HRCT and MRI Temporal bone - uncommon findings

Poster No.: C-0025
Congress: ECR 2015
Type: Educational Exhibit
Authors: A. R. Joshi¹, A. Bahua², A. P. sankhe³, J. S. Bava², T. Patel²;
¹Mumbai, Maharastra/IN, ²Mumbai/IN, ³Mumbai, ma/IN
Keywords: Head and neck, CT-High Resolution, MR, Education, Education and training
DOI: 10.1594/ecr2015/C-0025

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method ist strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Learning objectives

1. To remain aware about the uncommon pathologies of temporal bone.
2. Learn the anatomy and pathophysiology of important variations of rare but important disorders affecting the temporal bone.

Background

Temporal bone imaging has always been a challenge. Though infections and trauma are most common pathologies encountered; quite often we tend to overlook rare unexpected but intriguing vital pathologies (e.g. otospongiosis, labyrinthitis ossificans, etc.). These unique pathologies may be encountered in isolation or in combination with other common and/or serious pathologies. They also have a serious impact on the prognosis and management including intra-operative difficulties and post-operative outcomes.

Findings and procedure details

Plain HRCT temporal bone was done using 64 slice multidetector CT scan with axial, coronal and sagittal reconstruction in high bony algorithm and whenever required soft tissue window settings.

Labyrinthitis Ossificans:

Ossification of the membranous labyrinth; pathologic formation of new bone within the lumen of the otic capsule, is associated with profound deafness and loss of vestibular function.

The most common cause is suppurative labyrinthitis due to tympanogenic (chronic otitis, cholesteatoma, or postsurgical), meningogenic (bacterial or viral), or hematogenic (mumps or other haematogenous infections) meningitis, but has multifactorial pathogeneses, such as malignant infiltration and otospongiosis. The most common site of involvement is scala tympani of the basal turn of the cochlea.

Cochlear ossification does not involve the endosteal layer or alter the architecture of the enchondral bone.
Spectrum of Labyrinthitis:

Cochlear Stenosis:

The most limited form of labyrinthitis ossification is narrowing of the basal turn of the cochlea.

Cochlear Fibro-ossific Change (Early Labyrinthitis Ossification):

Early labyrinthitis ossification may show normal HRCT or hazy increased density within the basal turn of the cochlea. On MRI, the bright fluid of the normal cochlea is absent. MRI is sensitive in detection of early labyrinthitis (Fig 1).

Cochlear Ossification (Late Labyrinthitis Ossification)

CT detects ossification within the cochlea during the late stages. The diagnosis is very important if cochlear implantation is considered as extensive drilling into the scala tympani may be required to achieve limited electrode insertion (Fig 2 and 3).

Osseous Hypertrophy of the Round Window Niche

It is focal form of labyrinthitis ossification. Ossification of the round window niche is seen which requires the surgeon to drill off the obstructing bone before entering the scala tympani.

Otospongiosis:

Otospongiosis is an idiopathic condition in which normal osteochondral bone is replaced by a highly vascular haversian bone leading to conductive, sensorineural, or mixed hearing loss.

Two Types

- Fenestral- It most commonly involves the bone anterior to the oval window at a small cleft the fistula ante fenestrum (thin fold of connective tissue between the cochleariform process and the oval window)(Fig 4 and 5).
- Cochlear-Involving the cochlea either focal or may encircle the otic capsule.
Symons and Fanning CT grading system for otosclerosis:

Grade I- Fenestral, spongiotic or sclerotic, evident as a thickened stapes footplate, and/or decalcified, narrowed or enlarged oval windows;

Grade II- patchy localized cochlear disease (+ fenestral involvement)

Grade IIA - basal cochlear turn,

Grade IIB - middle/apical turns

Grade IIC-both basal and middle/apical turns

Grade III- diffuse confluent cochlear involvement of the otic capsule (+ Fenestral involvement).

**Exostosis of the external auditory canal:**

Also known as Surfer’s ear as it is predominantly found in cold water surfers.

It occurs due to chronic exposure (> 10 years) to cold wind and water which acts as local irritant and results in new bone formation.

