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DIAGNOSTIC VALUE OF ORBITAL ANGIOGRAPHY*

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THE value of the various methods of *x*-ray examination of the orbit is uncontested for the diagnosis of a space-occupying lesion in the orbit. These methods represent therefore an indispensable diagnostic tool, but nevertheless in many instances the nature of the space-occupying orbital lesion remains obscure. It is the purpose of this paper to discuss the value of orbital angiography as an accessory diagnostic method for such lesions. Curtis (1949), Schurr (1951), and Decker (1955) were amongst the first to describe the angiography of the normal ophthalmic artery and the choroidal plexus of the eye. But angiography of pathological orbital structures is a field which is so far largely unexplored.

In Schurr's opinion the ophthalmic artery is nearly always visible for at least part of its course in lateral carotid angiograms. But in 200 carotid angiograms performed with 35 per cent. contrast medium (Diodrast) we have been able to demonstrate the ophthalmic artery and its branches in only 24 per cent., i.e. in only about one-fourth of our cases. However for the last 2 years we have used the 60 per cent. contrast medium Urografin-Schering, with the result that the ophthalmic artery could be demonstrated in 98 per cent. of 200 carotid angiograms. In 11 per cent. of the cases this artery was visible for only 1 to 2 cm., but in 87 per cent. all the branches up to the frontal branches were demonstrated. In 74 per cent. the choroidal plexus of the eyeball was also seen as a thin crescent in the outer two-thirds of the orbit.

The normal course of the ophthalmic artery is to be seen in the diagrammatic interpretation of Fig. 1 (opposite) and in the arteriograms of Fig. 2 (*a*, *b*, opposite).

Its course is as a rule fairly constant. It is seen to arise from the internal carotid as it emerges from the cavernous sinus close to the anterior clinoid process. According to Schurr, the artery pursues a slightly tortuous course largely because of the freedom of movement which must be allowed to its branches in order to permit rotation of the eyeball. It is unlikely, therefore, that displacements by space-occupying lesions within the orbit would be easy to detect. The recognition of the different branches of the ophthalmic artery and of the choroidal plexus is not easy, especially in distinguishing them from the outlines of the bone which overlies them. In our experience the stereoscopic views of the angiograms were of great help in the demonstration of these vessels.

* Read at the combined meeting of the Society of British Neurological Surgeons and the 36th Annual Meeting of the Irish Ophthalmological Society in Dublin, May 16–18, 1957.

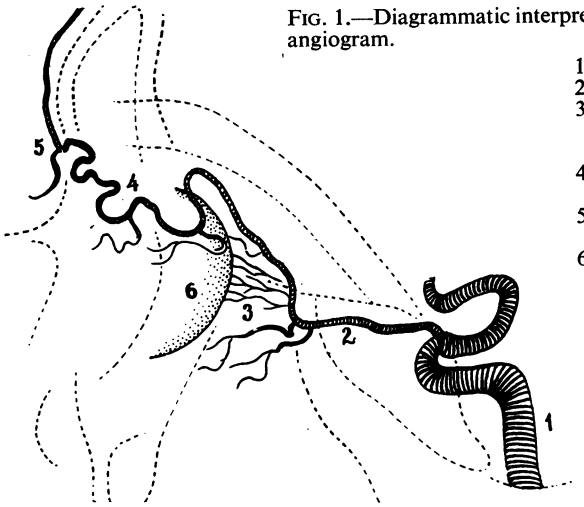
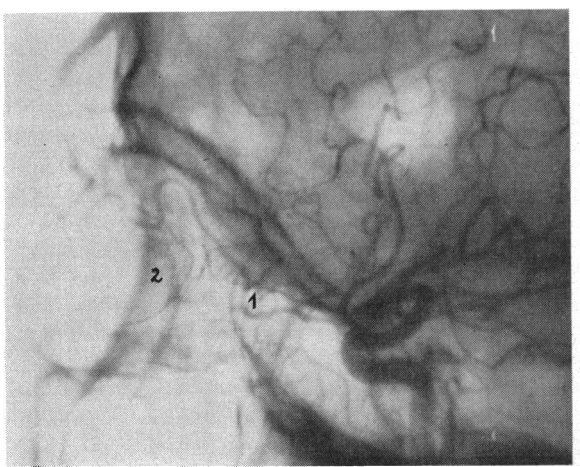


FIG. 1.—Diagrammatic interpretation of a normal orbital angiogram.

