

Aberrant internal carotid artery in the middle-ear space

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Abstract

The incidence of an aberrant internal carotid artery in the middle ear is approximately one per cent and most patients are asymptomatic. We present two patients with an aberrant internal carotid artery who presented with pulsatile tinnitus and an intra-tympanic mass. Here we discuss the clinical presentation, relevant radiographic investigations and further management of these patients.

Key words: Carotid Artery, Internal; Tinnitus

Introduction

Vascular masses in the middle-ear space are uncommon. They continue to present a diagnostic problem, as the clinical symptoms and signs are often non-specific and require radiological investigation to distinguish between glomus tumours, other vascular tumours, a dehiscent jugular bulb and an aberrant internal carotid artery (ICA).¹

In approximately one per cent of the population a dehiscent ICA canal is present and could result in the passing of an aberrant ICA through the middle-ear space.² It is important for the otologist to be aware of this anomaly, as a misdiagnosis can have catastrophic consequences.

The aberrant ICA course through the middle ear can be explained by an embryological malformation of the first and second branchial arches which would result in the persistence of embryological vessels and subsequent anastomosis in the middle ear.³ This would prevent the formation of the ICA bony covering over the tympanic part of the middle ear.⁴

Normally the ICA ascends vertically, medial and anterior to the middle-ear cavity before bending sharply anterior and medially below the eustachian tube and cochlea. It then passes through the carotid canal into the cranial cavity.³

The bony plate covering the artery in this area may frequently be less than 0.5 mm thick. It is usually in this area that an aberrant ICA occurs, presenting as a vascular mass in the antero-inferior quadrant.⁵

We discuss two cases with aberrant ICAs in the middle ear space, presenting with pulsatile tinnitus and a conductive hearing loss.

Case reports

Case 1

A six-year-old male presented with a left-sided pulsatile tinnitus, that could be heard by his mother, and mild conductive hearing loss. Otoloscopic examination revealed

an antero-inferior red pulsatile mass in the intratympanic space. The right tympanic membrane was normal. Audiometric assessment revealed a 30 db conductive hearing loss.

Computed tomography (CT) of the temporal bone showed a 5 mm enhancing vascular lesion related to the promontory but separate from the jugular bulb (Figure 1). The nature of this vascular mass was not initially recognized and a vascular tumour was suspected.

Magnetic resonance imaging (MRI) supplemented by magnetic resonance angiography (MRA) was performed for further elucidation. Review of the imaging at this stage by a neuroradiologist suggested the diagnosis of aberrant ICA. To exclude aneurysmal changes to the vessel, an angiogram was performed which further confirmed the diagnosis of an aberrant ICA and excluded a saccular aneurysm.

The patient was reassured and will be reviewed yearly for audiometric and otoscopic examination.

Case 2

A 16-year-old female with severe bilateral posterior plagiocephaly and a ventriculostomy for hydrocephalus, presented to our clinic with intermittent bilateral otalgia and persisting clicking sounds in her ears.

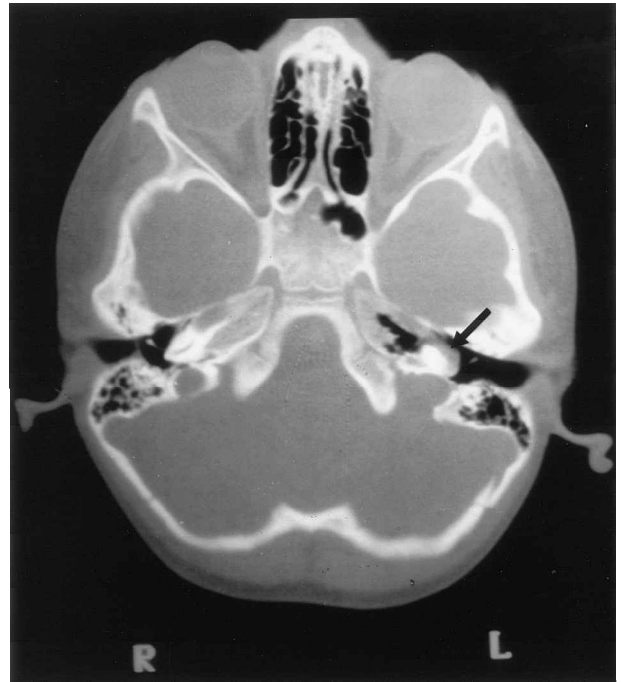
On otoscopic examination, the striking finding was that both right and left tympanic membranes were pulsating and revealed bilateral intratympanic masses in the antero-inferior aspect of the intratympanic space. Audiometric testing revealed a normal hearing threshold.

