Lesions in the external auditory canal

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Abstract

The external auditory canal is an S- shaped osseo-cartilaginous structure that extends from the auricle to the tympanic membrane. Congenital, inflammatory, neoplastic, and traumatic lesions can affect the EAC. High-resolution CT is well suited for the evaluation of the temporal bone, which has a complex anatomy with multiple small structures. In this study, we describe the various lesions affecting the EAC.

Key words: Cerumen; cholesteatoma; osteoma; otitis externa

Introduction

The external ear consists of the auricle and the external auditory canal (EAC). The EAC is divided into two parts. The lateral one-third is cartilaginous and the medial two-third is bony [Figure 1].[1] The main function of the EAC is to conduct sound waves in the form of vibrations to the tympanic membrane. The most common congenital lesion affecting the EAC is atresia. Inflammatory lesions include malignant otitis externa and osteomyelitis. Bone tumors are the most common neoplastic lesions encountered. Trauma can cause injury to the EAC. Miscellaneous conditions like accumulated ear wax and cholesteatoma also affect the EAC. Most of these lesions can be diagnosed clinically; however imaging is often required to evaluate the extent of the lesion, feasibility for surgery, differential diagnosis and to rule out complications. High resolution CT scan (HRCT) is a good tool to assess EAC abnormalities.

EAC Atresia

Atresia of the EAC can occur in isolation or it may be associated with middle ear and inner ear dysplasia. Isolated EAC atresias are amendable to surgery.[2] The outcome of surgeries performed in the presence of middle and inner ear dysplasia are not encouraging.[3] HRCT of the temporal bone [Figure 2] is indicated for preoperative planning. Preoperatively, the radiologist should look for contraindications for surgery such as atretic oval and or round window and unfavorable course of the facial nerve.[2] In addition, we also need to look for structures that may cause problems during surgery such as reduced volume of the middle ear cavity and poor pneumatization of the temporal bone.[4] Additional anomalies need to be looked for as well, such as the presence of severe incudomallear dysplasia, which when present has to be resected, as well as dysplastic stapes, which may need to be replaced by a prosthesis.[5] 3D reconstructed images should demonstrate the volume of the middle ear cavity[4] and also the distance from the middle ear structures to the atretic EAC [Figures 2A-D] and reveal any other anomalies of the external ear.

Malignant Otitis Externa

Malignant otitis externa is a misnomer as it is not a malignant condition; it is termed "malignant" because of the aggressive clinical behavior and high mortality associated with it.[6] Mortality has currently decreased to 20% from 30-40% due to good improved antibiotics.[7] Malignant otitis externa is a result of infection of the EAC with *Pseudomonas aeruginosa*. It is commonly seen in the elderly and in diabetic patients.[8] The infection soon spreads into the adjacent structures such as the temporomandibular (TM) joint, middle ear, mastoid air cells, and skull base. CT scan demonstrates the presence of an asymmetric soft tissue density in the EAC, with or without extension into the surrounding structures [Figure 3A]. Involvement of

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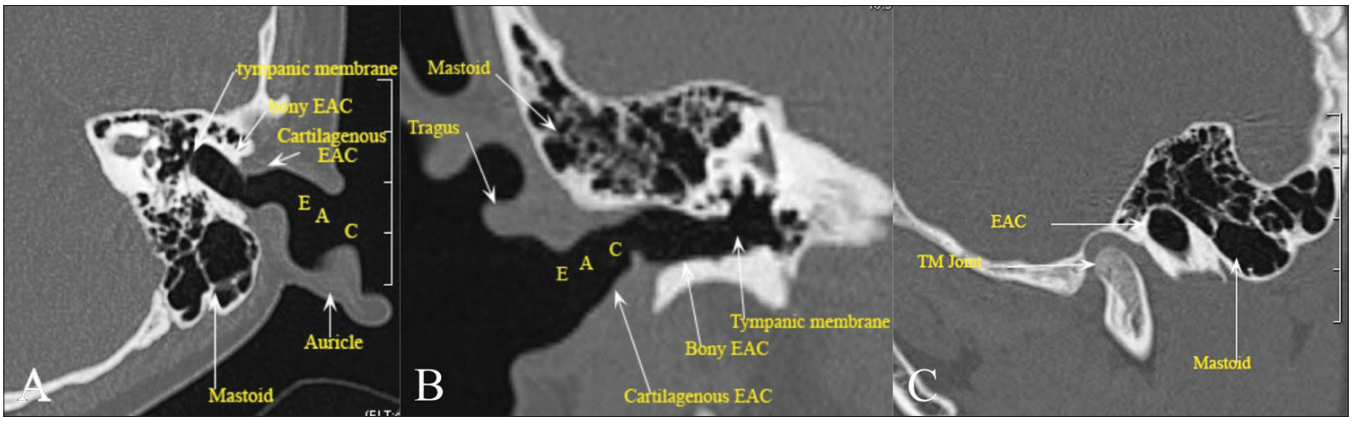