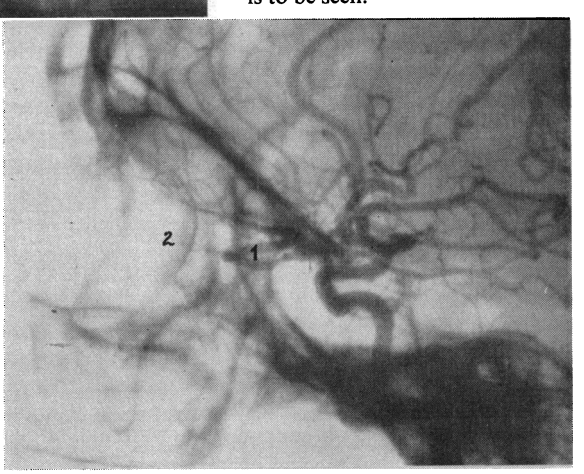
1. Internal carotid artery.
2. Ophthalmic artery.
3. Anterior and posterior ciliary arteries and central artery.
4. Internal palpebral branches.
5. Frontal and dorsal nasal artery.
6. Choroidal plexus.



(*a*)

FIG. 2 (*a*, *b*).—Lateral arteriogram showing tortuous course of ophthalmic artery (1) and choroidal plexus (2).

In Fig. 2 (*b*) a loop of the artery is to be seen.



(*b*)

As a second method of orbital angiography we developed orbital venography by percutaneous injection of the angular vein with the contrast medium. The method has some technical difficulties. If the angular vein is very thin it must be punctured with the head in a downward position and with compression of the facial and frontal veins. The course of the orbital veins is to be seen in the phlebogram Fig. 3 (*a*, *b*).

