The Angiography of the Cerebellopontine Angle

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椎骨動脈造影法による小脳橋角部腫瘍の診断

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従来，椎骨動脈造影法は小脳橋角部の腫瘍には，診断価値がないと考えられていたが，前下小脳動脈及び錐体静脈を像出することにより，症例によつては非常に有用であることが判つた．カテーテルによる椎骨動脈造影法の手技についても詳述する．

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Angiographic diagnosis of cerebellopontine angle tumors has depended upon presence of tumor vessels ([3], [6], [9], [13]), superior displacement of the superior cerebellar artery and posterior cerebral artery ([4], [9], [13]) as well as displacement of the basilar artery ([9], [13]). In a review of 250 catheter vertebral angiograms, it has become apparent that the anterior inferior cerebellar artery and the petrosal veins are constantly visualized on vertebral angiograms of good quality and have an important diagnostic significance in the evaluation of cerebellopontine angle tumors.

Materials and Methods

This study was based upon 250 selective vertebral angiograms, from which the subject materials were arbitrarily selected and divided into three groups. Group I consisted of 100 normal vertebral angiograms with good opacification of both posterior inferior cerebellar arteries in which there were no clinical or roentgenologic signs of an expanding lesion in the posterior fossa. Group II comprised 24 vertebral angiograms with surgically proven expanding lesions in the posterior fossa. Fourteen cerebellopontine angle tumors formed Group III which constitutes the primary subject of this report. There were 4 meningiomas, 2 neurinomas, 2 chordomas and one each of glomus jugulare tumor, pontine tumor with lobulated extension into the cerebellopontine angle, cholesteatoma, epidermoid carcinoma, astrocytoma and chromophobe adenoma with cerebellopontine angle extension.

Technique of Catheter Vertebral Angiography

The patients over 55 years of age are usually examined via the axillary artery and younger patients are examined via the femoral artery. The artery is punctured using an 18 gauge thin walled needle. Using the Seldinger technique a radiopaque polyethylene endhole catheter with a preformed curve tip is introduced into the artery and advanced into the subclavian artery near the orifice of the vertebral artery under fluoroscopic control. With the tip of the catheter at the orifice of the vertebral artery, the caliber

of the vertebral artery is ascertained by a test injection of 2 to 3 ml. of the contrast media. If there is stenosis or if the vessel is hypoplastic the catheter should not be advanced into the vertebral artery. As soon as the catheter enters the vertebral artery, another test injection of 2 to 3 ml. of contrast media is made and the rate of flow observed fluoroscopically. If the flow is slowed, the catheter is withdrawn from the vertebral artery and the contralateral artery is catheterized. The curved catheter is not advanced into the vertebral artery without a leading wire guide. If the artery is considered satisfactory for catheterization, the catheter tip is advanced to the level of the fourth or fifth cervical vertebra.

The contrast medium used is 60% meglumine iothalamate in an amount of 5 to 6 ml. per injection. Usually three injections are made by hand as rapidly as possible with serial films in straight anteroposterior, half-axial and lateral projections. Filming sequence is 2 per second for 2 seconds and 4 films equally spaced over a period of 6 seconds. With a forceful hand injection, reflux usually occurs down the opposite vertebral artery. The study is not considered satisfactory unless the contralateral vertebral artery together with the posterior inferior cerebellar artery is visualized.

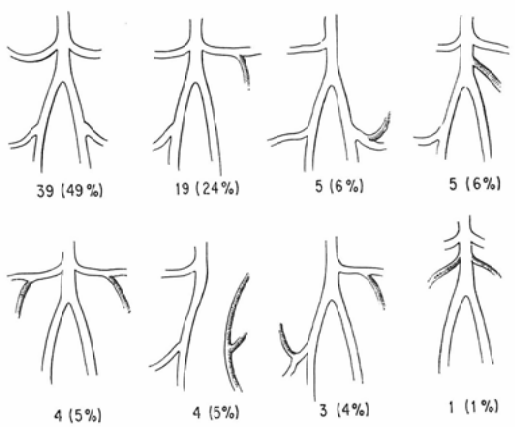
The anterior inferior cerebellar artery can usually be visualized on the straight anterior posterior views with the use of subtraction technique ([5]). The petrosal veins are evaluated on the half-axial views.