Figure 1 (A-C): Normal anatomy: axial (A), coronal (B) and sagittal (C) HRCT images shows parts of the external auditory canal and their relationship to surrounding structures

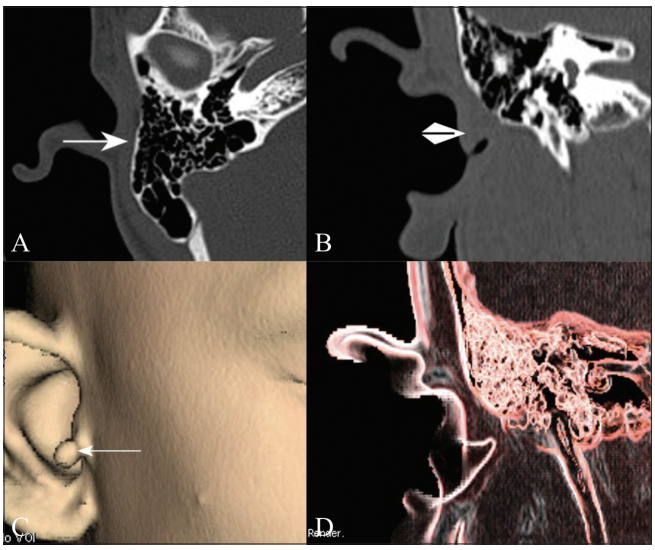

Figure 2 (A-D): EAC atresia. Axial HRCT image (A) shows a well-pneumatized atretic plate (arrow). Coronal HRCT image (B) shows atresia of the bony (arrow) and cartilaginous (arrowhead) parts. 3D surface-rendered image (C) shows an accessory tragus in the right ear. 3D volume rendered image of the right EAC (D) shows atresia

the temporalis muscle leads to formation of a temporalis abscess, which is seen as diffuse muscle thickening with hypodensity [Figure 3B]. Involvement of the TM joint is seen as widening of the joint space, with irregularity of the articular margins. Temporal bone osteomyelitis is seen as increased density of the bone, with linear periosteal reaction [Figure 3C], and accompanied by a soft tissue density around the EAC and mastoid. Differential diagnosis includes cholestatoma and squamous cell carcinoma of the EAC. Early diagnosis of this condition is important as aggressive management is necessary to avoid morbidiy and mortality.

Bone Tumors

Osteochondroma (exostosis) is the most common benign tumor found in the EAC.[9] Other tumors include osteoma, bone island, and osteoid osteoma.[10] Malignant tumors include Ewing sarcoma, osteosarcoma, and squamous cell carcinoma.[11] Osteomas can be single or multiple. Multiple osteomas are associated with Gardner syndrome, which is a constellation of polyps of the colon, multiple osteomas, and multiple impacted or unerupted teeth, in association with skin and soft tissue tumors.[12] Osteomas are asymptomatic and present as slowly growing pedunculated masses in the EAC.[13] HRCT [Figure 4A] demonstrates a bony outgrowth projecting into the EAC. Imaging of the cranium [Figures 4B and C] is indicated in these cases to look for additional osteomas.