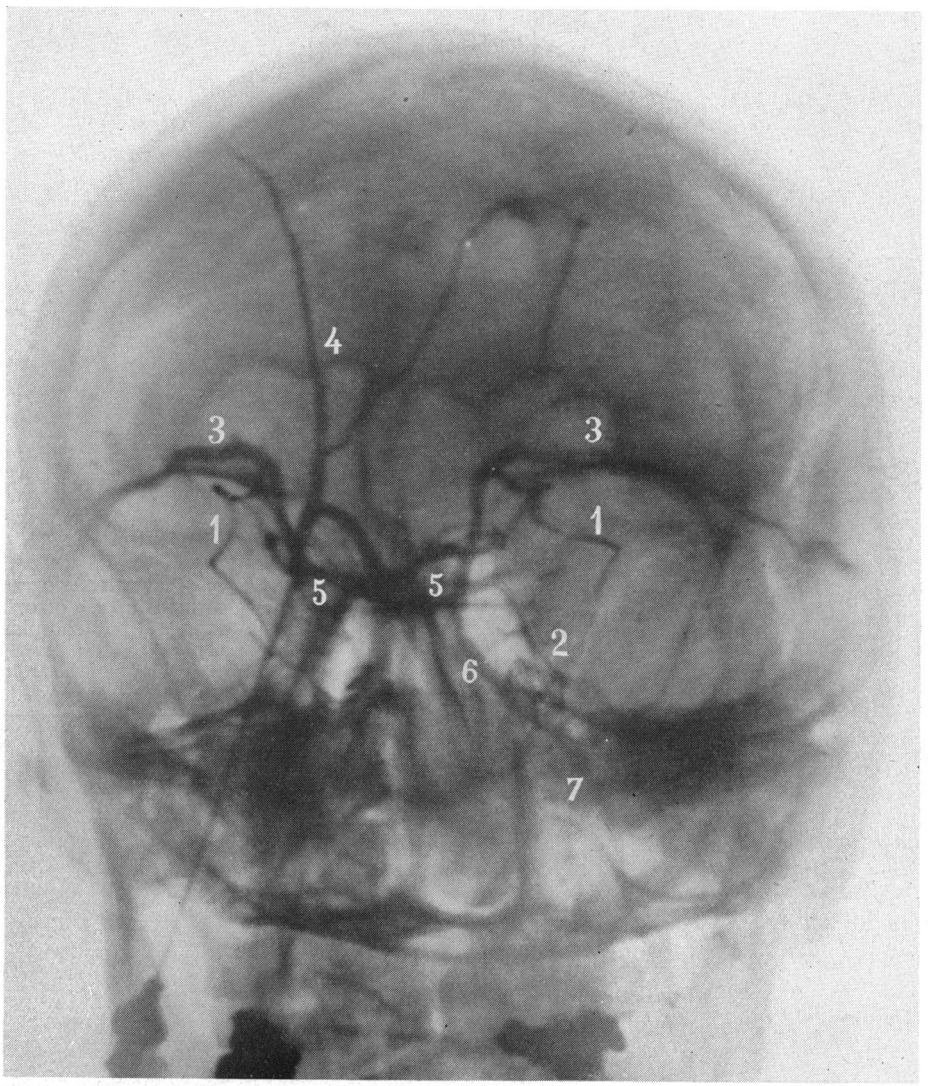


FIG. 3 (*a*, *b*).—Antero-posterior and lateral phlebogram showing the superior (1) and inferior (2) ophthalmic veins, and the supra-orbital (3), frontal (4), angular (5), nasal (6) and anterior facial (7) veins.

FIG. 3 (*b*).

1.	Intra-orbital Tumours	22
2.	Peri-orbital Tumours	36
3.	Vascular Diseases:	
	(*a*) Intracranial saccular aneurysms	7
	(*b*) Intracranial arteriovenous aneurysms	2
	(*c*) Traumatic fistulous carotid-cavernous aneurysms	21
	(*d*) Orbital varix	4
4.	Inflammatory Processes:	
	(*a*) Acute	3
	(*b*) Chronic	2
	(*c*) Thrombosis of the cavernous sinus	3
5.	Graves's Disease	5
6.	Miscellaneous	12

Our case material, which has been analysed by Yaşargil (1957), consists of 117 cases of unilateral proptosis. The underlying pathological disease in each case is shown in the Table.

From this material were taken the following nine cases of unilateral exophthalmos in which the cause was detected by orbital angiography.

These appear to be amongst the first such cases to be reported in the angiographic literature.

FIG. 4.—Lateral angiogram demonstrating a large diffusely-stained, retrobulbar melanoma in Case 1.

Case Reports

Case 1, a 46-year-old male, had suffered from slowly progressive left-sided proptosis with gradual failure of vision for 8 years. There was a huge left orbital tumour and proptosis, left papilloedema, and visual loss (1/60). *X* ray of the left orbit showed some increase in density of the orbital contents. Left carotid angiography revealed a marked forward and upward displacement of the choroidal plexus of the left eyeball and a huge retrobulbar diffusely-stained tumour (Fig. 4).

The ophthalmic artery was very thin and not displaced, but the internal maxillary artery was considerably enlarged.

The tumour, a huge melanoma, was removed at operation.

The patient died 6 weeks later from general metastases.

Case 2, a 2-year-old boy, was noted to be developing a left-sided parenchymatous keratitis and a gradually increasing left-sided proptosis after an alleged injury of the left eyeball with a pencil 8 weeks before. Numerous ophthalmologists were consulted, and the diagnosis was made of primary or secondary glaucoma and of an abscess of the lens. 9 months after the onset of the illness, on October 5, 1956, the left eyeball was finally removed and a prosthesis was implanted. But there was a progressive protrusion of the prosthesis combined with staphylococcal infection, and the patient was admitted to the neurosurgical clinic for orbital angiography. A retrobulbar tumour or abscess was diagnosed.

The left carotid angiogram (Fig. 5) demonstrated a huge tumour with numerous, very fine pathological vessels in the left orbit and no displacement of the ophthalmic artery.

