A New Method of Orbital and Cavernous Sinus Venography

Technical Note

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ALTHOUGH orbital venography is a potentially valuable diagnostic method, its current dependence on angular venous puncture has limited its use, both because the puncture is difficult to perform and because it may create a hematoma in the medial canthus.

One day when we had been unsuccessful in making an angular venous puncture, we attempted to puncture the adjacent supratrochlear vein instead. This resulted in fine radiograms. Subsequently, this modification was found to be useful in the diagnosis of not only intraorbital disease but also pathological changes of the cranial base and the superficial and deep facial region. We have described the technique in this paper and added representative case reports.

Method

With the patient in a supine position under sodium thiopental anesthesia, distention of otherwise hidden veins of the forehead occurs. When both sides of the neck are slightly squeezed, these veins can be further distended and easily cannulated. A relatively large (12 gauge) needle is used for venous puncture, and 10 ml of contrast media is injected rapidly. Both anteroposterior and lateral views of the head are usually taken, with the occasional addition of a submentovertical view (Fig. 1). When pressure is applied to the angular veins or facial veins, radiopaque material also reaches the cavernous sinus via the orbit.

The advantages of this venographic method are its use of a reliable and easily puncturable vein, little risk of damaging the orbital contents, and a capability for quick injection of radiopaque medium under sufficient pressure.

The usual areas visualized by this method can be divided into two principal groups: 1) superficial facial veins, such as the supratrochlear vein, the angular vein, and the facial vein, and 2) deep veins, such as the basal venous plexus of the cavernous sinus and the inferior petrosal sinus via the supratrochlear vein, the nasofrontal vein, and the superior ophthalmic vein. Deep facial venous plexi, such as the pterygoid plexus, can also be identified via the inferior ophthalmic vein, while the large collateral vein between the supratrochlear vein and the superficial temporal veins becomes visible at the upper rim of the orbit running in a transverse direction. This collateral vein must be identified carefully in a lateral view because it is easily mistaken for the superior ophthalmic vein or the cavernous sinus (Figs. 2 and 3).

All of these veins are generally visible bi-

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Fig. 1. Radiographic technique.
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laterally during a single unilateral injection of radiopaque material. In the submentover- 
tical view, the area around the ophthalmic veins and the cavernous sinus is clearly visu-
ized, including a round shadow representing the internal carotid artery, while the cav-
ernous sinus is distinctly seen on either side of the sella turcica in the anterior portion.

Case Reports

We have now applied this diagnostic tech-
nique to cases of unilateral exophthalmos,
mass lesion of the cranial base, soft tissue
tumor of the cranial and facial region, and
nasal sinus diseases. The following cases are
typical examples.

Case 1. This 13-year-old boy had been in
good health until he developed progressive
intermittent exophthalmos of the left eye of
3 years’ duration when bending the head for-
ward or squeezing the neck. There were no
abnormalities found in the left carotid angio-
gram, but our modified orbital venographic
technique uncovered abnormal shadows in
the superior ophthalmic vein, marked venous
dilatation around the pterygoid plexus, and
distended veins in the right temporal region.
The diagnosis of an extensive cavernous he-
mandioma was subsequently confirmed (Fig.
4).

Case 2. This 69-year-old man for the past
30 years had complained of progressively se-
vere left exophthalmos, and after a diagnosis
of orbital tumor, underwent two surgical op-
erations. On admission he was found to have
exophthalmos of 15.0 mm on the right and
21.5 mm on the left. Left carotid angiog-
raphy showed abnormal vascular supply with a
probable tumor stain in the upper lateral
part of the left orbit. Our venographic
method revealed that, although the right
non-exophthalmic side showed a normal pic-
ture of the superior ophthalmic vein and the
collateral vein to the superficial temporal ve-
ins, there was no visible collateral vein to
the superficial temporal veins despite the
normal ophthalmic vein on the left. This
was thought to be due to destruction of the
upper orbital wall and compression and ob-
struction of the adjacent veins by tumor
(Fig. 5). Surgical exploration revealed a
mixed tumor, the size of a chicken’s egg, de-
veloping from the lacrimal gland and de-
stroying the wall of the orbit.