External Auditory Canal Injuries

EAC injuries can be due to blunt trauma or penetrating injuries. Road traffic accidents are the most common cause of blunt trauma. Trauma is usually associated with injury to the pinna, with or without TM joint dislocation.[14] EAC injuries may or may not be associated with temporal bone fractures. HRCT shows the presence of high-density fluid (hematoma) in the EAC, with fracture fragments [Figures 5A and E] and associated TM joint dislocation [Figures 5B-D]. Three-dimensional CT volume-rendered images demonstrate laceration of the pinna.

Ear Wax (Cerumen)

Accumulation of wax in the EAC is a physiological process. Cerumen impaction is considered pathological only when it produces symptoms or prevents assessment of the ear canal, the audiovestibular system, or both. Diagnosis is mainly clinical and CT scan is only indicated when impaction removal has been unsuccessful. HRCT demonstrates a hypodense lesion filling the EAC [Figure 6]. Fat attenuation within the lesion and the presence of a rim of air around the lesion confirm the diagnosis.[15]

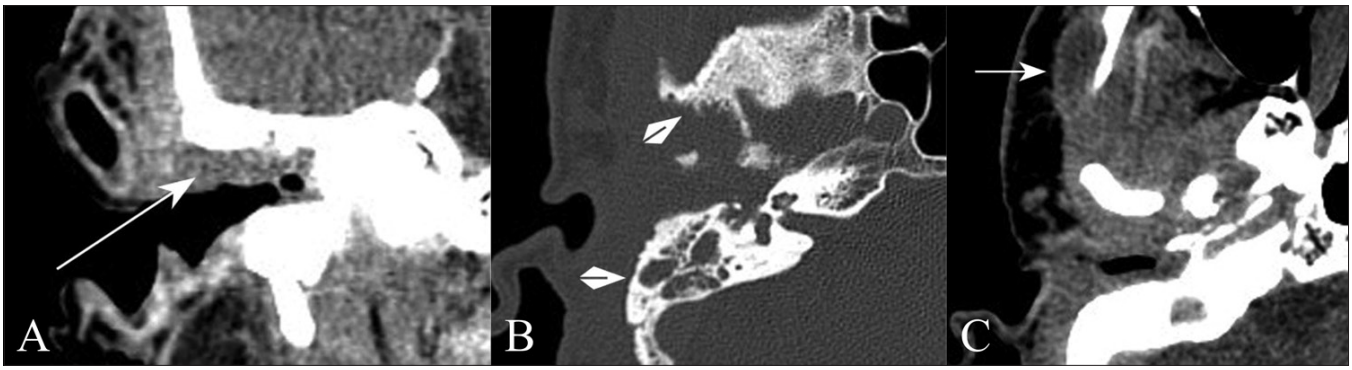

Figure 3 (A-C): Malignant otitis externa: coronal contrast-enhanced CT scan (A) shows soft tissue thickening of the EAC (arrow). Axial HRCT image (B) shows irregularity of the right TM joint (arrowhead) and mastoid (arrowhead). Axial contrast-enhanced CT scan (C) shows a temporalis abscess (arrow)

