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Clinical Records

Arterial anomalies of the middle ear associated with stapes ankylosis

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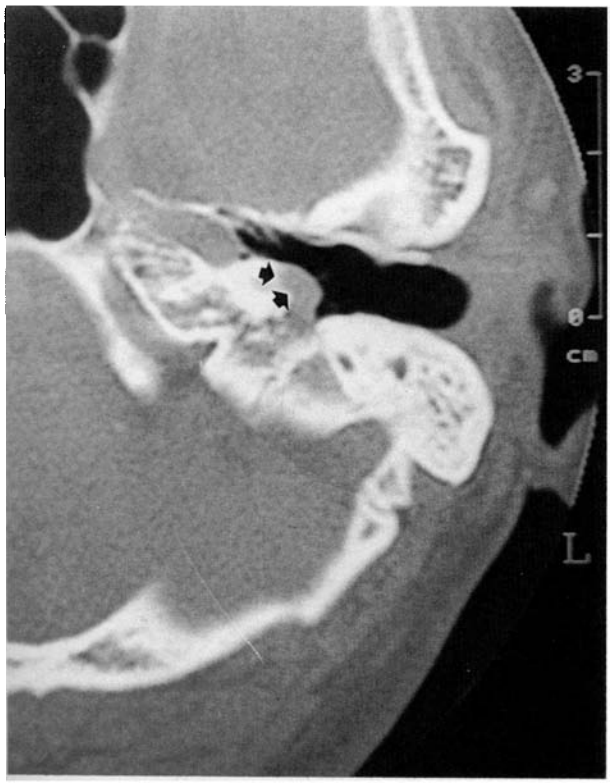
Abstract
An aberrant internal carotid artery in a young woman complaining of pulsatile tinnitus and conductive hearing loss was diagnosed pre-operatively by CT scan and angiographic findings. An exploratory tympanotomy was performed in order to evaluate the cause of the severe conductive hearing loss. It was possible to detect a large persistent stapedial artery associated with a stapedial fixation of unknown cause. Despite these vascular anomalies a stapedotomy was performed successfully.

Key words: Carotid artery, internal; Tinnitus, pulsatile; Glomus tympanicum tumour

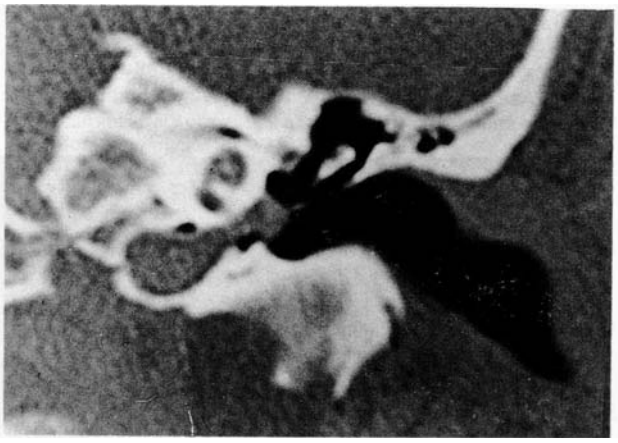
Case report

A 26-year-old woman was admitted to the ENT Department of the University of Bologna with a six-month history of progressive left-sided hearing loss, pulsatile tinnitus and pain in the left ear. The patient had previously undergone a tympanoplasty in the opposite ear in 1980.

On physical examination the left tympanic membrane was intact but thickened; no middle ear mass was noted. Impedance



(a)



(b)

FIG. 1
CT tomograms of the left ear showing an intratympanic enhanced mass in continuity with the horizontal portion of the ICA (arrowed): (a) axial CT; (b) coronal CT.