Axial cranial CT excluded neoplastic lesions of the petrous bones. Bilateral aberrant ICAs were demonstrated, the arteries lying in a more lateral position than normal, abutting the region of the tympanic membrane inferiorly (Figure 2).

The patient was reassured and offered follow-up for audiometric testing and otological examination.



(a)



(c)

FIG. 1(a-c)

Axial computed tomograph (bone windows) continuous images. (a) Note normal carotid canal on right (black arrow) and absent canal on left side. (b) Normal horizontal portion of carotid canal on right side (black arrow), reduced calibre of canal on left. (c) Soft tissue mass related to promontory on left (black arrow).



(b)

Discussion

Vascular anomalies of the middle-ear space are uncommon and often a diagnostic problem because the symptoms and signs are non-specific.

These patients may be asymptomatic or complain of pulsatile tinnitus, hearing loss, otalgia or an aural fullness. On otoscopic examination, a vascular red mass may be seen in the antero-inferior quadrant of the middle-ear space with or without a pulsating drum. On audiometric

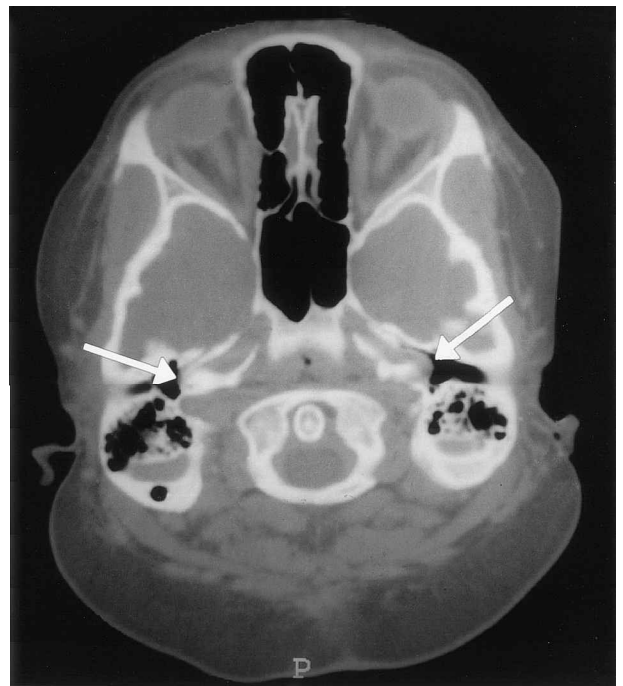


FIG. 2

Axial computed tomograph (bone windows): internal carotid arteries adjacent to promontory are visible bilaterally (see arrows).

TABLE I

DIFFERENTIAL DIAGNOSIS OF A VASCULAR MASS IN THE MIDDLE EAR

Aberrant internal carotid artery
Dehiscent jugular bulb
Glomus tumour
Other vascular temporal bone lesions
Cholesterol granuloma
Petrous carotid aneurysm with dehiscent bone

These symptoms and signs cannot distinguish between an aberrant ICA and the other vascular anomalies that could be present in the middle-ear space (Table I).

Clinical diagnosis must be confirmed by performing the appropriate imaging examinations. The initial radiographic study requested should be a high resolution CT scan of the temporal bone. The purpose is to define a normal vascular arrangement and the absence of bone erosion in the normal individual.

