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The Ascending Pharyngeal Artery: Normal and Pathological Radioanatomy

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Summary. A radioanatomical study of the ascending pharyngeal artery has been performed. Based on 10 injected specimens of anatomical material and 8 superselective, normal and pathological angiograms. The meningeal role of the ascending pharyngeal artery and its anastomoses with the middle meningeal and/or occipital arteries is emphasized.

Key words: Ascending pharyngeal artery, Anatomical study, Radiological study, Pathological findings.

Historical and Anatomical Review

The ascending pharyngeal artery has been known for a long time. It arises more often from the proximal portion of the external carotid artery on its posterolateral side (65% of cases) otherwise from the facial, the lingual, the occipital, or even from the internal carotid artery [7].

Its frequent origin from the external carotid artery is associated with a variable level of origin [1]. Its course is immediately vertical, ascending on the posterolateral wall of the pharynx. Classically it gives rise along its extracranial course to:

1) The pharyngeal rami which run transversely towards the midline.

2) The posterior muscular branches.

Near the base of the skull, it generally divides into:

1) A posterior meningeal ramus.

2) A middle ramus or inferior tympanic artery.

3) An anterior ramus for the eustachian tube.

4) A branch which accompanies the internal carotid artery within the carotid canal [9]. Hyrtl (quoted by Sappey) has followed this branch to the sella turcica, where he has seen it anastomose with the middle meningeal artery [9].

Among the occasional varieties, it should be pointed out that the ascending palatine artery may arise from the ascending pharyngeal artery. (Hildebrant quoted by Poirier) [7]. Rarely the superior laryngeal artery (usually arising from the superior thyroid artery) may originate from the ascending pharyngeal artery or from its inferior pharyngeal ramus.

All these rami have many anastomoses either with branches of the internal carotid artery or of the external carotid artery (Table 1).

Radioanatomy has benefited by the recent progress in angiography such as superselective catherization, serial direct magnification with micromillimeter focal spots and substraction techniques.

Many authors have shown the value of performing selective ascending pharyngeal angiograms in craniofacial pathology with emphasis on the diagnostic and therapeutic aspects such as embolization [2, 5, 6, 8, 10].

Material and Methods

Eight demonstrative selective ascending pharyngeal angiograms were performed by the femoral approach. Serial direct magnification and subtraction were used in all cases. Five of the cases were pathological and three were normal.

Ten specimens of fresh cadaver heads were injected with plastic according to G. Salamon's technique. Anatomical dissection was then performed in order to have a comparison with the angiographic findings.

Table 1. Collateral and anastomitic pathways

Collateral branches of the ascending pharyngeal artery	Arteries anastomosing with the ascending pharyngeal artery	Usual origin of the arteries anastomosing with the ascending pharyngeal collateral.
Pharyngeal rami	contralateral pharyngeal rami ascending palatine artery superior laryngeal arteries	ascending pharyngeal artery facial artery superior thyroid artery
Inferior tympanic artery	caroticotympanic artery superior tympanic artery	intrapetrous portion of the internal carotid artery middle meningeal artery
Eustachian tube ramus	pterygopalatine artery accessory meningeal artery	maxillary artery maxillary artery (65%) or middle meningeal artery (35%)
Muscular branches	muscular arteries	vertebral artery occipital artery ascending cervical artery
Meningeal rami through the anterior condyloid canal	meningeal rami medial clivus artery (ipsi and contralateral)	occipital artery middle meningeal } if present vertebral artery internal carotid artery (C_5)
Meningeal rami through the foramen jugulare	petrosquamous ramus meningeal ramus medial branch of the lateral clivus artery ipsilateral	middle meningeal artery middle meningeal artery } if exists occipital artery internal carotid artery (C_5)
Carotid ramus (meningeal ramus through the foramen lacerum)	recurrent artery of the foramen lacerum	internal carotid artery (C_5)