Case 3. This 23-year-old man 2 months
before admission fell approximately 5 meters
to a concrete floor, hitting the right side of
his face. Following this accident his con-
sciousness was cloudy for 3 days. After con-
sciousness had returned to normal, severe
tinnitus of the right ear and pulsating exoph-
thalmos of the right eye appeared. Right car-
notid angiography showed hardly any intra-
cranial blood vessels. Some abnormal shad-
ows in the cavernous portion of the internal
carotid artery and a markedly dilated supe-
rior ophthalmic vein indicated a traumatic
fistula between the internal carotid artery
and the cavernous sinus. Venography dem-
onstrated a normal left superior vein but did
not show the right one at all, suggesting a
rise in the venous pressure of the right or-
bital area due to arteriovenous fistula (Fig.
6).
Case 4. This 54-year-old man 10 months before admission had noticed swollen non-tender lymph nodes in both sides of the neck. Approximately 4 months before admission he developed diplopia and headache. He was admitted to our clinic with a tentative diagnosis of brain tumor. Although papilledema was not found, there were deficits...
in the function of the third through the eleventh cerebral nerves bilaterally; this suggested malignant tumor extending over a large part of the cranial base. A plain skull film showed advanced bone destruction in the area between the sella turcica and the clivus. Biopsy of the cervical lymph nodes confirmed our diagnosis of metastatic squamous cell carcinoma. The venographic technique demonstrated a large space between the cavernous sinus and the cranial base, thus pinpointing the exact location and size of the tumor (Fig. 7).

**Case 5.** This 15-year-old school boy 2 months before admission was kicked in the back of the neck. Nausea and vomiting developed 2 weeks later, with pain in both eyes, diplopia, and diminished vision in the left eye. On admission he had no vision in the left eye, and could only count fingers at 1 meter with the right eye. Other than this marked visual disturbance, bilateral exophthalmos, and left abducens nerve paralysis, there were no neurologic abnormalities.

In the plain skull film, extensive destruction of the sella turcica was seen, suggesting a large tumor of the cranial base.

Anteroposterior venographic studies showed that the right cavernous sinus was pushed outward and laterally; it also showed the shadow of the penetrating portion of the internal carotid artery. However, we were not able to identify the left cavernous sinus, and this suggested that the tumor was larger on the left than on the right (Fig. 8 left). A submentovertical view (venographic technique) also demonstrated a markedly increased distance between the right and left cavernous sinus. Only a small portion of the left cavernous sinus was seen in this film, and this was thought to be due to the tumor (Fig. 8 right). Giant cell sarcoma in the base of the skull was verified by surgery.
Discussion

Although many attempts at localized facial and basal venography have been made, there have been no reports suggesting visualization of a large area with a single exposure.\(^1\)\(^-\)\(^3\),\(^5\)\(^-\)\(^7\)

In Case 1 we had unsuccessfully attempted orbital venography using Krayenbühl’s method through the angular vein. Despite a successful puncture after many attempts, rapid intravenous injection caused bleeding as well as extravasation leak of radiopaque material, and this resulted in swelling of the orbital area. Injection of radiopaque material into the nearby dilated supratrochlear vein clearly demonstrated not only the intraorbital veins, as expected, but also other veins such as basal and facial veins.

Since then, we have performed this technique on 36 cases. We reported this new venographic method and its clinical value to the Tohoku Regional Meeting of the Japan Ophthalmology Association in June, 1966;\(^4\) later we found that Neubauer,\(^5\) an ophthalmologist in West Germany, had reported the same method with one clinical experience around the same time.

The method is relatively simple, carries no risk of damage to the orbital contents, and has a capability for safer and faster intravenous injection of radiopaque material. By applying pressure on the angular vein, the technique may also demonstrate basal veins such as the cavernous sinus.

Compared to the radiographic techniques reported by Hanafee, \textit{et al.},\(^1\) and Rand and Hanafee,\(^7\) our technique is simpler and easier; our radiograms are better in the anterior portion of the cavernous sinus while their method is superior for visualization of the posterior portion of the cavernous sinus.

The clinical importance of being able to take a radiograph of the cavernous sinus is uncertain, but because the cavernous sinus is clearly seen lateral to the sella turcica in the submentovertical view of our method it is probably capable of detecting pathology near the sella turcica. Our technique is also capable of radiography of the pterygoid plexus in the diagnosis of carcinoma of the maxilla and other diseases around this area and is simpler than the retrograde method.\(^6\) Other intraorbital pathological changes (carotid cavernous fistula, maxillary carcinoma, and nasal tumors) can also be demonstrated by this technique.

The disadvantages of this venographic technique are that the supratrochlear vein cannot always be found and that puncture is sometimes difficult to perform in fat women. We attempted 36 cases, succeeded in 32, and failed in 4.

Summary

We have described the use of supratrochlear venous puncture for radiographic study of the orbital, facial, and basal veins, and have reported typical examples from our 36 cases.
The new method is easier to perform than that of the angular venous puncture technique, and visualizes deep facial and basal as well as intraorbital veins. Visualization of the cavernous sinus is easier to carry out and gives more distinct pictures of the anterior portion of the cavernous sinus than is done by catheter insertion into the internal jugular vein.

References