Fenestration of the internal carotid artery: a rare mass of the hypotympanum associated with persistence of the stapedial artery.

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Fenestration of the Internal Carotid Artery: A Rare Mass of the Hypotympanum Associated with Persistence of the Stapedial Artery

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Summary: A 61-year-old woman was examined because of unilateral nonpulsatile tinnitus involving the right ear. CT scanning showed a soft-tissue mass in the hypotympanum. Angiographically, the mass was identified as a fenestrated or duplicated internal carotid artery associated with persistence of the stapedial artery. Embryologic considerations are discussed.

Index terms: Arteries, abnormalities and anomalies; Arteries, carotid, internal

Anomalies of the internal carotid artery are rare, usually detected as an incidental finding during the evaluation of an unrelated neurologic problem. A few cases have been reported describing duplication of the internal carotid artery (1, 2). Persistence of the stapedial artery is also a rare vascular anomaly that can occur in isolation or be associated with anomalies of the internal carotid artery (3–9). This case illustrates a rare duplication or fenestration of the internal carotid artery presenting as a mass in the hypotympanum associated with persistence of the stapedial artery.

Case Report

A 61-year-old woman was examined because of acute onset of nonpulsatile tinnitus of the right ear. Physical examination demonstrated an opaque, retracted tympanic membrane without evidence of an underlying vascular mass. Audiometric testing identified a moderate conductive hearing loss suggestive of mild otosclerosis.

A high-resolution computed tomographic (CT) examination showed a soft-tissue mass within the hypotympanum (Fig 1). It projected laterally along the inferiomedial surface of the tympanic membrane and was contiguous medially with the promontory. An unusually large inferior tympanic canaliculus was demonstrated at the skull base (Fig 2A). The bony margin of this canal demonstrated regions of dehiscence adjacent to the hypotympanic mass involving both the inferior tympanic canaliculus and the carotid canal (Fig 2B). CT findings further indicated that the superior margin of the mass was contiguous with the horizontal segment of the internal carotid artery (Fig 2C). The tympanic segment of the facial nerve canal was enlarged (see Fig 1). The stapes superstructure was poorly defined, and the ipsilateral foramen spinosum could not be clearly identified. The left temporal bone was normal.

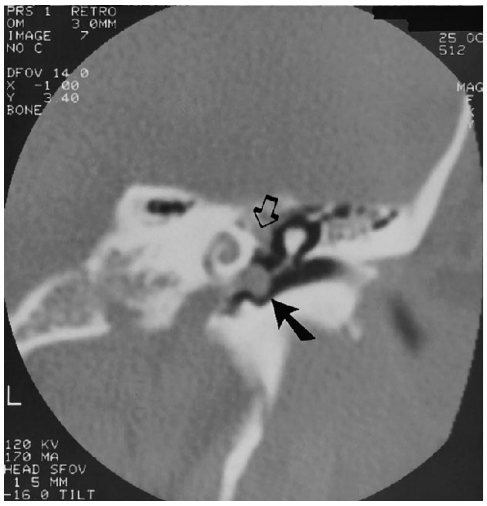

Fig 1. Coronal CT scan shows a soft-tissue mass within the hypotympanum (*solid arrow*). Note the enlarged tympanic segment of the facial nerve canal (*open arrow*).

A digital subtraction angiogram (selective right internal carotid injection) showed duplication of the right cervical internal carotid artery from the level of the bifurcation to the petrous segment (Fig 3A and B). The duplication consisted of "normal" and "aberrant" vessels uniting at the horizontal segment. The presence of a stapedial artery was further identified, originating from the distal aberrant segment, from which the right middle meningeal artery arose.

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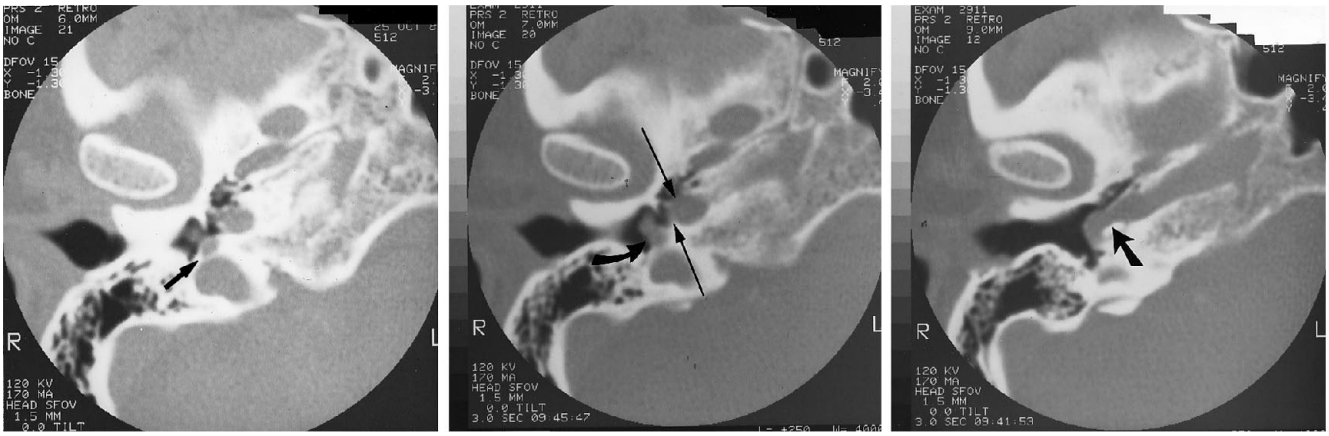