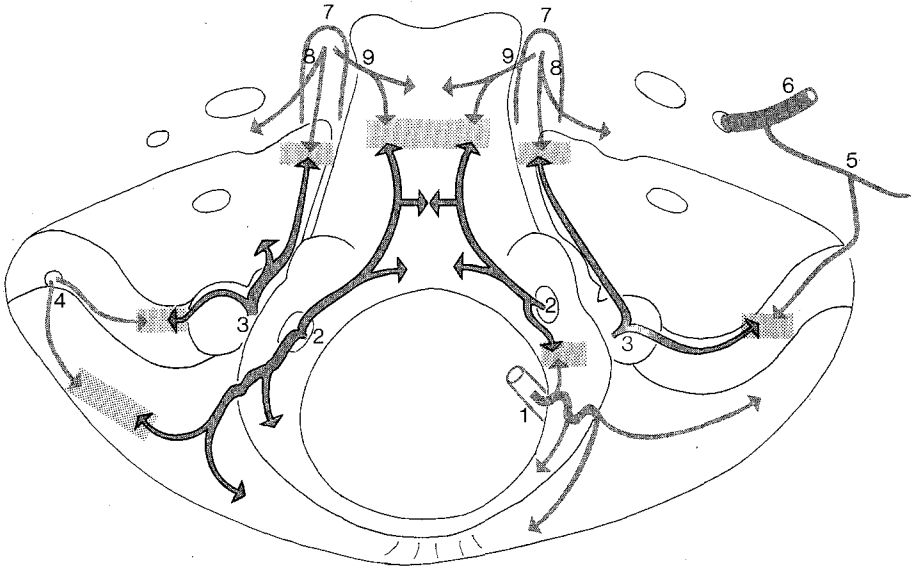

Fig. 1. Schematic drawing of the posterior fossa showing the variable anastomoses of the hypoglossal and jugular rami of the ascending pharyngeal artery. 1. Vertebral artery, 2. Hypoglossal canal, 3. Jugular foramen, 4. Transmastoid branch of the occipital artery, 5. Petrosquamous branch, 6. Middle meningeal artery, 7. C_5 portion of the carotid siphon, 8. Lateral clivus artery, 9. Medial clivus artery. The shaded squares dipict the areas of anastomoses