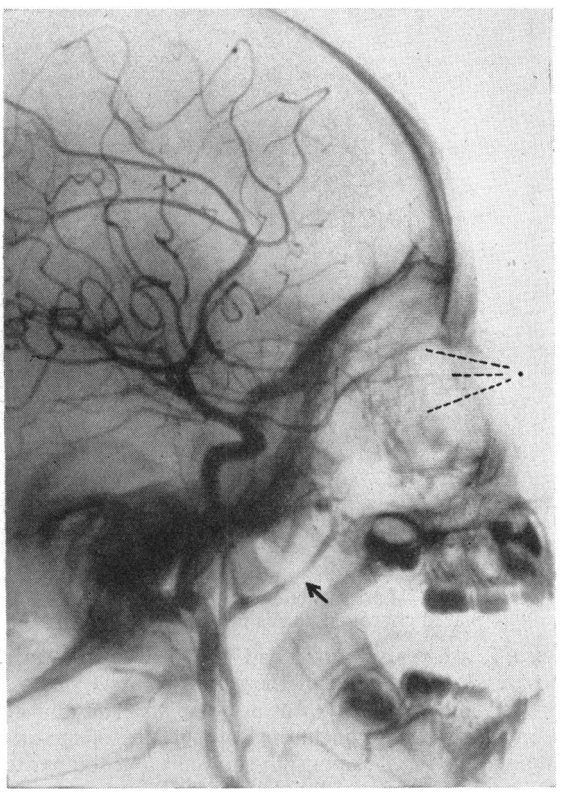


FIG. 5.—Lateral angiogram showing a large orbital retinoblastoma with fine pathological vessels and enlarged internal maxillary artery (arrow) in Case 2.

On December 21, 1956, the tumour was removed totally by Prof. M. Amsler, and proved to be a retinoblastoma. The post-operative course was uneventful and post-operative *x*-ray treatment was instituted.

Case 3, a 52-year-old woman, had suffered from diplopia and slight protrusion of the left eye for a few months. There was proptosis of 4 mm. and downward displacement of the left eye, as well as some impairment of adduction and abduction, and hypaesthesia in the left first trigeminal division. *X* rays of the skull and orbit were normal.

The left carotid angiogram (Fig. 6, overleaf) showed a normally placed left ophthalmic artery which gave use to abnormal branches surrounding a tumour the size of a cherry behind the eyeball. The forward displacement of the choroidal plexus is well seen. As the patient's general condition was not good, no operation was performed. The patient died 6 months later from carcinoma of the lung, of which the retrobulbar tumour was a metastasis.

FIG. 6.—Lateral angiogram showing a retrobulbar encapsulated tumour and displaced choroidal plexus in Case 3.

Case 4, a 6-year-old girl, had been suffering from right-sided headache, diplopia, and progressive protrusion of the right eye for 4 weeks. There was considerable proptosis of the right eye with downward displacement and impairment of all ocular movements. *X* rays of the skull, including tomography of the orbit, were normal. The right carotid angiogram (Fig. 7, opposite) showed a retrobulbar tumour, the size of a cherry, without displacement of the ophthalmic artery.

In the venous phase of a right external carotid angiogram, the facial, angular, nasofrontal, and superior ophthalmic veins were demonstrated as well as the downward displaced choroidal plexus (Fig. 8, opposite). At operation (orbitomy) the tumour was found to be well encapsulated and was radically removed. Histological examination showed it to be a retinoblastoma. A post-operative course of *x*-ray treatment was given.

Case 5, a 44-year-old man, had suffered from a gradually increasing protrusion of the right eye for 2 years. There was right-sided exophthalmos of 6 mm., downward and inward displacement of the right eye, and complete paralysis of the right sixth nerve. The right carotid angiogram (Fig. 9, opposite) showed an avascular tumour with fine capsular blood vessels between the thinned and elevated orbital roof and the ophthalmic artery. The choroidal plexus was well shown and downwards displaced. A clinical diagnosis of a lipoma or dermoid cyst was made. The patient refused a surgical exploration.

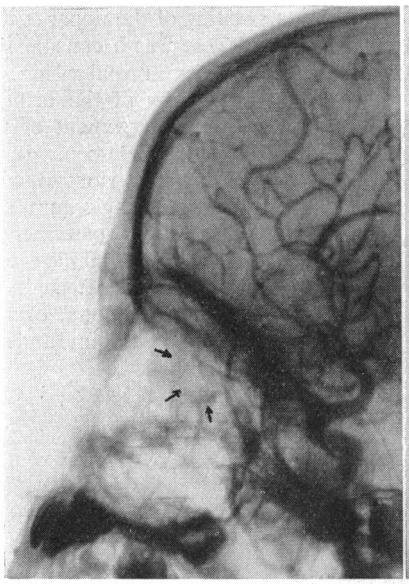


FIG. 7.—Lateral angiogram showing a retrobulbar retinoblastoma in Case 4.