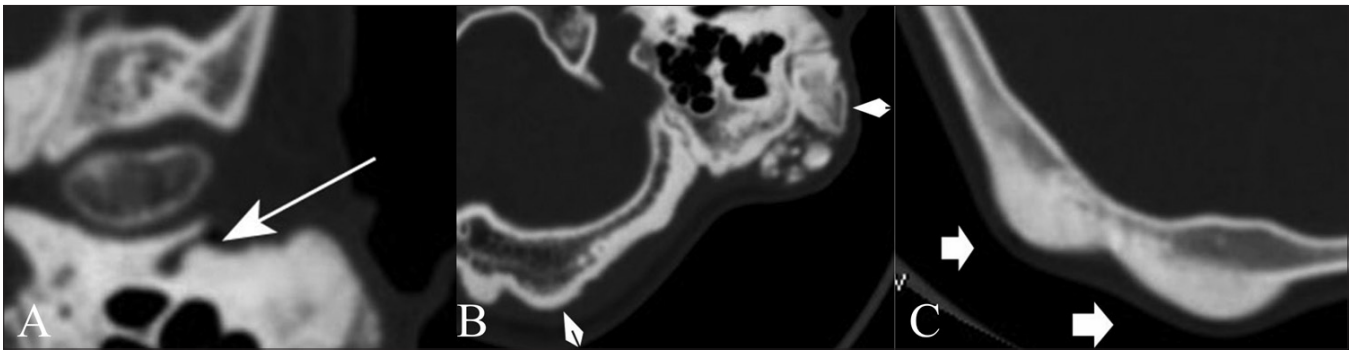

Figure 4 (A-C): EAC osteoma: axial HRCT image (A) shows an osteoma arising from the posterior wall of the EAC. Axial CT scans in bone windows (B, C) show multiple osteomas (arrowheads) of the skull

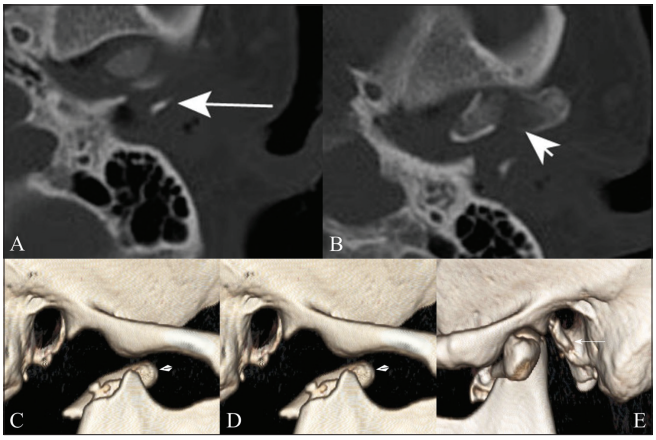

Figure 5 (A-E): EAC injury: Axial HRCT image (A) shows fracture of the anterior wall of left EAC (arrow). Axial HRCT image (B) shows fracture and subluxation of the left TM joint (arrowhead). Volume rendered images (C-E) show a dislocated right TM joint (arrow in C and arrowhead in D) and subluxed left TM joint with a fracture fragment (arrow in E)

Figure 6: Ear wax: axial HRCT image shows a hypodense lesion in the left EAC (arrow) causing mild dilatation of the bony EAC

Cholesteatoma

Cholesteatomas arise as a result of ingrowth of the stratified squamous epithelium of the EAC into the middle ear.[16] The EAC is a rare site for cholesteatoma. Cholesteatomas can be primary (idiopathic) or secondary. Secondary cases are due to trauma or inflammatory disease and are much more common than the primary form.[17] Seung-Ho Shin