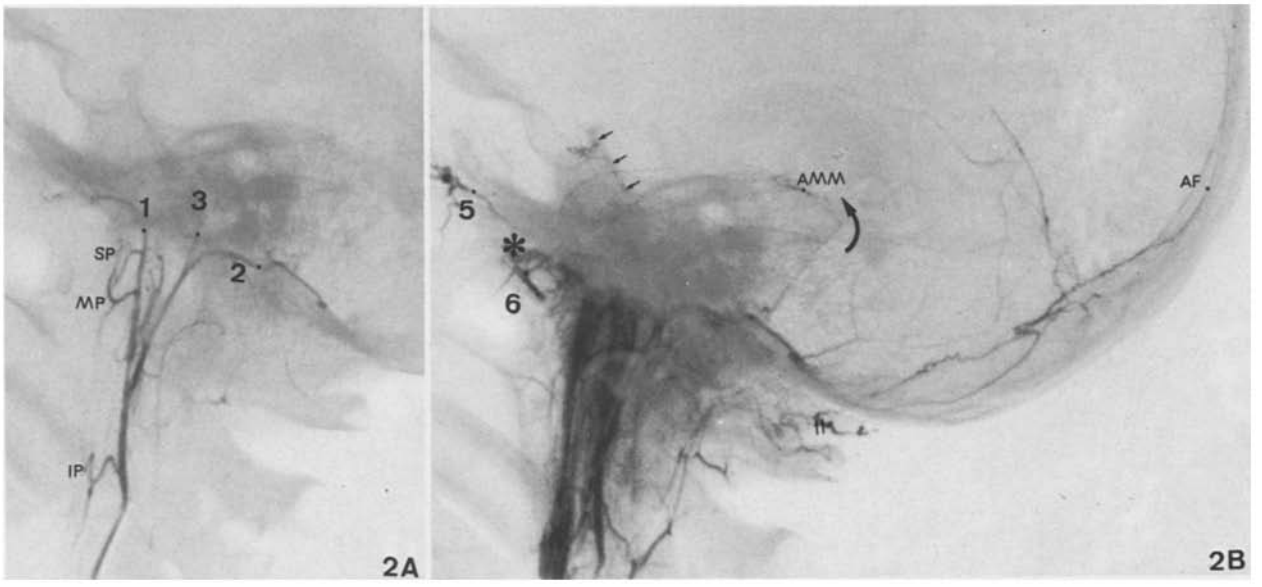

Fig. 2. Superselective ascending pharyngeal angiogram, lateral views, normal case. a. Early phase: the inferior pharyngeal (IP) medial pharyngeal (MP), and superior pharyngeal (SP) rami; the eustachian tube (1), meningeal (2) and tympanic (3) branches are well identified. b. Late phase: note the prominent mucosal stain and retrograde opacification of the pterygopalatine (5) and of the accessoray meningeal arteries (6). * = meatus of the eustachian tube. Note the blush of the posterior pituitary gland (three arrows). The petrosquamous branch of the middle meningeal artery is opacified in retrograde manner (curved arrow). The arteries of the falx cerebelli and of the falx cerebri (AF) are opacified by the occipital artery via the anastomoses around the foramen magnum (two arrows).

Results

Anatomical (Fig. 1)

In this report we will consider only the meningeal distribution of the ascending pharyngeal artery, since the extracranial distribution has been well described by the classical anatomists. We found two constant branches entering the skull; one runs in the anterior condyloid canal (hypoglossal canal) and the other runs in the jugular foramen. Each one is of variable significance:

1) The hypoglossal ramus accompanies the hypoglossal nerve which it nourishes. It distributes to the dura surrounding the foramen magnum and clivus where it anatomoses medially with the branches arising from the ipsi- and contralateral cavernous carotids (Table 1). Sometimes this ramus also supplies the dural sheats of the adjacent cerebellar fossa separately as the only nourishing dural supply, in balance with the transmastoid dural branch from the occipital artery, or with the petrosquamous branch of the middle meningeal artery.

The hypoglossal ramus does not exist sometimes. In these cases the vertebral artery gives rise, in its extradural course, to the corresponding ramus.

2) The jugular ramus accompanies the IX, X and XI nerves in the jugular foramen and extends to the dural sheath of the inferior part of the cerebellopontine angle [10]. It anastomoses in the sigmoid sinus with the dural branch of the occipital artery (if present) and in the inferior petrosal sinus with the medial ramus from the lateral clivus artery [4].

3) The carotid ramus originates from the anterior branch of the ascending pharyngeal artery and accompanies the internal carotid in its canal. It anastomoses at the level of the foramen lacerum with a recurrent twig arising from the C_5 portion of the carotid siphon. This ramus did not distribute to the foramen magnum or to the cerebellar fossa in any of our dissections.

In 9 of the 10 specimens, successful filling of the vertebrobasilar system was obtained by bilateral common carotid injections of plastic. In one subject the plastic filled both carotid systems without reflux into the posterior circulation. This latter case showed complete vascularization of the subarachnoid course of the lower four cranial nerves via the intradural rami of the ascending pharyngeal artery.

Angiographic

1) Normal radioanatomical Findings. In the lateral projection the pharyngeal branches run transversely in front of the main trunk of the ascending pharyngeal artery and along the superior and middle pharyngeal constrictor muscles in a characteristic T shape (Fig. 2a).