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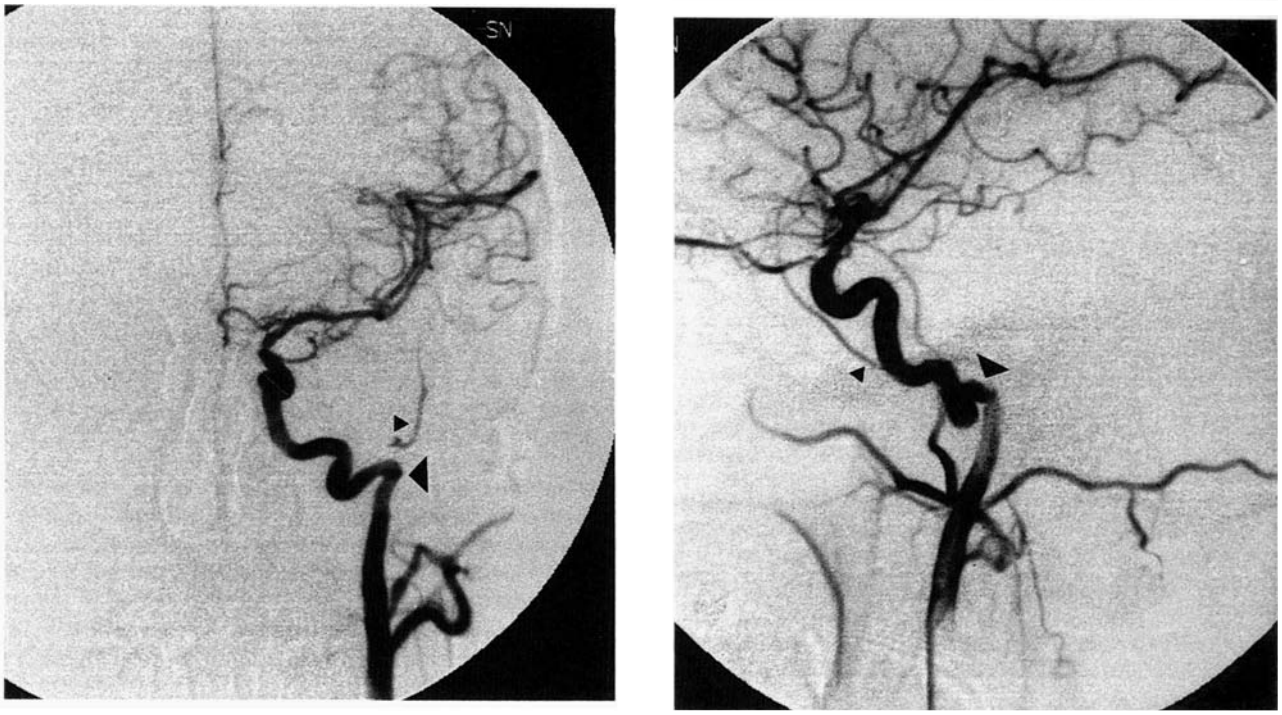


