External carotid blood supply to acoustic neurinomas

Report of two cases

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Two typical verified cases of acoustic neurinoma showed radiological evidence of tumor vasculature supplied from the external carotid artery. In one case there was no demonstrable supply from the vertebrobasilar system while in the other the tumor blood supply from this source was poor and incomplete. In each case the vascular blush shown in external carotid angiography conformed exactly to the size of the tumor found and removed at surgery.

Key Words · acoustic neurinoma · labyrinthine artery · external carotid artery · tumor vascularity

Evaluation of posterior fossa masses in recent years has stressed the vertebral angiographic examination. In diagnosing extra-axial lesions in the cerebellopontine angle, one angiographic differentiation between meningioma and acoustic neurinoma has been that meningiomas receive their blood supply from the external carotid system, while acoustic neurinomas, which have radiologically demonstrable vascularity (20% to 50%), derive their blood supply from the vertebrobasilar system. The origin of the tumor stain in neurinomas has been difficult to delineate exactly but comes off the middle or lower portion of the basilar artery in the region of the internal auditory or anterior inferior cerebellar arteries. As far as we are aware, there has not been a description of external carotid blood supply to acoustic neurinomas. Recently we have seen two such cases and these provide the substance of this report.

Case Reports

Case 1

This 38-year-old man entered University Hospital with progressive hearing loss in the right ear of 1 year’s duration. For 3 weeks before admission he had experienced dizziness, numbness of the right side of his face, and difficulty in walking. There was decreased sensation over the right side of the forehead and face and marked nerve deafness on the same side; right facial nerve function was intact.

Radiological Examination. The plain skull roentgenograms and petrous bone tomograms demonstrated marked enlargement of the right internal auditory canal.
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with pressure erosion of its posterior wall. The dorsum sellae was normal. Selective left vertebral angiography performed via the retrograde femoral route revealed marked elevation of the right anterior inferior cerebellar artery (Fig. 1) and elevation of the right petrosal vein. No abnormal (tumor) vessels were seen, and no other significant vascular displacement was apparent except for slight medial displacement of the ambient portion of the right superior cerebellar artery compatible with upward extension of the tumor mass. On right carotid angiography, the internal carotid injection was normal except for evidence of slight enlargement of the lateral ventricle. The lateral view of selective right external carotid angiography (Fig. 2) showed tumor blush and a rather large vessel, probably arising from the middle meningeal artery and extending posteriorly toward the cerebellopontine angle. Frontal plane angiograms in the early phase (Fig. 3 left) demonstrated multiple fine vessels outlining a mass in the region of the cerebellopontine angle; a later film in the series (Fig. 3 right) showed a homogeneous "tumor cloud." The radiologically visible blood supply of the tumor was derived solely from the external carotid system.

Operation. A posterior fossa craniotomy was performed, and an acoustic neurinoma measuring 2 x 2 x 3 cm was totally removed.

Case 2

This 58-year-old man entered University Hospital with hearing loss in the right ear of several years' duration; he had also been seen for "optic neuritis" because of rapidly failing vision. There was a visual deficit, probably due to an ischemic neuropathy of the optic nerve. There was a decreased corneal reflex on the right, right-sided facial paresis, and a severe right neural hearing loss.

Radiological Examination. Plain skull films and polytomography showed a demineralized dorsum sellae compatible with increased intracranial pressure and marked widening of the fundal portion of the canal with almost complete absence of the posterior wall and the petrous apex. A selective left vertebral angiogram performed via the retrograde femoral route showed elevation of the right anterior inferior cerebellar artery (Fig. 4) in association with a slight blush in the right cerebellopontine angle outlining the medial portion of a mass;
FIG. 3. Case 1. Anteroposterior selective right external carotid angiogram. Left: Early phase showing several large vessels involving a mass in the region of the petrous apex (arrows). Right: Later phase demonstrating a homogeneous vascular blush extending superiorly from the cerebellopontine angle and delineating the tumor (arrows).

the tumor stain appeared to be derived from the labyrinthine (internal auditory) artery. The lateral projection (Fig. 5 left) showed, as in Case 1, several branches extending over the petrous apex. The origin of these vessels, while not determined, was believed to be from the middle meningeal artery or meningeal branches of the ascending pharyngeal artery. The frontal projection (Fig. 5 right) in the late arterial phase demonstrated a huge homogeneous vascular blush.