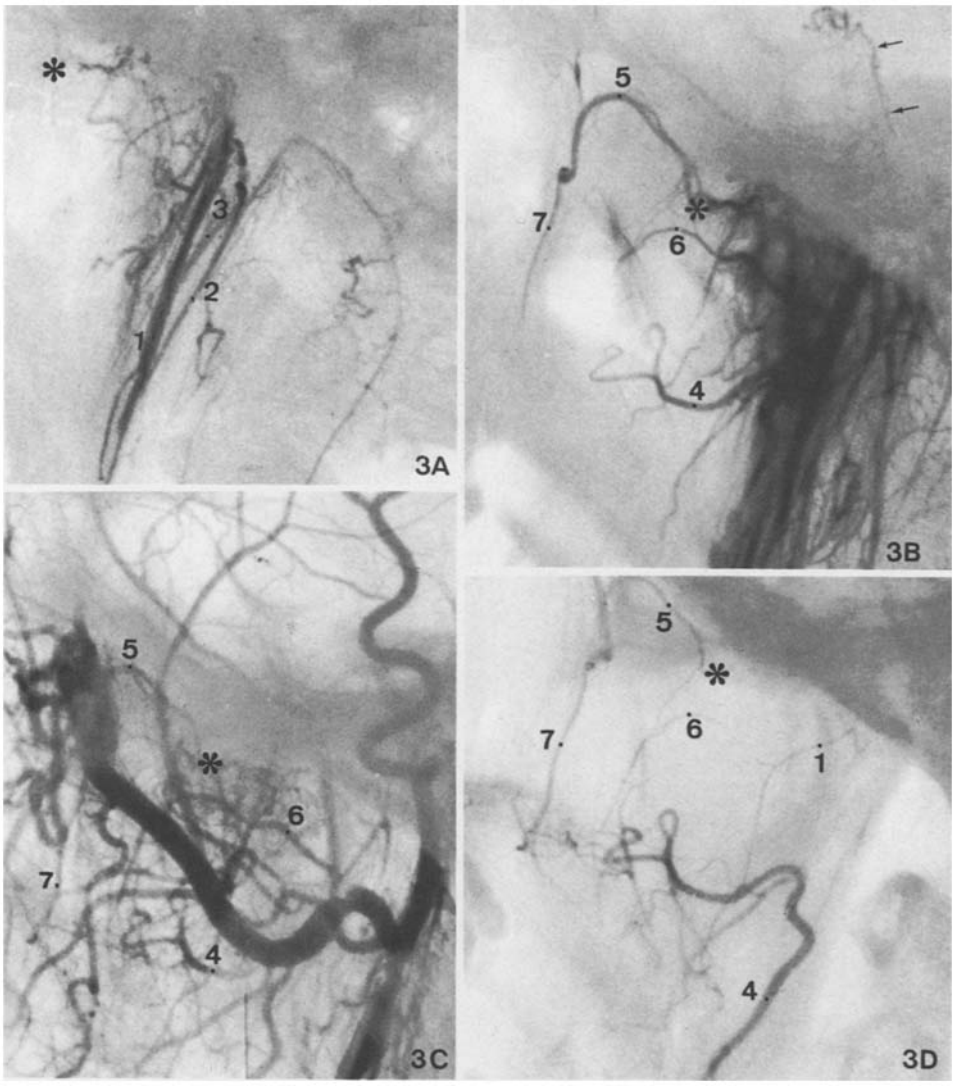

Fig. 3. Superselective ascending pharyngeal angiogram, lateral views, normal case. a. The eustachian tube ramus (1), the meningeal ramus (2) and the tympanic ramus (3) are well visualized. b. Late phase: note the stain of the pituitary gland (small arrows); retrograde opacification of the ascending palatine artery (4), the ptyerygopalatine artery (5), the accessory meningeal artery (6), and the descending palatine artery (7). c and d. The anastomotic pedicles described in b can all be directly identified on selective maxillary (c) and ascending palatine (d) angiograms. * = meatus of the eustachian tube; clivus artery: two arrows

The muscular rami are also visible running backwards, and may fill the vertebral artery (Fig. 4), the occipital artery, or the deep ascending cervical artery by their respective muscular anastomoses.