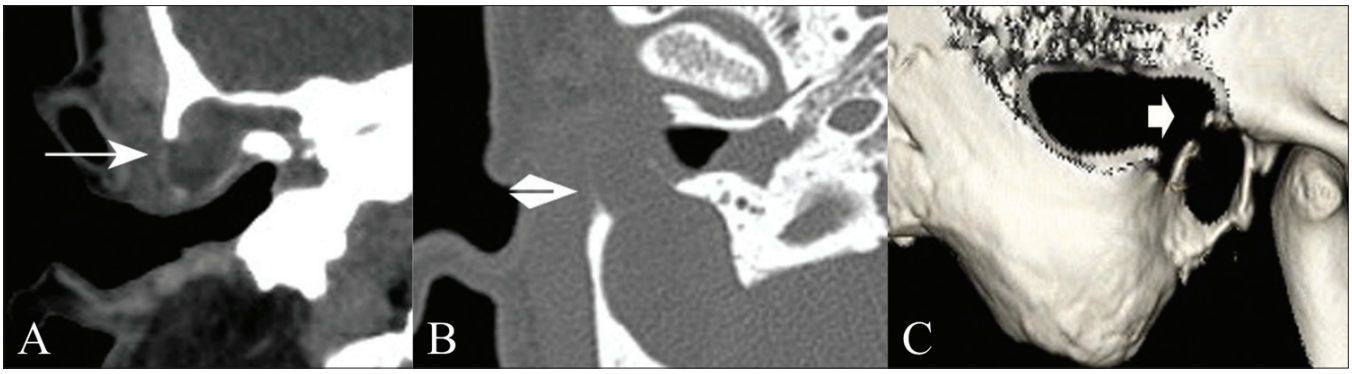

Figure 7 (A-C): Cholesteatoma of the EAC: noncontrast coronal CT scan (A) and axial HRCT image (B) show a hypodense lesion in the right EAC (arrow in A and arrowhead in B) invading the mastoid (stage III). 3D volume rendered image (C) shows a small, post-biopsy defect in the mastoid wall

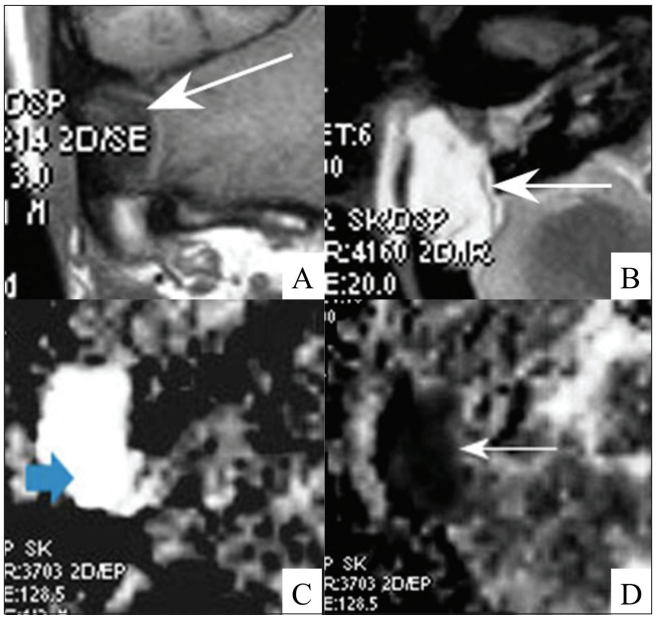

Figure 8 (A-D): Cholesteatoma of the EAC: coronal T1W MRI image (A) shows a hypointense lesion (arrow) in the right temporal bone. Axial STIR MRI image (B) shows a hyperintense lesion (arrow) extending into the mastoid. Diffusion-weighted (C) and axial apparent diffusion coefficient (ADC) (D) images show restricted diffusion (arrows)

et al.[18] classified EAC cholestetomas (EACC) into four groups based on the CT scan and clinical findings. Stage I cholesteatoma is limited to the EAC. Stage II cholesteatoma involves the tympanic membrane and the middle ear. An EAC cholesteatoma is considered stage III if in addition to the EAC it involves the mastoid air cells [Figure 7]. In stage IV cholestetomas the lesion extends beyond the temporal bone.

EACC must be differentiated from malignant otitis externa. EACC is a slowly progressing chronic disease and is well localized, with a soft tissue density eroding one of the walls of the EAC.[19] On the other hand, malignant otitis externa is a rapidly progressive disease and a diffuse process involving most of the EAC.[20] Malignant otitis externa shows enhancement of the soft tissue on contrast-enhanced studies, whereas there is no enhancement in the case of cholesteatomas. Diffusion MRI imaging is of particular help in tricky situations. EACC show prompt diffusion restriction [Figures 8A-D], whereas malignant otitis externa does not show restriction on diffusion.[21]

Conclusion

The EAC is an important part of the temporal bone and is involved in sound conduction. HRCT has an integral role in the diagnosis and management of lesions in the EAC. MDCT coupled with 3D reconstruction helps in better visual representation of these lesions and thus facilitates appropriate management.

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