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CT of Petrous Carotid Aneurysms

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Aneurysms arising from the petrous part of the internal carotid artery (ICA) are exceedingly uncommon. Only 21 angiographically proven cases have appeared in the literature [1-6]. The CT appearance of these rare lesions has not previously been reported. In the two cases described here, the CT pattern closely resembles that of the more common petrous apex meningioma. Consideration of a petrous carotid aneurysm, when confronted with a lesion in the subtemporal region on CT scan, may have important therapeutic implications. The presence of such an aneurysm may be easily confirmed by angiographic study, averting the possibility of an ill-advised surgical procedure. Cerebral angiography is crucial to a definitive diagnosis. The precise location of the petrous aneurysms in these instances, as well as coexistence of other aneurysms at more common sites, supports the hypothesis that many intrapetrous aneurysms are congenital and develop at the site of origin of an embryologic artery.

Case Reports

Case 1

A 61-year-old, previously asymptomatic retired nurse presented to a referring hospital shortly after the abrupt onset of a severe occipital headache. Lumbar puncture retrieved bloody subarachnoid cerebrospinal fluid. Subarachnoid hemorrhage was seen on the initial (non-contrast) CT scan, particularly prominent in the left lateral pontine cistern. On transfer to the University of California at San Francisco 3 days later, the patient was slightly lethargic and had a mild right-sided facial weakness of central origin. Otoscopic examination was normal. Otherwise, there was no focal neurologic deficit. A repeat CT scan showed multiple round contrast-enhancing foci in the basal cisterns. In addition, a 1.5-cm-diam, homogeneously dense contrast-enhancing extraaxial lesion arose from the anterior petrous apex beneath the medial right temporal lobe and projected superiorly (fig. 1A). Before angiography, the first-mentioned lesions were thought to be aneurysms and the latter, a meningioma.

Cerebral angiography disclosed the presence of aneurysms located within the subarachnoid space, arising from the junction of the posterior communicating artery and left posterior cerebral artery (P₁ segment), the anterior communicating artery, and the left middle cerebral artery at its bifurcation. A fourth aneurysm, located extracranially, arose from the lateral aspect of the right intrapetrous ICA at

its posterior genu (fig. 1B). This corresponded with the anterior petrous lesion seen on CT scan. Several days later, a left temporal craniotomy was performed. The left P₁ aneurysm was identified as the source of the subarachnoid hemorrhage and was successfully clipped.

Case 2

A 63-year-old man presented with diplopia. Neurologic examination revealed a left sixth nerve palsy. Cranial CT was performed after intravenous infusion of contrast material and demonstrated two abnormal contrast-enhancing structures adjacent to the skull base (fig. 2A). The larger lesion was located in the pontine cistern and had a fusiform configuration. It was shown angiographically to represent a basilar trunk aneurysm, arising near the origin of the left anterior inferior cerebellar artery. At the same level on CT, a smaller, rounded lesion was situated at the anterior margin of the left petrous apex, abutting the lateral aspect of the trigeminal ganglion (fig. 2A). Cerebral angiography also confirmed the presence of an aneurysm at this location, arising from the petrous ICA just distal to its posterior genu (fig. 2B).

Discussion

Discovery of the petrous ICA aneurysms in these two patients was serendipitous. More commonly, patients with such lesions present with ipsilateral eighth cranial nerve dysfunction (hearing loss, pulsatile tinnitus, hyperacusis) or spontaneous hemorrhage from the ear or nose [6]. The proximity of such an aneurysm to the mesotympanum and to the eustachian tube accounts for the eighth nerve dysfunction and for the external hemorrhage, respectively. Less common neurologic deficits in such cases include ipsilateral trigeminal dysesthesia [1, 7], sixth cranial nerve paralysis [8], and the jugular foramen syndrome [1].

The aneurysms illustrated in figures 1 and 2 are intracranial by virtue of erosion through the anterior petrous apex, but could not account for subarachnoid hemorrhage as they remain external to the dura. The CT appearance of these epidural masses bears striking resemblance to that of a petrous apex meningioma reported by Goin [9]. Given the location of these lesions, meningioma seemed a reasonable tentative diagnosis before angiography. Meningiomas in this

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Fig. 1.—Case 1. **A**, Transaxial CT scan at level of petrous apices in patient with recent subarachnoid hemorrhage. Enhancing subtemporal extraaxial mass visible on right. Bone windows showed erosion of anterior petrous apex. **B**, Oblique digital subtraction image after injection of contrast material into right internal carotid artery. CT abnormality in **A** is shown to represent aneurysm arising posterolaterally from petrous segment.