The Anterior Inferior Cerebellar Artery

(1) Anatomy

The anterior inferior cerebellar artery traverses the cerebellopontine angle cistern in close association with the seventh and eighth cranial nerves and supplies the medulla, inferior pons and anterior portion of the cerebellum ([1, 2]). Many variations of the anterior inferior cerebellar artery have been observed in association with the anomalies of the posterior inferior cerebellar artery ([2, 8]). Variations of the two arteries are the rule rather than the exception. The anterior inferior cerebellar artery may supply areas which would normally receive blood supply from the posterior inferior cerebellar artery when the latter vessel is hypoplastic or absent. Conversely branches of the posterior inferior cerebellar artery may contribute to the blood supply in areas normally supplied by the anterior inferior cerebellar artery. Figure 1 shows a schematic diagram of variations of the anterior inferior cerebellar artery and posterior inferior cerebellar artery in 80 normal vertebral angiograms. The statistics were obtained disregarding the side.

Fig 1.



(2) Angiographic Findings

There was displacement of the anterior inferior cerebellar artery in 9 of 14 cerebellopontine angle and clivus tumors (Group III). There was upward displacement in 6 cases and downward displacement in 2 cases. One case with an acoustic neurinoma showed stretching and elongation of the artery without definite depression or elevation. In three patients the anterior inferior cerebellar artery was the only artery which showed displacement while this artery showed the most significant arterial changes in four patients. In the remaining two patients there was other marked arterial displacement which suggested tumors in this location.

Control study with 24 posterior fossa expanding lesions (Group II) and 100 consecutive normal angiograms (Group I) revealed no case in which there was elevation of the anterior inferior cerebellar artery. In three patients with expanding lesions in the posterior fossa there was questionable depression of this artery.

(3) Illustrative Cases

Figure 2 shows subtraction print of vertebral angiogram in a patient with a right eighth nerve neurinoma. The right anterior inferior cerebellar artery is markedly elevated (3 arrows). There is minimal tumor staining (arrow head) which appears to be supplied by this artery. There is also minimal elevation of the right superior cerebellar artery.

Fig 2.

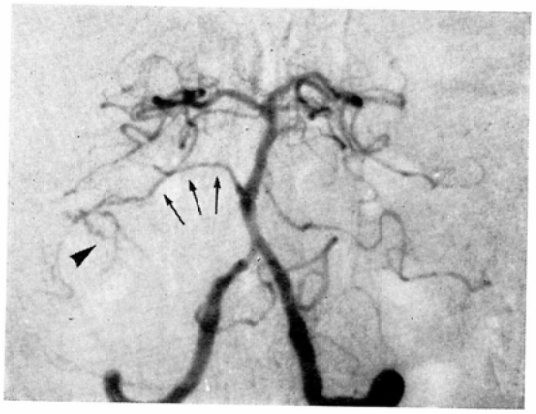


Fig 3.

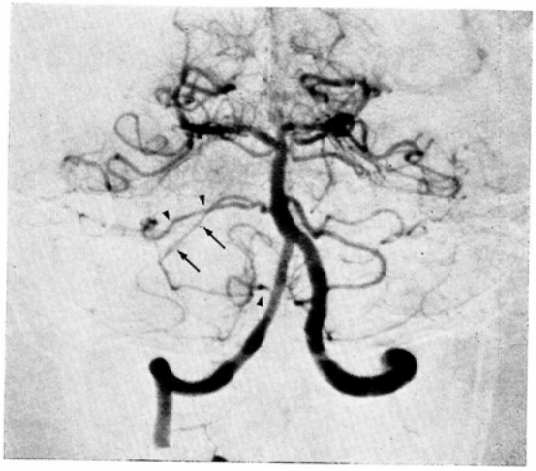


Figure 3 shows a large chordoma which displaces the anterior inferior cerebellar artery upward. There is duplication or early bifurcation of the anterior inferior cerebellar artery on the right (2 arrow heads and 2 arrows). The posterior inferior cerebellar artery is hypoplastic (arrow head). Note the dominant anterior inferior cerebellar artery on the left which supplies the areas normally vascularized by the posterior inferior cerebellar artery. The basilar artery was displaced posteriorly on the lateral projection.

