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Computed Orbital Phlebography of the Cavernous Sinuses

Kaj Ericson[1] and Gustaf Bergstrand[1]

Computed orbital phlebography (COP), described as computed tomography with concomitant injection of contrast medium into a frontal vein, was used to evaluate the cavernous sinuses in 19 patients with intrasellar or parasellar lesions and in two normal controls. Bilateral opacification occurred in 12 subjects, eight of whom had pituitary tumors. Unilateral partial obliteration was encountered in four subjects, all of whom had pituitary tumors with marked parasellar extension. In three subjects with parasellar tumors, ipsilateral total obliteration of the cavernous sinus was seen. In one subject with no sign of parasellar tumor, there was no opacification of the cavernous sinuses, a failure attributed to technical factors. In one other subject, the frontal vein puncture was unsuccessful and COP could not be performed.

Since its introduction in 1951 by Dejean and Boudet [1], orbital phlebography has been used routinely in many institutions to examine the parasellar extension of pituitary tumors. The neuroradiologic examination of pituitary tumors is currently performed with contrast-enhanced computed tomography (CT). It therefore seemed logical to use a frontal instead of a cubital vein for the administration of the contrast medium. If CT scanning is performed during the injection of the contrast agent, the procedure may be called computed orbital phlebography (COP).

An adequate outline of large intrasellar and parasellar tumors is obtained in most instances when the contrast medium is administered intravenously by the conventional brachial approach. The cavernous sinuses are also visualized, at least when not obliterated by expanding lesions [2, 3]. However, it may be difficult even with modern high-resolution scanners to delineate precisely the border between the cavernous sinus and a nearby lesion. In the expectation that COP would improve the ability to delineate this border, the technique was evaluated in a series of patients with sellar and parasellar lesions.

Subjects and Methods

Study subjects were 19 patients and two healthy volunteers. Four patients had Cushing disease, 12 had pituitary tumors (chromophobe adenoma or prolactinoma), two had parasellar meningiomas, and one had a malignant tumor of the skull base.

A frontal vein was punctured with the patient positioned on the CT table. A thin Teflon cannula (Viggo Venflon) with an outer diameter of 0.8 mm and a length of 25 mm was used in all examinations.

A localizing scan was obtained to determine the scanning level. A scanning angle parallel with the cavernous sinus was usually chosen; in some patients, additional coronal views were also obtained. A precontrast scan was obtained at the chosen level immediately before injection of the contrast medium. The contrast medium used was Isopaque cerebral (280 mg I/ml) diluted with physiologic saline solution to a concentration of 100–140 mg I/ml. About 20 ml of the mixture was injected manually. Injection commenced with the start of the scanning procedure and continued throughout the scanning procedure (11.5 sec). The first postcontrast scan was obtained at the same level as the precontrast scan. In most cases, several levels were examined in order to obtain optimal visualization of the cavernous sinuses.

A simple compression device was used to direct the contrast medium toward the cavernous sinuses and prevent flow through the facial veins: Two plexiglass cubes covered with soft gauze were pressed against the infraorbital margins and fixed in position with tape (fig. 1).

A GE CT/T 8800 scanner was used for all examinations. The slice thickness was 5 mm. So-called target reconstruction (ReView) was used in most subjects to increase the spatial resolution.

Results

Good contrast filling of both cavernous sinuses was observed in 12 patients. Eight of these had pituitary tumors, in five cases with involvement of one cavernous sinus, in one case with involvement of both sinuses, and in one case without involvement of the cavernous sinuses. In three subjects with Cushing disease and in the two normal controls, the cavernous sinuses were also visualized on both sides (fig. 2).

Unilateral almost complete obliteration of the cavernous sinus was seen in four subjects, all of whom had pituitary tumors with marked parasellar extension (figs. 3 and 4).

Ipsilateral total obliteration of the cavernous sinus was seen in all three subjects with parasellar tumors.

In one subject with a small intrasellar tumor, opacification of the cavernous sinuses was not obtained on either side.

The frontal vein puncture was unsuccessful in one subject and COP could not be performed.

No side effects of the examination were seen in this series.

Discussion

With conventional orbital phlebography, patients often experience headache, heat sensation, or feelings of tension in the head. This discomfort is considerably less pronounced with COP because the contrast medium is diluted.

[1]Department of Neuroradiology, Karolinska Hospital, S-104 01 Stockholm, Sweden. Address reprint requests to K. Ericson.