The ramus for the eustachian tube is usually visible and fills the pterygopalatine artery and the accessory meningeal artery in retrograde manner (Figs. 2b, 3b, 4). The palatine ramus (arising from the middle pharyngeal branch) fills the distal portion of the ascending palatine artery (Fig. 3b).

In normal cases we were able to observe a posterior hypophysial gland stain via the clivus anastomoses with the dural branches of the ascending pharyngeal artery. This relates to the more common origin of the posterioinferior hypophysial artery as a common trunk with the medial clivus artery [4]. In other words, the dural branches of the ascending pharyngeal artery anastomose with the medial clivus branches which in turn fill the posterioinferior hypophysial vessels and cause the posterior pituitary stain (Fig. 2b, 3b).

One case showed an internal carotid origin of the ascending pharyngeal artery (Fig. 5) and another case a common trunk of the ascending palatine and ascending pharyngeal arteries (Fig. 4).

The inferior tympanic artery is rarely identified angiographically because of the dense petrous structures (Fig. 2a).

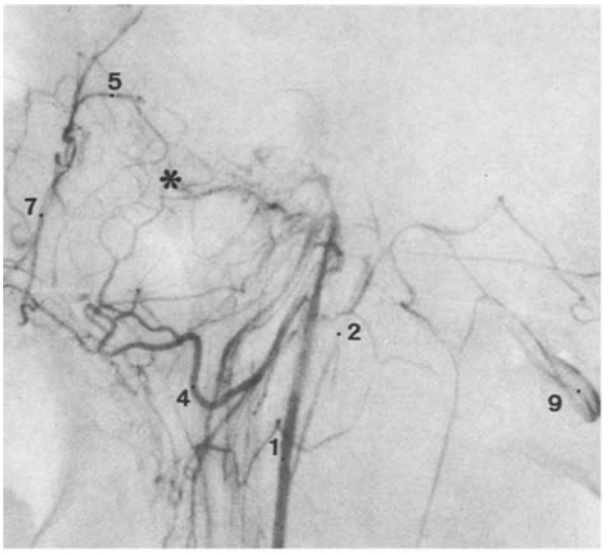

Fig. 4. Selective catheterization of a common trunk of the ascending pharyngeal artery and the ascending palatine artery, 4. 1. Anterior trunk, 2. Posterior meningeal trunk, 5. Pterygopalatine artery, 7. Descending palatine artery, 9. Vertebral artery, * = Meatus of the eustachian tube

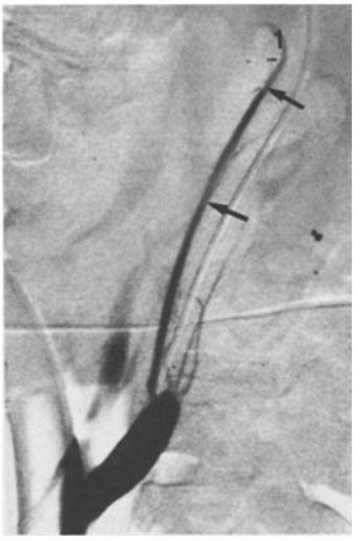

Fig. 5. Internal carotid origin of the ascending pharyngeal artery. Carotidcavernous fistula. Common carotid angiogram, lateral view, after balloon embolization of the fistula. Note the definite opacification of the ascending pharyngeal artery (arrows) arising from the occluded internal carotid artery