The Petrosal vein

(1) Anatomy

The great anterior cerebellar vein or petrosal vein lies in the cerebellopontine angle, below the course

of the fifth nerve and drains into the superior petrosal sinus just above the internal auditory meatus. It drains a major part of the anterior portions of the cerebellar hemispheres as well as the anterolateral aspect of the pons and medulla. There are usually 4 or 5 major tributaries of this vein ([10], [11], [12]) which anastomose richly with the posterior cerebellar veins, the venous plexus of the pons and the anterior pontocerebellar vein. Incidence of visualization is shown in Table 1. The largest and most constant tributary is

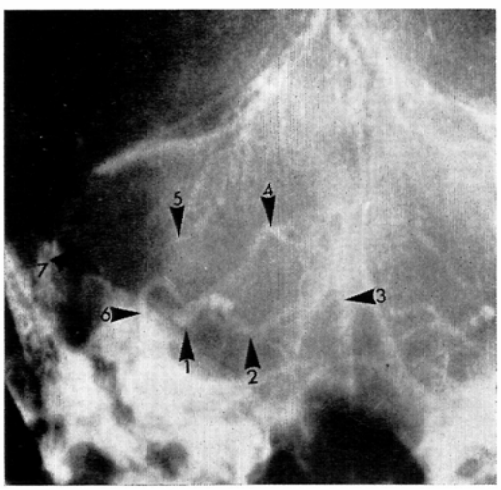
Table 1. Incidence of visualization of 5 Major Tributaries of the Petrosal vein in 72 Cases

	Good-Excellent	Poor-None
Anastomotic tributary	60	12
Pontine tributary	48	24
Inferior tributary	27	45
Superior tributary	11	61
Lateral tributary	10	62

the anastomotic channel between the petrosal vein and the basilar vein of Rosenthal which runs in the lateral mesencephalic sulcus of the pons within the ambient cistern ([9], [15]). The second largest tributary is the draining vein from the pontomedullary venous plexus. The third tributary drains the anterior inferior cerebellar hemisphere and on half-axial roentgenograms it has a sharp bend as it courses around the flocculus. There are additional small tributaries which drain the superior and lateral cerebellar hemispheres.

As the portions of cerebellar hemisphere which are drained by the petrosal vein are largely vascularized by the posterior inferior cerebellar artery, there is usually poor or no visualization of the petrosal vein when the posterior inferior cerebellar artery is not opacified with contrast media. Some of the drainage into the petrosal vein is also from the anterior inferior cerebellar artery, the anterior branches of the superior cere-

Fig 4.



bellar artery and the pontine branches of the basilar artery, but these vessels contribute to visualization of the petrosal vein to a lesser extent.

Figure 4 demonstrates a normal venous phase of a vertebral angiogram. Numbers indicate (1) the outlet of the petrosal vein into the petrosal sinus, (2) the pontine tributary, (3) the pontine venous plexus, (4) the anastomotic tributary, (5) superior tributary, (6) the inferior tributary, and (7) a portion of the superior petrosal sinus just above the mastoid antrum.

(2) Angiographic Findings

In 12 of 14 cerebellopontine angle tumors (Group III) there was excellent reflux of contrast media into the contralateral vertebral artery or injection was made on the side of tumor, thus giving good visualization of the posterior inferior cerebellar artery on the involved side. On the side of the mass lesion there was displacement or compression of the petrosal vein in seven patients, and there was no or poor visualization of the petrosal vein in five patients.