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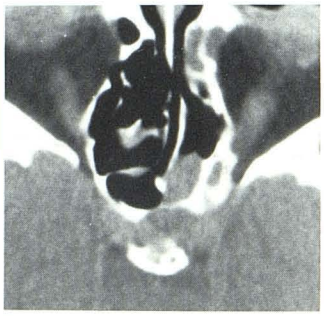
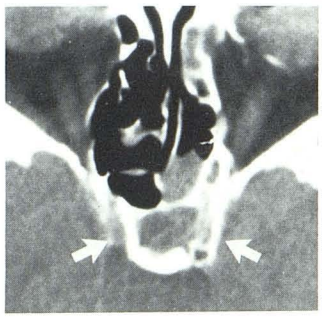


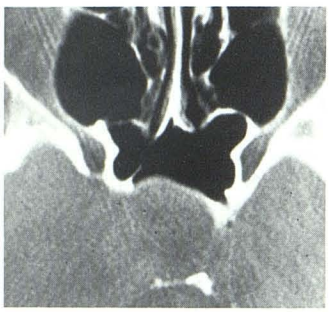
2A



2B

Fig. 1.—Cranial CT scan showing compression device (two gauze-covered plexiglass cubes) pressed against infraorbital margins.

Fig. 2.—Patient with Cushing disease. CT scans before (**A**) and during (**B**) contrast injection. Normal cavernous sinuses (*arrows*).



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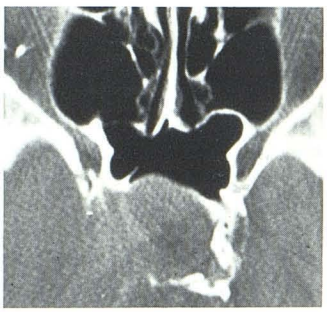

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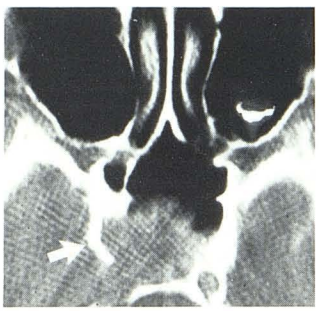
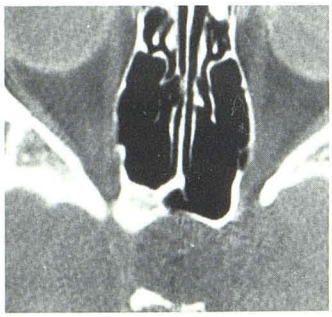


C

Fig. 3.—Intrasellar tumor with parasellar extension. CT scans before (**A**) and during (**B**) contrast injection. Almost total obliteration of right cavernous sinus. In slightly lower slice (**C**), part of right cavernous sinus is opacified (*arrow*).



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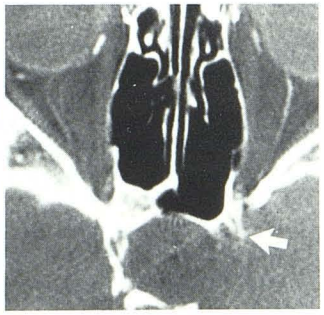

B

Fig. 4.—Cystic intrasellar tumor. CT scans before (**A**) and during (**B**) contrast injection. Almost total obliteration of left cavernous sinus. Small amount of contrast medium seen in anterior part of occluded sinus (*arrow*).

A good visualization of the cavernous sinuses may be obtained with the so-called rapid high-dose contrast infusion method used by Hayman et al. [2]. However, with this technique, the arteries are contrast-filled to the same extent as the veins, which is not always desired. Furthermore, opacification is obtained of not only the lumen but also the walls of the cavernous sinuses. With doses lower than those used by Hayman et al., opacification of the cavernous sinuses is usually poor except in children [4]. This is true particularly when the sinuses are partly obliterated.

Exact delineation of a sellar lesion is always of value. For accurate stereotaxic irradiation of pituitary tumors, a precise determination of their lateral extension is necessary. Such a determination can be made better with the present technique than with other methods. Thrombosis of the cavernous sinus can also be diagnosed with this technique, although we have not yet encountered such a case.

In the present series, all subjects with parasellar tumors exhibited nonfilling of the ipsilateral cavernous sinus. The single subject with nonfilling of both cavernous sinuses despite no sign of a parasellar lesion requires some consideration. This subject was examined early in the series, and technical factors seem to be the only plausible explanation for the failure. Inadequate compression of the facial vein may have prevented the contrast medium from being directed toward the cavernous sinuses. With the present device, no compression is obtained of the temporal veins, leaving another pathway available for the contrast medium. The compression device might easily be improved in this respect.

Small doses of contrast medium are needed with the present technique. Multiple sections can therefore be examined and thin collimators used. Furthermore, scanning may be performed in the axial as well as the coronal plane, while maintaining low-dose administration of the contrast medium. After the cavernous sinuses have been examined, a conventional contrast-enhanced scan may also be obtained. The reason for diluting the contrast medium is to reduce interference from artifacts in the CT images. It is possible that even lower concentrations than 100 mg I/ml may be feasible.

The contrast dose may also be increased from 20 ml to 40 ml of the dilute solution. A higher injection rate and pressure is then obtained, which may result in better visualization of the cavernous sinuses.

The small cannula used for the COP examinations was the same type as that used for conventional orbital phlebographies in our institution. In our experience, frontal vein punctures are more easily achieved with this cannula than with the larger cannulas previously used. In the last 350 patients referred for orbital phlebography, failure to puncture a frontal vein was experienced in only five, indicating that an adequate examination could be performed in 98.6% of the patients.

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