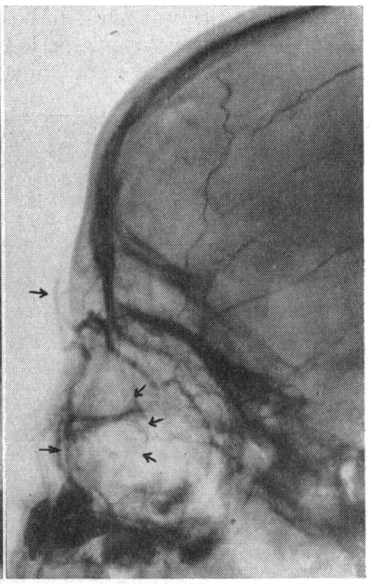


FIG. 8.—Orbital phlebogram showing the downward displaced choroidal plexus in Case 4.

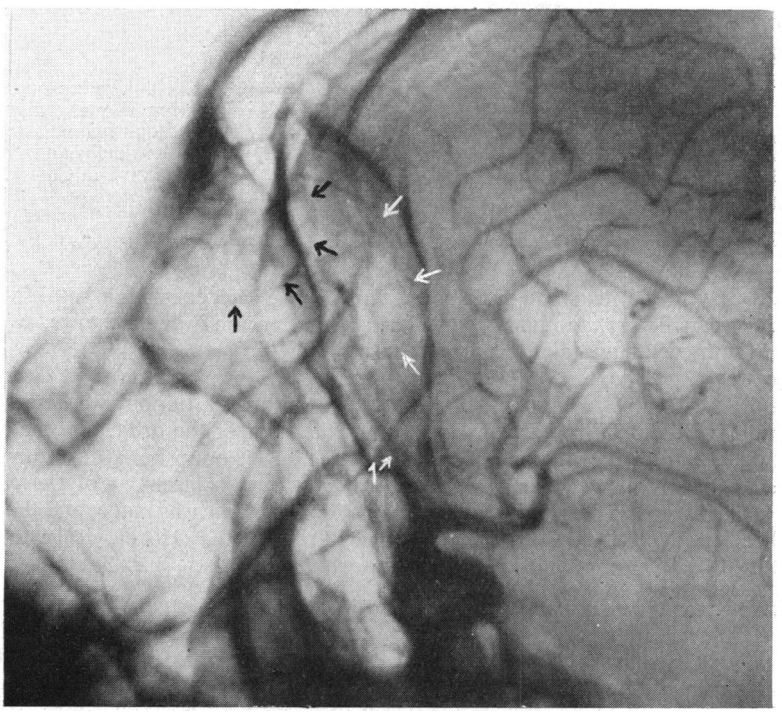


FIG. 9.—Lateral angiogram showing an avascular tumour between the elevated orbital roof and ophthalmic artery in Case 5.

Case 6, a 3-year-old girl, was noted to be developing a swelling of the upper eyelid and a protrusion of the right eye over a period of one year. There was a considerable right exophthalmos of 7 mm., and right primary optic atrophy with normal vision. Radiography of the orbit showed an enlargement of the right optic foramen. In the antero-posterior view of the right carotid angiogram (Fig. 10) a medial displacement of the right ophthalmic artery at its origin was detected. At operation a glioma of the optic nerve was found and removed.

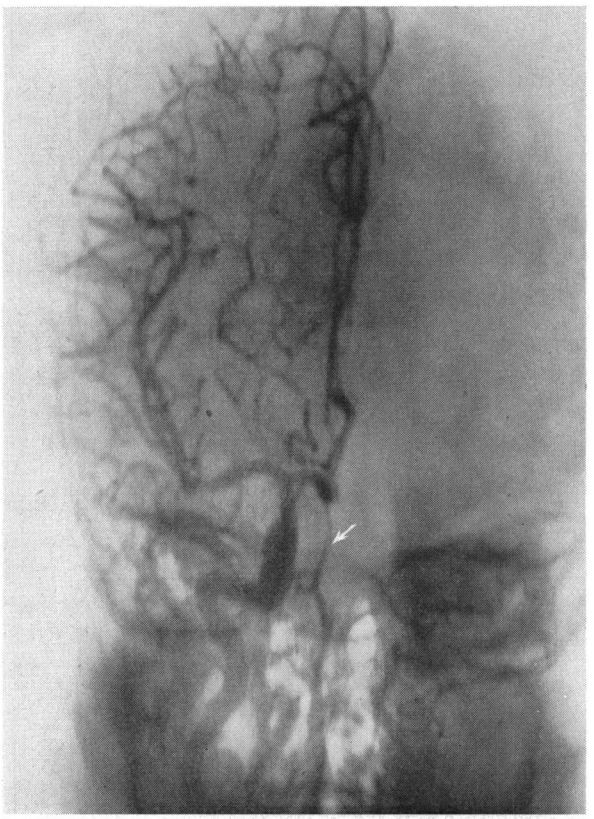


FIG. 10.—Antero-posterior angiogram showing displacement of the ophthalmic artery to the opposite side by an intra-orbital optic glioma in Case 6.