In 19 of 24 cases with posterior fossa expanding lesions (Group II) there was good to excellent opacification of both petrosal veins. In two of these, there was straightening or flattening of the petrosal vein against the petrous bone on the side of tumor, presumably due to compression by an expanding process. Angiograms in 4 of 24 posterior fossa expanding lesions revealed bilaterally poor visualization of the petrosal vein, while there was one case which showed non-visualization of both veins. Two of them resulted from poor opacification of the posterior inferior cerebellar artery, but the other three had good opacification of these arteries.

Both petrosal veins could be visualized in 73% of all vertebral angiograms (14). When cases with good visualization of the posterior inferior cerebellar arteries were tabulated, the figure increased to 94%. There were no cases of Group I which simulated compression or displacement of the petrosal veins (14).

(3) Illustrative Cases

Figure 5 shows a subtraction print of venous phase of vertebral angiogram in a patient with a meningioma of the foramen magnum extending into the left cerebellopontine angle and down to the neck.

Fig 5.

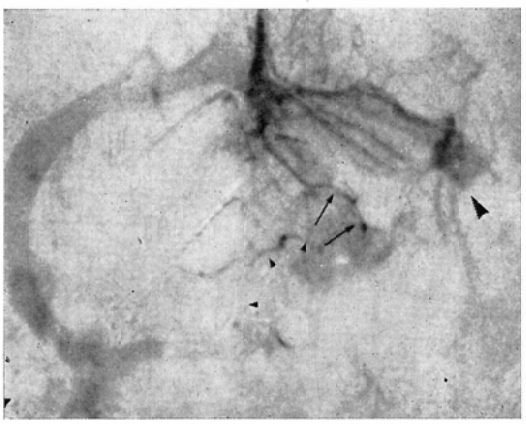
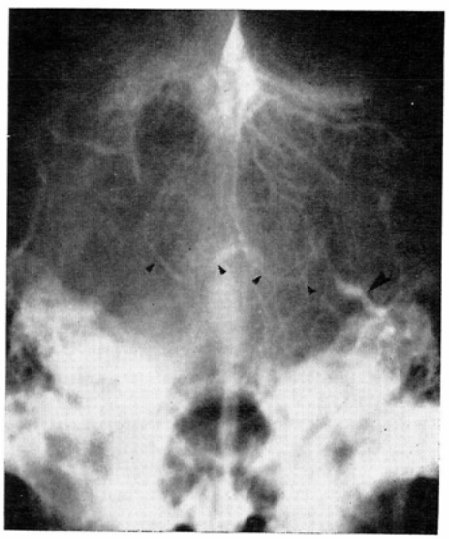


Fig 6. →



There is superior and lateral displacement of the anastomotic tributary of the petrosal vein (2 arrows). The pontine tributary is also elevated and displaced medially (3 arrow heads), indicating medial extension of the mass. There is complete obstruction to the flow of the left lateral sinus (large arrow head). Note poor visualization of the right posterior cerebellar vein secondary to nonvisualization of the right posterior inferior cerebellar artery.

Figure 6 shows a venous phase of vertebral angiogram in a patient with a neurinoma of the right eighth nerve. There is good visualization of the petrosal vein with opacification of the anastomotic, lateral and inferior tributaries (large arrow head). There is paucity of venous filling in the right posterior fossa. The petrosal vein is not identified due to a mass lesion in the right cerebellopontine angle. The normal upper brain stem is outlined by the posterior mesencephalic vein (4 arrow heads).

Conclusion

It has been concluded that elevation of the proximal portion of the anterior inferior cerebellar artery as seen on the straight anteroposterior views is a strong indication of an extra-axial mass lesion in the posterior fossa but depression of this artery is not as reliable as elevation in differential diagnosis. As for the veins, displacement and stretching of the petrosal vein and its tributaries are diagnostic of an expanding lesion in the cerebellopontine angle, whereas non-visualization in the presence of good filling of the posterior inferior cerebellar artery on the same side is an accessory sign in a mass lesion of the cerebellopontine angle. The control study with 24 expanding lesions in the cerebellum and the pons did not reveal any displacement of the petrosal vein, but non-visualization or compression of the vein against the petrous bone was present in a small number of these lesions.

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