Fig 2. *A,* Axial CT scan shows a large inferior tympanic canaliculus interposed between the carotid and jugular foramina (*arrow*).
B, Axial CT scan just superior to *A* shows dehiscence of the anterolateral wall of the aberrant carotid canal (*curved arrow*). Note the adjacent soft-tissue mass within the hypotympanum. *Straight arrows* show the normal carotid canal.
C, Axial CT scan just superior to *B* shows contiguity of the mass with the horizontal segment of the internal carotid artery (*arrow*).

Discussion

This case illustrates fenestration of the right internal carotid artery, associated with persistence of the stapedial artery. Embryologically, the normal cervical carotid artery develops from paired aortic arches (1–9). The first and second arches lead to development of the primitive mandibular and hyoid arteries, respectively, the latter of which gives rise to the stapedial artery. The stapedial artery bifurcates into an upper division, the future middle meningeal artery, and a lower division, the maxillomandibular artery, the precursor of the inferior alveolar and infraorbital arteries.

The stapedial artery usually regresses after linkage of the external carotid artery to the lower stapedial artery division. If the stapedial artery persists, it usually courses between the stapedial crura, extending through the tympanic portion of the facial canal and distally supplying the middle meningeal artery. The connection of a normal middle meningeal artery to the external carotid artery is a prerequisite for formation of a foramen spinosum. When the middle meningeal artery is supplied from a persistent stapedial artery, the inferior alveolar and infraorbital arteries maintain their connection with the external carotid system.

Normal involution of the stapedial artery leads to the formation of the caroticotympanic artery, a small branch of the petrous portion of the carotid artery (6). However, when the cervical segment of the internal carotid artery is underdeveloped, perhaps because of low flow, the caroticotympanic artery may enlarge and anastomose with the inferior tympanic artery.

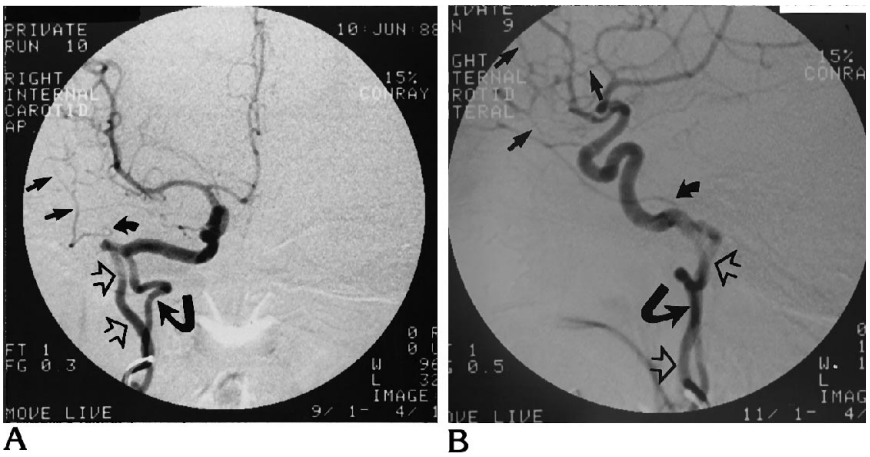

Fig 3. Anteroposterior (*A*) and lateral (*B*) selective internal carotid digital subtraction angiograms (aberrant internal carotid artery injection) show the normal internal carotid artery (*large curved arrows*), aberrant internal carotid artery (*open arrows*), stapedial artery (*small curved arrows*), and middle meningeal artery (*solid straight arrows*).

This artery is the terminal branch of the ascending pharyngeal artery from the external carotid circulation. This creates an aberrant course of the internal carotid artery. The aberrant carotid artery thus enters the tympanic cavity through an enlarged inferior tympanic canaliculus.

This case illustrates simultaneous development of both aberrant and normal internal carotid arteries of equal but reduced caliber creating an arterial fenestration. The normal carotid artery was seen on CT within the carotid canal extending to the level of the horizontal segment in a normal position. The aberrant carotid artery traversed the hypotympanum entering the skull base through a separate foramen, the enlarged inferior tympanic canaliculus. This foramen is situated between the carotid and jugular canals. These arteries then joined through a dehiscence in the wall of the carotid canal. A normal carotid siphon was seen distally. In this case, the stapedial artery persisted as a branch of the aberrant vessel, coursing through the enlarged facial canal and distally supplying the middle meningeal artery.

This case serves as an important embryologic link in demonstrating simultaneous development of the aberrant internal carotid artery with a normal-position adult internal carotid artery. It is of interest that despite the multiple congenital anomalies described in this case, this patient was asymptomatic until her seventh decade. As the tinnitus was described as nonpulsatile by the patient, its precise cause remains elusive.

Acknowledgment

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