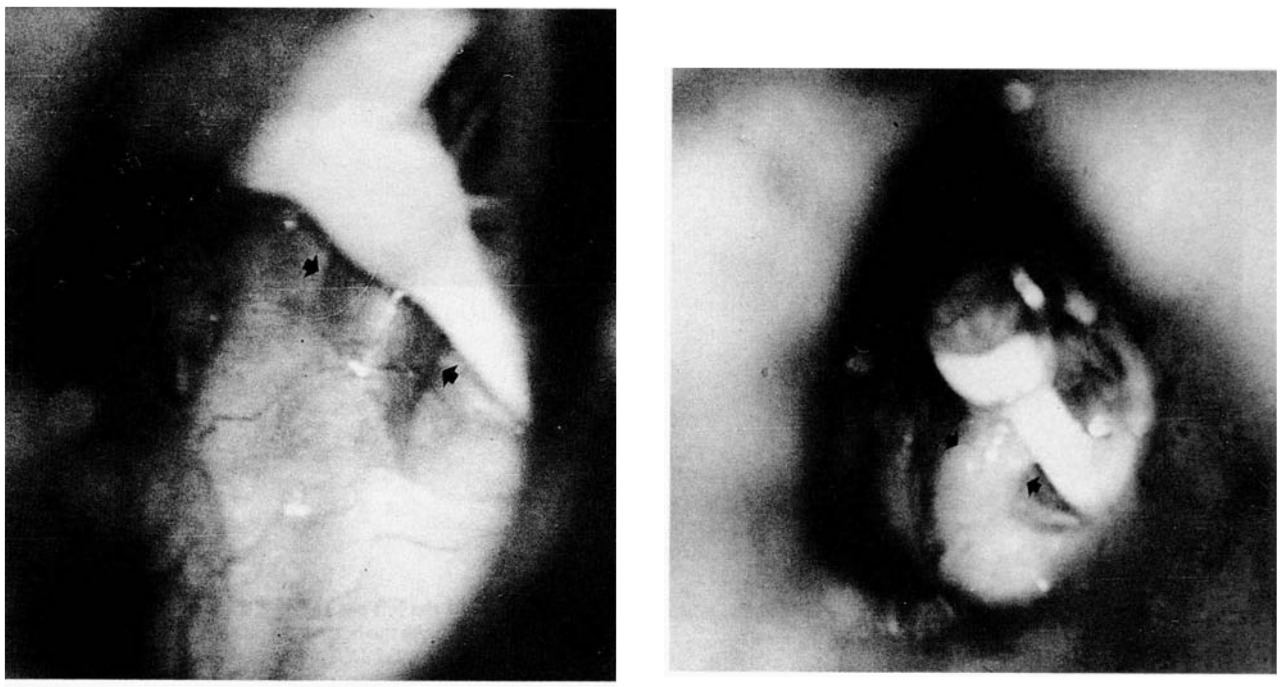
(a) (b)

FIG. 2

Subtraction angiograms of the left ICA: (a) frontal view; (b) lateral view. Aberrant course of the ICA with a narrowed segment bulging within the tympanic cavity (large arrow); note the persistent stapedial artery (small arrow).

testing revealed pulsations synchronous with the heart beat, while the stapedial reflex was undetectable. Audiometric evaluation documented a mostly conductive severe hearing loss on the left side. The diagnosis, on the basis of the tympanographic findings, was a suspected tympanic glomus tumour. CT scan showed an enhancing intratympanic mass in contiguity with the internal carotid artery (ICA) through a dehiscent lateral carotid plate; erosion of the ossicles was not seen (Figure 1).

Subsequent angiography revealed that the middle ear mass was due to an aberrant ICA coursing through the hypotympanum; on subtraction angiograms enlarged anastomoses between the inferior tympanic branch of the ascending pharyngeal artery



(a) (b)

FIG. 3

(a) Intraoperative aspect of the large stapedial artery coursing on the promontory (arrow); (b) stapedial prosthesis *in situ*: the small fenestra has been made in the very posterior part of the footplate in order to avoid any contact with the vessel.

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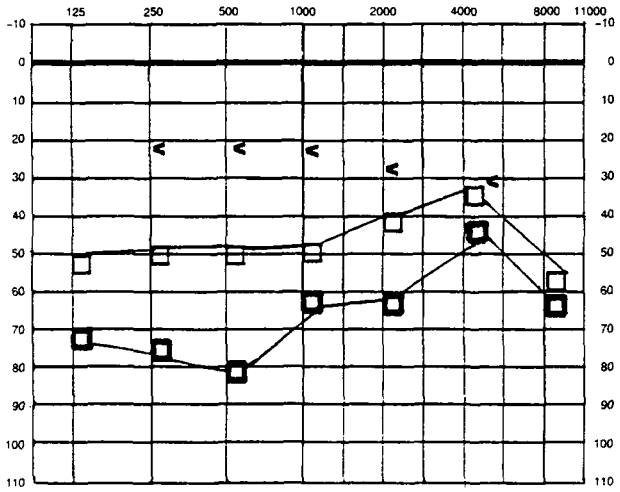

FIG. 4
Pre- and post-operative audiograms. ◘, pre-operative audiogram; □, post-operative audiogram.

and the carotico-tympanic branch of the petrous ICA were demonstrated (Figure 2). An exploratory tympanotomy was therefore performed in order to evaluate the anatomical conditions and possibly remove the cause of the hearing loss. A persistent large stapedial artery originating from the aberrant ICA was found (Figure 3a); in addition, the stapes was fixed and the footplate thickened.