Operation. Posterior craniotomy revealed a large tumor extending upward through the tentorial notch and conforming to the size and configuration of the vascular blush seen on the carotid angiogram. The tumor was removed; its histological characteristics were those of an acoustic neurinoma. In this case, the blood supply to the acoustic neurinoma was derived in small part (medial aspect) from the vertebrobasilar circulation and to a greater degree (superior and lateral aspect) from the carotid circulation.

Discussion
In evaluating patients with tumors in the cerebellopontine angle and particularly those patients suspected of having an acoustic neurinoma, it has been customary to obtain plain roentgenograms of the calvarium with emphasis on the petrous apex and the internal auditory canal. In most instances tomography of the petrous temporal bone is performed for evaluation, not only for the porus but also for the fundal portion of the internal auditory canal. Tomography, of course, is done on patients with the appropriate clinical otologic findings. In the earlier days of neurosurgery and
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neuroradiology, many physicians would operate on patients with only the plain skull roentgenographic and/or tomographic findings. However, because of the advanced technical state of angiography as well as cisternography, most patients now receive a complete neuroradiological work-up before surgical exploration. When there is only vestibular and auditory nerve involvement, the procedure of choice at most institutions is positive contrast cisternography. On the other hand, in patients who have clinical or radiological evidence of extension into the cerebellopontine angle or indeed of primary localization in the angle, angiographic studies are usually performed.

It has generally been accepted that the blood supply to acoustic neurinomas is from the anterior inferior cerebellar artery or the internal auditory (labyrinthine) artery. In an excellent recent article Smaltino, et al., reviewed the literature and described their anatomical and radiological studies concerning the anatomy of the internal auditory artery. They indicated three different patterns. In one (87% of their cases) a single arterial trunk arises from the midportion of the basilar artery and divides shortly into two major branches. The upper branch, named the cerebello-labyrinthine artery, runs up to or even enters the internal auditory meatus close to or within which it gives off one or two labyrinthine (internal auditory) branches. The vessel then reverses its course and extends posteriorly to supply the cerebellum. The inferior branch of the common trunk from the basilar is the true anterior inferior cerebellar artery.

In their second type (10%) the cerebello-labyrinthine artery arises directly from the basilar slightly above the anterior inferior cerebellar artery. The courses of the vessels are otherwise similar to those in the first category.

In the last group (3%) it is the labyrinthine artery which arises directly from the basilar and, coursing into the internal auditory meatus, supplies only the inner ear. The distribution of the anterior inferior cerebellar artery in this arrangement is limited to the cerebellum.

Although it is still somewhat difficult to be certain of the exact blood supply to acoustic neurinomas, it seems most likely that the labyrinthine (internal auditory) artery or perhaps the cerebello-labyrinthine artery is the source. Certainly this has been so in our experience.

In our two cases reported here, not only was there an external carotid blood supply, but in Case 1 there was no apparent supply from the vertebrobasilar circulation. In Case 2 there was a dual blood supply, the major portion coming from the external carotid system. We believe that small branches of the middle meningeal artery or possibly meningeal branches of the ascending pharyngeal artery are the most likely sources of supply when the external carotid system contributes to the tumor circulation. The blush from the external carotid circulation occurred in the midarterial phase, was rather homogeneous, and persisted well into the venous phase of the angiogram. These
features, in conjunction with the external carotid arterial supply, would have suggested a meningioma, but the clinical and tomographic findings were typical of acoustic neurinoma. The arterial blush provided an excellent demonstration of the size and precise location of the tumors. It is suggested, therefore, that in the evaluation of acoustic neurinomas, it may be useful to study the external carotid circulation, particularly when evidence of tumor circulation is not obvious in vertebral angiographic studies.

Summary

Two cerebellopontine angle tumors are reported in which clinical, plain film, and tomographic findings indicated an acoustic neurinoma. Vertebrobasilar angiography demonstrated typical findings of an avascular cerebellopontine angle mass in one case and a poorly vascularized angle mass in the other. These were found to have tumor stains which were derived from the external carotid circulation. Surgical proof that these were indeed acoustic neurinomas was obtained. While it is true that acoustic neurinomas may derive a tumor blush from the labyrinthine artery, it is useful to perform external carotid angiography in patients who do not demonstrate tumor circulation from the vertebrobasilar system.

References


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