Exostosis are usually broad based elevated lesions which are often multiple and bilaterally symmetrical which most commonly occur near the anterosuperior portion of the external auditory canal (Fig 6 and 7).

Usually asymptomatic but infrequently cause severe stenosis of the external auditory canal with conductive hearing loss, impaction of cerumen and subsequent recurrent infections, where surgical removal and canalplasty is required.

The main differential is osteoma which is usually solitary and pedunculated bony growth attached to tympanosquamous or tympanomastoid suture.

Other rare mimics are metallic foreign body and B.I.P.P gauze (Bismuth Subnitrate, Iodoform and Paraffin Paste Impregnated Gauze) usually used to pack cavities following a number of ear procedures where it acts as an antiseptic and astringent (Fig 8).

**Crista Falciformis Meningioma:**

Anatomy:
The internal auditory canal is divided into superior and inferior compartments by crista falciformis or the falciform crest. Crista falciformis (Falciform crest) consist of a thin horizontal plate of bone within the internal auditory canal which is thickest at the fundus where each nerve exits through its own foramen. Internal auditory canal is further divided into anterior and posterior compartments by Bill's bar.

Thus internal auditory canal is divided into four compartments - anterosuperior through which exits the facial nerve, anteroinferior through the cochlear nerve exits, posterior-superior through which the superior vestibular nerve exits and postero-inferior through which the inferior vestibular nerve (Fig 9).

The dilatation of internal auditory canal which results in hearing loss is most common due to space occupying lesion such as acoustic neuroma. Rarely other lesions, like a meningioma near the crista falciformis can cause such dilatation (Fig 10).

There is also an anatomical variant of the internal auditory canal dilatation known as patulous internal auditory canal in patients with impaired hearing, where there is no lesion within the dilated IAC. It is diagnosed on HRCT by increased height (normal range 2-9 mm with difference of less than 2mm between two sides) at mid-portion of IAC and is invariably bilateral.

**Persistent Stapedial artery:**

It is a rare congenital vascular anomaly that can be purely incidental or present as tinnitus. It is a reason for surgical complication.

**Embryology (Fig 11):**

The embryological ventral and dorsal aortic arches are connected by small arterial branches, the aortic arches which correspond to the branchial arches. Hyoid artery is a branch of the second branchial arch from which the stapedial artery arises. The stapedial artery passes through the mesenchymal primordium and forms an imprint near the footplate of the stapes (the obturator foramen). It further divides into upper and lower division.

The upper (Supraorbital) division continues as middle meningeal artery in the normal adult life, whereas the lower (Maxillofacial or Maxillomandibular) division leaves the cranium through the foramen spinosum. The lower division anastomoses with the ventral pharyngeal arteries (definitive adult ECA) which arise from the third branchial arch.
In the definitive adult system, there is regression of the tympanic portion of the stapedial artery. Hence, there is flow reversal in the lower division through foramen spinosum directed towards the cranium. Also the hyoid artery decreases in size and persists as the carotico-tympanic branch of the ICA.

If there is persistence of the stapedial artery into postnatal life, the tympanic portion of the stapedial artery supplies the middle meningeal artery. The persistent stapedial artery arises from the hyoid artery (petrous ICA) which does not regress. Hence there is absence of foramen spinosum (Fig 12).

Intracranially, the persistent stapedial artery courses along the posterior direction in the bony ridge to the promontory (Fig 13), then cephalad through the obturator foramen to enter the tympanic portion of the facial canal causing its enlargement (Fig 14) and exits into the middle cranial fossa just before the geniculate ganglion.

A rare variant of persistent stapedial artery, the pharyngostapedial artery, in which there is regression of the hyoid artery near its ICA origin. Here, the stapedial artery arises from the ascending pharyngeal artery and enters the cranium through the inferior tympanic canaliculus along the Jacobson's nerve (Fig 15 and 16). Whatever may be the origin, intracranially the course of the persistent stapedial artery is the same in either case.

Preoperative knowledge of the presence of a PSA is useful in planning the endovascular interventions and thus avoids the unnecessary complications during the surgical procedures.