Case 7, a 54-year-old man, had sustained a motor-cycle accident with a basal fracture of the skull 4 years before, and had been suffering from tension in the right eye, swelling of the right lower eyelid, and diplopia for 6 months.

There was right proptosis of 7 mm., upward displacement of the right eyeball, and slight right sixth nerve weakness. At the base of the orbit a tumour was palpated and tomography of the orbit revealed destruction of the floor of the orbit. In the capillary and venous phase of the right carotid angiogram (Fig. 11, opposite) a huge tumour was seen with peripheral, capsular vessels and an upward displacement of the choroidal plexus. The diagnosis of a peri-orbital and maxillary tumour was made, and the tumour was radically removed from the maxillary sinus by Prof. Rüedi. Histological examination showed it to be a neurinoma of the right infra-orbital nerve.

Case 8, a 59-year-old man, had sustained an accident to the right temple with injury of the right eye and fracture of the right orbit one year ago. Immediately after the accident he was blind in the right eye, and there was a complete right-sided ophthalmoplegia; 4 months later the right eye was removed because of progressive panophthalmitis. At the same time he developed some protrusion of the left eye with some swelling of the veins of the eyelids. After 6 months an intracranial bruit and a slight left-sided exophthalmos

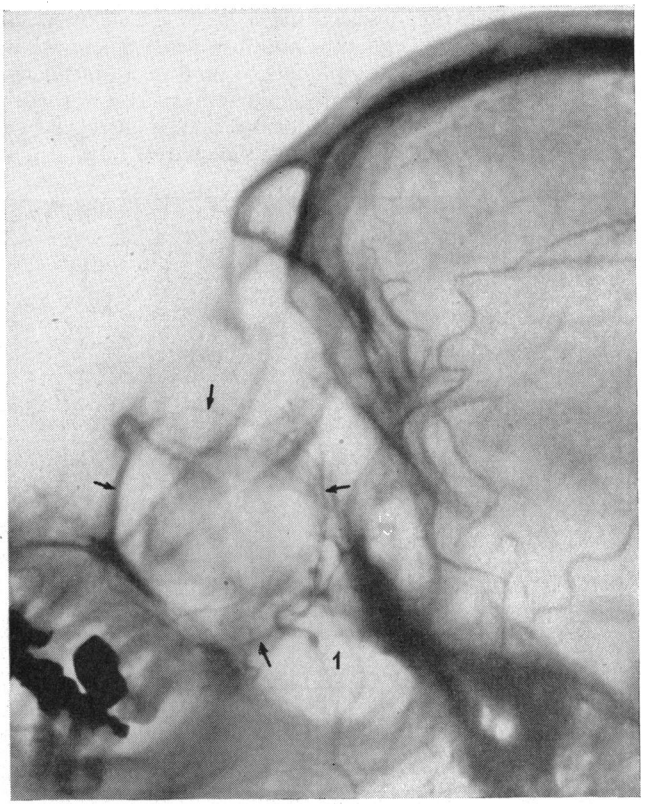
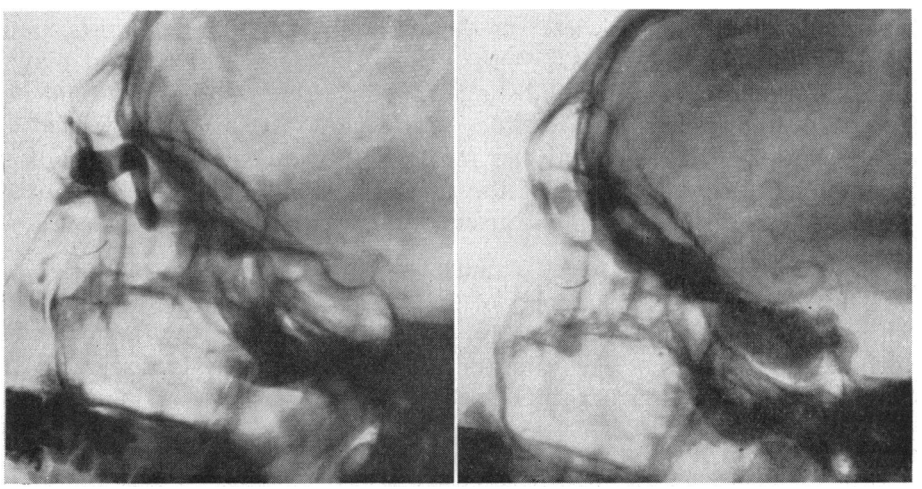