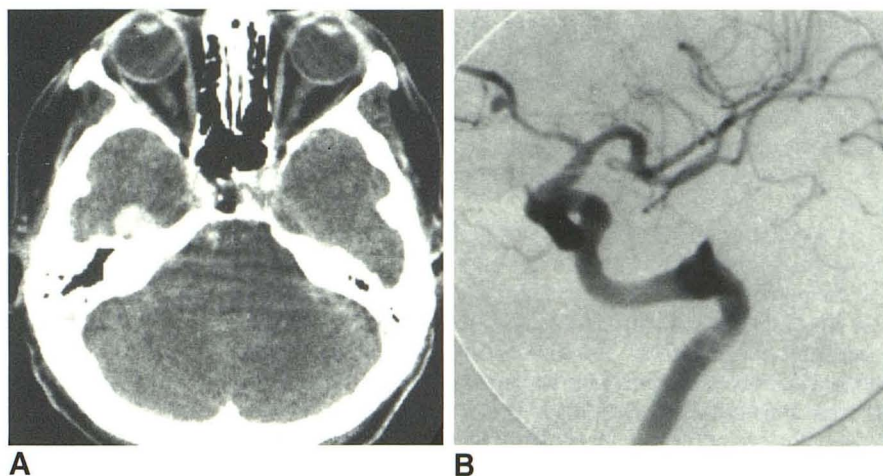
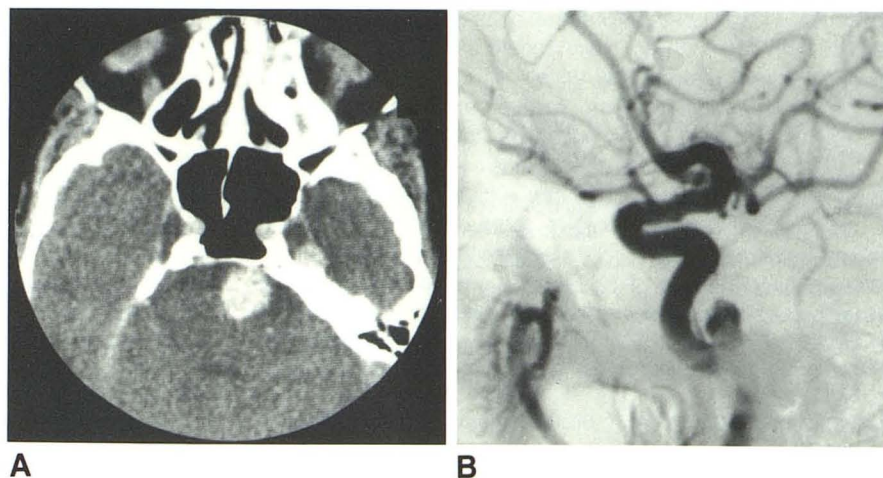


Fig. 2.—Case 2. **A**, contrast-enhanced CT scan of patient with left sixth cranial nerve palsy. Two rounded lesions (each representing aneurysm) are visible. **B**, Lateral cerebral angiogram (left common carotid artery injection) shows petrous aneurysm. Vertebral injection (not illustrated) showed basilar aneurysm, accounting for other lesion on CT.



location are fairly common; they account for 1.6% of all brain tumors [10]. They are thought to arise from arachnoid granulations located near the geniculate ganglion (and greater superficial petrosal nerve), above the eustachian tube, and accompanying cranial nerves in the jugular foramen or internal auditory canal. A noncontrast CT scan usually shows uniform hyperdensity. After intravenous administration of contrast material, enhancement is homogeneous and often intense [11]. Erosion of adjacent bone, similar to that present in case 1, is not unusual with meningiomas. In fact, attenuation characteristics, enhancement patterns, and relations to nearby bony structures may not permit differentiation of petrous aneurysm from other lesions on the basis of CT findings alone. Other entities that might enter into a CT differential include neurinoma, sarcoma, and invasive cholesteatoma [12, 13]. Clearly, these possibilities are excluded by the angiographic study.

Clinically, petrous ICA aneurysms are often mistaken for other, more common vascular lesions. Glomus tumors (jugulare and tympanicum), anomalous high jugular bulbs, aberrantly coursing ICAs, and arteriovenous malformations may

cause both eighth cranial nerve dysfunction and otorrhinal hemorrhage [14]. They usually present as middle-ear masses and can be detected with high-resolution CT and accurately diagnosed via selective internal/external carotid artery angiography. In the absence of angiographic exclusion of these entities, biopsy of a lesion in this region is extremely hazardous and has resulted in exsanguinating hemorrhage [1, 2].

A congenital origin for petrous ICA aneurysms is supported by several embryologic observations. Branches of the petrous segment of the ICA include the commonly found caroticotympanic artery and the rarely present pterygoid (Vidian) artery [15]. The caroticotympanic artery, too small to be routinely identified angiographically (even with magnification/subtraction technique), arises from the petrous ICA laterally at its posterior genu. It ultimately anastomoses with branches of the external carotid artery [16]. Developmentally, it is derived from a remnant of the hyoid artery. This relation may have etiologic significance, as one theory advanced for the origin of intracranial aneurysms postulates that their development in areas of congenital weakness corresponds to remnants of otherwise obliterated embryologic arteries [17]. In the cases

illustrated, as well as most of those in the literature, the petrous carotid aneurysms originate near the presumed origin of the caroticotympanic artery [4]. In at least two cases, pathologic examination of petrous ICA aneurysms has shown the medial aplasia and internal elastic lamina degeneration that is typical of congenital intracranial berry aneurysm walls [8, 18].

The location, configuration, and multiplicity of intracranial aneurysms in these patients is most consistent with a common congenital origin. Trauma, inflammation, and atherosclerosis are other causal possibilities. The first may be important in patients with a history of skull-base fracture or surgery. Mastoiditis, cholesteatoma, pharyngitis, and tonsillar abscess are local inflammatory conditions that may predispose to aneurysm development. Significant atherosclerosis of the petrous ICA is distinctly uncommon, as elucidated in a detailed study by Samuel [19], and would seem unlikely to play a significant role in aneurysm formation at this location.

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