Other common vascular anomalies that may lead to serious postoperative bleeding which should be diagnosed in HRCT temporal bone are aberrant internal carotid artery (Fig 17) and dehiscent jugular foramen (Fig 18).

**Congenital Facial Nerve Hypoplasia:**

Congenital facial nerve hypoplasia (Fig 19) occurs as a part of other congenital inner ear malformations, or part of Moebius syndrome (Congenital Facial diplegia), congenital oculo-facial paralysis and rarely as isolation.

Isolated facial nerve palsy patients have normal vestibulo-cochlear nerve and the vestibule.
Other congenital anomalies that affect facial nerve are facial canal dehiscence, duplication of the facial nerve, abnormal course like anterior migration of facial nerve. These too usually occur with other congenital inner ear abnormalities.

Congenital anomalies other than facial nerve hypoplasia are not included.

**Images for this section:**

**Fig. 1:** A (axial) and B (coronal) images of heavily T2 weighted 3D sequences showing loss of normal bright signal of the cochlea on the right side (yellow) as compared to the normal bright signal of the cochlea on the left side (blue)

**Fig. 2:** A-Axial images showing ossification in basal turn of cochlea bilaterally. B- Axial image showing normal basal turn of cochlea.
Fig. 3: (A and B) Coronal images showing ossifications in the basal turn of cochlea bilaterally.

Fig. 4: A- Axial CT shows demineralization just anterior to the oval window, near the small cleft fistula ante fenestrum. B- Axial CT showing normal cleft.

Fig. 5: A- Coronal CT shows demineralization just anterior to the oval window, near the small cleft fistula ante fenestrum. B- Coronal CT showing normal cleft.
Fig. 6: A (Axial) showing a broad based bony lesion (yellow) causing obliteration of the external auditory canal and retained secretions in the external auditory canal (B), compared with normal right side (blue arrow).

Fig. 7: Coronal image at the level of external auditory canal showing bony exostosis on the left causing obliteration of the canal, compared with the normal right external auditory canal.

Fig. 8: A (Axial) and B (coronal) images showing hyperdense B.I.P.P gauze within the EAC mimicking a bony lesion.
Fig. 9: Graphical representation showing normal anatomy of the internal auditory canal (green line-Crista Falciformis, red line-Bills Bar)

Fig. 10: A (axial) and B (coronal) images showing widening of the internal auditory canal as a result of calcified meningioma near the right crista falciformis.
**Fig. 11:** Graphical Representation showing the normal embryological development and the persistence of the stapedial artery.

**Fig. 12:** Axial HRCT image showing absence of foramen spinosum on the left side compared to the normal right side.
Fig. 13: A and B- Axial and coronal images showing the intracranial course of the stapedial artery in the bony ridge to the promontary.

Fig. 14: Coronal image showing enlarged right facial nerve (yellow arrow) compared to normal (blue arrow).
**Fig. 15:** Sagittal image on the left side showing course of persistent stapedial artery traversing through the canaliculus to enter the cranial cavity.

**Fig. 16:** A (Sagittal) and B (Coronal) images showing the extracranial course of the rare variant of persistent stapedial artery, pharyngotympanic artery arising from the extracranial ECA (ascending pharyngeal artery).
**Fig. 17:** Axial images at the level of internal carotid artery showing its aberrant course entering the tympanic cavity and lateral to the vestibular line of Lapayowker (vertical line from lateral aspect of vestibular apparatus). Blue arrow showing normal carotid canal on left side.

**Fig. 18:** A - Axial image showing right dehiscent jugular bulb with absence of sigmoid plate and jugular bulb bulging into the middle ear cavity. B - Axial image showing high riding right jugular bulb with thinned out sigmoid plate.
**Fig. 19:** A (Axial) and B (Coronal) images showing hypoplastic labyrinthine segment of facial nerve on the right side (yellow arrow). Compare with the normal calibre left facial nerve.
Conclusion

A wide range of specific pathologies may affect the relatively small anatomical region of temporal bone which can be easily ignored if one is not vigilant. Systematic approach and careful interpretation of the HRCT images of temporal bone and whenever done of MRI is important to diagnose the unusual pathologies.

Personal information

References