The aberrant ICA can be identified by the following characteristics: 1) an enhancing intratympanic mass; 2) an enlarged inferior tympanic canaliculus; 3) absence of the vertical segment of the ICA canal and absence of bone covering the tympanic portion of ICA.⁷ On coronal CT scan, the important features are the presence or absence of the normal septum between the hypotympanum and carotid canal. When the vessel lies lateral to its normal position, this septum cannot be identified. In glomus tumours the soft tissue mass will be distinct from the normal carotid artery, which has an intact wall.⁸

Although it has been suggested that CT scan alone is sufficient to confirm the diagnosis of vascular anomalies, it does not always differentiate between a vascular anomaly and a highly vascularized glomus tumour.⁹

Conventional carotid angiography remains the standard of reference for defining anomalies of the ICA, it is also important in the assessment of vascular supply, exclusion of an aneurysm and when intervention is planned.¹⁰ The classic finding in an aberrant ICA is that the medial bend of the ICA is lateral to a line drawn vertically through the vestibule, as described by LaPayowke *et al.* in 1971.¹¹ Also common is displacement of the ICA posterior to the overlying image of the external auditory canal.

Arteriography is, however, an invasive procedure with a small but real risk of neurological and contrast medium-related complications.⁷

Recent advances in MRI and MRA allow enhancement of flow dependent features of the magnetic signal, providing angiographic visualization of vascular structures without the risks of conventional angiography.¹² Limitations of MRA relate primarily to characteristics of flow. With reduced flow velocity or non-laminar flow, signal intensity is reduced, limiting visualization in lesion such as large aneurysms.¹³

MRI may help characterize and define the extent of lesions. The advantages of MRI over CT include its multiplanar capability and the option of MRA, nevertheless the findings may be less conspicuous than on CT, with its exquisite demonstration of bone detail.¹⁴

The need for treatment is controversial. Some of the reasons for treatment would be to relieve the patient of troublesome symptoms, prevent possible destruction of the middle-ear structures, formation of an aneurysm and endovascular embolization of an embolism. Once an aberrant ICA is diagnosed within the middle ear, treatment is neither necessary nor indicated.⁷

Ruggles and Reed recommend separation of the ICA from the middle-ear space by covering the vessel with fascia and then compressing it into the promontory defect and covering it with a bone graft.¹⁵ However, this may

further compromise the blood flow through these already narrowed vessels and may predispose them to development of an aneurysm.¹⁶ Another method described is to place a silastic sheet or a fascia graft between the ossicles and the artery, to prevent the possibility of erosion of the ossicles.¹⁷ The treatment for a confirmed aneurysm would be embolization. This can be performed by filling the aneurysm with detachable platinum coils.¹⁸

The principles of covering the vessel wall and preventing the possibility of aneurysmal dilatation and endovascular embolization should constitute the basis of surgical treatment for this condition if at all considered.

Emergency treatment for an injury to an aberrant ICA e.g. after a myringotomy by an unsuspecting surgeon, should be to control the bleeding by packing the ear canal and applying a pressure bandage. If bleeding persists, surgical intervention may be required.

Conclusion

The failure to suspect or accurately diagnose a vascular anomaly in the middle-ear space could have disastrous consequences.

An aberrant ICA presenting as a middle-ear mass in an uncommon finding in the differential diagnosis of middle ear masses. The presenting symptoms are non-specific and the clinical findings may or may not reveal an intratympanic mass, pulsating drum or audible bruits.

High resolution CT scan or MRI scan of the temporal bone should be performed. If the results are inconclusive MRA imaging or conventional angiography should be considered, the latter probably only if a therapeutic procedure is planned.

Treatment for this condition is controversial and should be determined by the patient's symptoms and imaging results. The key message is that a high index of suspicion should be maintained and neuroradiological examination should be performed prior to surgery.

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