FIG. 11.—Lateral angiogram showing a large periorbital neurinoma of the infra-orbital nerve surrounded by the terminal branches of the internal maxillary artery (1) in Case 7.

with vascular engorgement of the eyeball were detected, and a traumatic fistulous carotid-cavernous aneurysm was diagnosed. The angular and carotid phlebograms (Fig. 12 *a*, *b*) showed an enormous dilatation of the angular and superior ophthalmic veins up to the cavernous sinus.



(*a*) (*b*)

FIG. 12.—Angular and carotid phlebograms showing very marked dilatation of the angular and superior ophthalmic veins in a case of traumatic fistulous carotid-cavernous aneurysm (Case 8).

Case 9, a 35-year-old woman, was developing a slight swelling of the left eye with impairment of vision on bending the head forward. There was a very slight left proptosis, and a slight increase of the exophthalmos on forward inclination of the head. *X* rays of the skull and orbit, and right carotid angiogram were normal. Percutaneous venography of the left angular vein (Fig. 13) demonstrated a cherry-like enlargement of the left superior orbital vein, and an orbital varix was diagnosed.

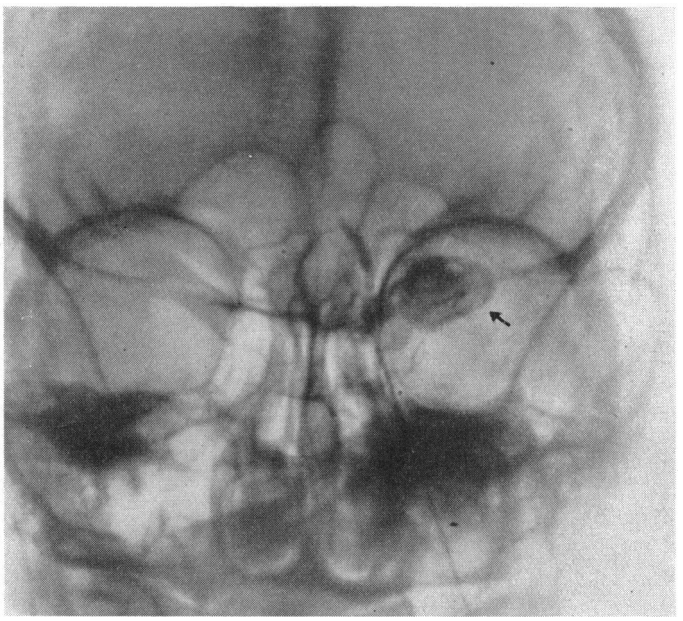


FIG. 13.—Antero-posterior angular phlebogram showing an intra-orbital varix of the superior ophthalmic vein.

Definite conclusions cannot yet be drawn from this relatively small series regarding the diagnostic value of orbital angiography. But as Schurr has pointed out this method deserves the attention of ophthalmologists, radiologists, and neurosurgeons. With further experience the method may be used to demonstrate and to distinguish both orbital and peri-orbital neoplasms and vascular abnormalities. This series seems to show that the value of orbital angiography lies most likely in the demonstration of the pathological vascularization of the space-occupying lesion and not of the displacement of the ophthalmic artery and its branches.

Summary

The angiographic appearances of the ophthalmic artery and the choroidal plexus of the eye and also the orbital veins are described by the method of orbital angiography. The value of orbital angiography is discussed with regard to a small series of orbital space-occupying lesions.

REFERENCES

CURTIS, J. B. (1949). *J. Neurol. Neurosurg. Psychiat.*, **12**, 167.
DECKER, K. (1955). *Fortschr. Röntgenstr.*, **82**, 667.
SCHURR, P. H. (1951). *Brit. J. Ophthal.*, **35**, 473.
YAŞARGIL, G. (1957). "Die Röntgendiagnostik des Exophthalmus unilateralis." Fasc. 50 of *Bibl. Ophthal. (Basel)*.