A stapedotomy was performed: previous posterior crurotomy was necessary to avoid any contact with the stapedial artery. Subsequently a Shea cup-piston prosthesis was articulated with the incus (Figure 3b).

Post-operative audiometry showed a hearing improvement with incomplete closure of the air–bone gap (Figure 4): this is probably due to the impaired mobility of the incus checked during the operation.

Discussion

Arterial abnormalities of the middle ear are rarely seen and the majority of reported patients were initially misdiagnosed as having a glomus tumour (Baines *et al.*, 1974; Glasscock *et al.*, 1980; Sinnreich *et al.*, 1984). The principal arterial variants are: persistence of the stapedial artery, 'aberrant course of the internal carotid artery', 'aberrant course of internal carotid artery' with persistence of the stapedial artery and persistence of the pharyngotympanostapedial artery (Lasjaunias *et al.*, 1977). Other reported abnormalities of the ICA bulging into the middle ear include aneurysms (usually congenital) or a laterally displaced ICA (Glasscock *et al.*, 1980).

In the reported case, angiographic and operative findings revealed the presence of an aberrant course of the internal carotid artery with a persistence of the stapedial artery: this association has been reported in few cases (Sinnreich *et al.*, 1984). A possible explanation for a laterally displaced ICA could be attributed to the absence of the bony covering within the tympanic cavity (Sinnreich *et al.*, 1984); another theory involves the abnormal persistence of embryonic vessels that produce sufficient traction to pull the developing ICA into an abnormal position (Steffen, 1968; Sinnreich *et al.*, 1984). A different mechanism has been proposed by Lasjaunias and Bernstein (1987). They postulated an error in the embryonic programme causing the disappearance of the cervical portion of the ICA, which is replaced by the ascending pharyngeal artery by means of the intratympanic anastomoses. No explanation has been reported for the predominance (over 92 per cent) of these congenital defects in female patients (Ruggles and Reed, 1972; Glasscock *et al.*, 1980; Sinnreich *et al.*, 1984; Williskey *et al.*, 1990; Fukuda *et al.*, 1991).

As for the stapedial ankylosis, it could be of otosclerotic origin because of the morphological characteristics of the footplate and the alleged recent onset of the hearing loss which might exclude a congenital abnormality. However histological confirmation was not possible because it was not practical to remove the stapes without a potential hazard to the large stapedial artery, and therefore the cause of the fixation remains unknown. Although persistent stapedial arteries are occasionally noted during stapes surgery (Glasscock *et al.*, 1980; Pahor and Hussain, 1992), a case of stapedial fixation associated with an aberrant internal carotid artery must be considered an exceptional finding. It is well known that in the presence of undetected intratympanic aberrant vessels a tympanotomy may produce profuse bleeding from the ICA with consequent complications (Goldman *et al.*, 1971; Goodman and Cohen, 1981; Fukuda *et al.*, 1991).

Our patient was scheduled for a tympanotomy on the basis of an appropriate radiological pre-operative investigation. CT scans, showing an intratympanic soft tissue mass in continuity with the horizontal portion of the ICA, suggested the possibility of an arterial anomaly; angiography, necessary to rule out a tympanic glomus tumour, was able to identify this unusual arterial malformation. Because of the complete radiological information tympanotomy could be performed under safe conditions, even in the presence of aberrant intratympanic vessels; in this reported case, the intraoperative findings suggested the possibility of a surgical approach to the stapes with low risk to the patient.

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