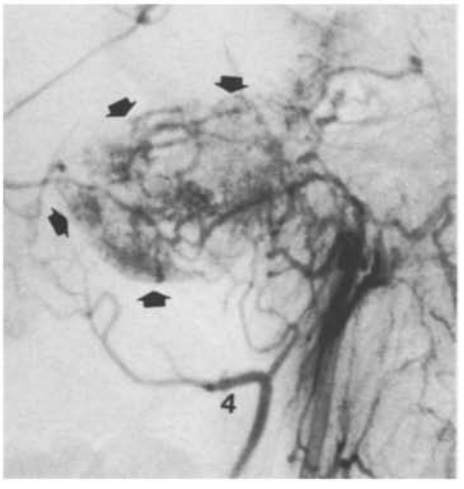

Fig. 6. Nasopharyngeal angiofibroma, selective ascending pharyngeal angiogram, lateral view. Note the retrograde opacification of the ascending palatine artery (4) and the tumor supply from the ascending pharyngeal artery (arrowheads)

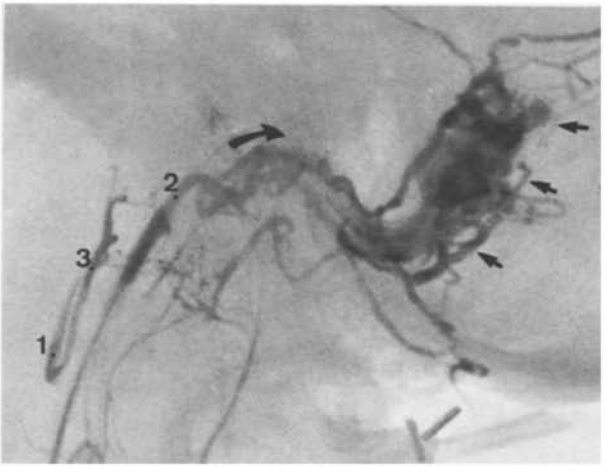

Fig. 7. Dural arteriovenous fistula, superselective catheterization of the posterior ramus (2) of the ascending pharyngeal artery. Note the opacification of the anterior ramus of the ascending pharyngeal artery and of the tympanic ramus (3)

Pathological Findings

The pathological findings can be classified according to the variable nature and origin of the lesions.

1) Extracranial: nasopharyngeal angiofibroma (Fig. 6)

2) Cranial: glomus jugulare tumor (Fig. 8).

3) Intracranial: dural arteriovenous fistula of the posterior fossa (Fig. 7), dorsum sellae meningioma (Fig. 9), accoustic neuroma [10], and posterior carotid collateral fistulas (Fig. 10).

Other lesions such as glomus tympanicum tumors, sarcomas of the base of the skull, occipital bone tumors and cervical angiomas may be vascularized by the ascending pharyngeal artery.

If we consider the cerebellopontine angle, it seems that only meningiomas and glomus jugulare tumors are supplied partially or totally by the ascending pharyngeal artery. The external carotid blood supply of acoustic neuromas seldom involves the ascending pharyngeal artery [10]. Possibly the ascending pharyngeal artery may be involved in the vascularization of lower cranial nerve neuromas.

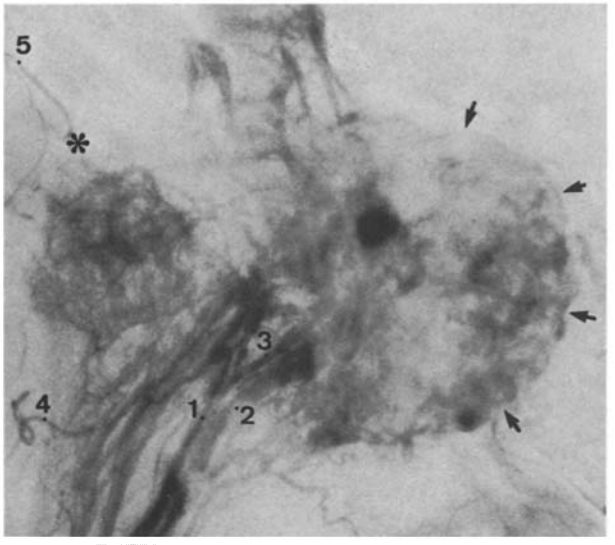

Fig. 8. Glomus jugulare tumor, selective ascending pharyngeal angiogram. The anterior ramus (1), posterior ramus (2), tympanic (3), ascending palatine artery (4), and pterygopalatine artery (5) are well opacified. Note the vascularization of the tumor (arrowheads). * meatus of the eustachian tube

