex, and walls of the external auditory canal. Contrast-enhanced magnetic resonance imaging is superior for evaluating soft tissues, the dura mater, internal auditory canal, cranial nerves, and intracranial extension. Radiological findings do not independently confirm a fungal etiology; however, they help identify an appropriate biopsy target and support the selection of an optimal treatment strategy.

Keywords: fungal otitis media, otomastoiditis, high-resolution computed tomography, magnetic resonance imaging, temporal bone, osseous destruction, skull base osteomyelitis.

Relevance. Invasive fungal infection of the middle ear is rare in clinical practice; however, delayed diagnosis may allow the disease to spread to the mastoid process, petrous apex, temporomandibular joint, and skull base. Aspergillus and Candida species are reported most frequently, while the risk increases in patients with diabetes mellitus, immunosuppression, prolonged antibiotic therapy, previous ear surgery, and chronic suppurative otitis media [1, 2]. Routine otoscopy cannot fully determine the depth of inflammation or its extension to osseous structures. Modern radiological methods enable assessment of the local stage of disease, differential diagnosis from cholesteatoma and neoplasms, planning of the extent of surgical access, and monitoring of treatment response [3, 4].

Objective. To analyze the diagnostic capabilities of the principal radiological examination methods used in fungal diseases of the middle ear and to determine their clinical significance.

Results and Discussion. Conventional temporal bone radiography in the Schüller, Mayer, and Stenvers projections may demonstrate reduced mastoid pneumatization or major destructive changes. Nevertheless, superimposition of anatomical structures, low contrast resolution, and an inability to demonstrate small anatomical details substantially limit its current diagnostic value. Plain radiography is therefore not recommended as the primary imaging method in complicated or chronic inflammatory ear disease [5]. High-resolution computed tomography (HRCT) of the temporal bone is performed using 0.5–0.625 mm axial and coronal sections. It accurately demonstrates soft-tissue-density opacification of the middle ear cavity and mastoid air cells, obstruction of the aditus ad antrum, erosion of the auditory ossicles, destruction of the external auditory canal and mastoid cortical plate, and defects of the tegmen tympani, sigmoid sinus plate, carotid canal, and facial nerve canal. In invasive fungal otitis, CT may show irregular osseous erosion accompanying opacification, extension to the petrous apex or skull base, and involvement of the temporomandibular

joint and zygomatic region [1, 3]. Bone-algorithm images are particularly important for surgical planning.

Contrast-enhanced CT provides additional information when inflammatory infiltration, abscess formation, venous sinus thrombosis, or extension to adjacent soft tissues is suspected. However, non-contrast HRCT remains the principal technique for detailed assessment of osseous structures. CT findings alone cannot reliably determine whether disease is confined to the middle ear or distinguish fungal inflammation from cholesteatoma or granulation tissue. Imaging findings should therefore be interpreted together with clinical, mycological, and histopathological results.

Magnetic resonance imaging is superior for evaluating the soft-tissue and neurovascular components of inflammation. The recommended protocol includes T1-weighted and T2-weighted sequences, fat-suppressed post-contrast T1-weighted imaging, diffusion-weighted imaging, and MR venography when indicated. MRI demonstrates enhancement of pathological tissue in the middle ear and mastoid, its relationship to the dura and intracranial structures, labyrinthitis, facial neuritis, petrous apicitis, meningeal enhancement, brain abscess, and sigmoid or cavernous sinus thrombosis. In skull base osteomyelitis, changes in bone marrow signal may precede cortical destruction visible on CT; consequently, MRI is particularly valuable for detecting early medullary and soft-tissue extension [3, 4].

Diffusion-weighted MRI assists in the differential diagnosis of cholesteatoma. Cholesteatoma typically demonstrates marked diffusion restriction, whereas inflammatory granulation tissue or fungal masses show variable signal characteristics. Nevertheless, the density of fungal elements and the presence of hemorrhagic or protein-rich contents may occasionally produce atypical signals; these findings cannot replace etiological confirmation.

The most important role of radiological examination is not to identify the fungal species, but to distinguish an invasive process from uncomplicated otomycosis,

delineate the boundaries of disease, identify a safe and informative biopsy site, and justify the extent of surgical or conservative treatment. Fungal etiology should be confirmed by microscopy and culture of ear discharge or surgical material, special histochemical staining, and histopathological examination [1, 2, 6].

Conclusion.

Radiological examinations are an essential component of the comprehensive diagnosis of fungal diseases of the middle ear. HRCT has the greatest value for assessing temporal bone anatomy and osseous destruction, whereas contrast-enhanced MRI is superior for evaluating soft tissues, bone marrow, cranial nerves, and intracranial complications. Diffusion-weighted MRI strengthens the differential diagnosis from cholesteatoma, while radionuclide methods may be used to monitor disease activity in complicated skull base osteomyelitis. Combining imaging findings with mycological and histopathological confirmation improves early diagnosis, prevents severe complications, and facilitates the selection of an individualized treatment strategy.

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