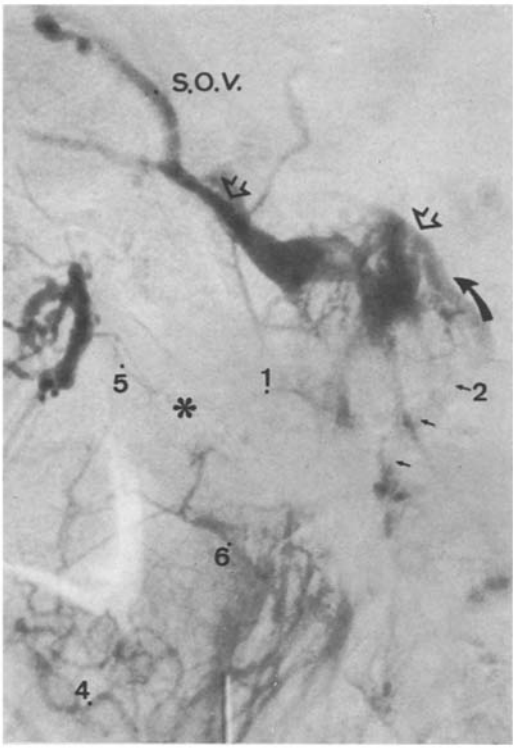

Fig. 9. Selective ascending pharyngeal angiogram. Note the eustachian tube ramus (1) and the meningeal branch (2) which continue to supply a minute portion of the fistula (arrowheads). 4. Ascending Palatine Artery, 5. Pterygo palatine Artery, 6. Acessory Meningeal artery, S. O. V. Supperior ophtalmic vein

Conclusion

The ascending pharyngeal artery belongs to the group of arteries with wide craniofacial distribution and a significant meningeal role. As described for the accessory meningeal artery [3] and for the middle meningeal artery [4], the ascending pharyngeal artery should be studied as selectively as possible whenever a lesion of the base of the skull, the cerebellopontine angle, or the sellar region is suspected.

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References

1. Aaron, C., Doyon, D., Fischgold, H., Metzger, J., Richard.: Artériographie de la carotide externe. Paris: Masson 1970
2. Djindjian, R., Merland, J. J., Theron, J.: Exploration super-sélective de la Carotide Externe. In press
3. Lasjaunias, P., Theron, J.: The accessory meningeal Artery. To be published
4. Lasjaunias, P., Vignaud, J., Doyon, D.: Les Collatérales intracaverneuses de la Carotide Interne. Radiographie et photographie médicale N_0 14. Kodak Pathe 1975
5. Merland, J. J.: Artériographie super-selective de la carotide externe. These de Medecine, Paris 1973
6. Newton, T. R., Weidner, W., Greitz, T.: Dural arterio venous malformation in the posterior fossa Radiology **90**, 27–35 (1968)
7. Poirier P.: Traité d'anatomie humaine Paris: Masson 1896
8. Salamon, G., Grisoli, J., Paillas, J. E., Faure, J., Guidicelli, G.: Etude artériographique des Artères Méningées. Neurochirurgie **10**, 6–19 (1967)
9. Sappey, Ph. C.: Anatomie descriptive. Paris: Delaye 1876
10. Theron, J., Lasjaunias, P.: Participiation of the external and internal carotid artery in the blood supply of the acoustic neurinomas. Radiology **118**, 83–88 (1976)

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