ROENTGENOLOGIC DIAGNOSIS OF ANOMALOUS COMMUNICATIONS BETWEEN THE EXTERNAL CAROTID ARTERY AND INTRACRANIAL VEINS*

By SHOICHI D. TAKEKAWA, M.D., and COLIN B. HOLMAN, M.D.
ROCHESTER, MINNESOTA

RECENTLY, we observed 3 instances of anomalous communications between branches of the external carotid artery and the intracranial venous system. The diagnosis was established by selective carotid angiography and the television-subtraction method.1 This type of anomalous communication is not to be confused with that between the external carotid artery and the internal carotid artery. It is reasonable to assume that these communications involve so-called emissary veins rather than venous plexuses.

On review of the literature, no specific study of this type of arteriovenous communication was found, although the finding of such cases was mentioned from time to time (for example, this type of arteriovenous communication was mentioned by Ruggiero and Jay4). Olivecrona and Riives5 reported 5 cases among a total of 43 cases of arteriovenous aneurysm of the brain in which the blood supply came largely, but not solely, through branches of the external carotid artery, although the aneurysmal malformation was actually located within the brain. The 3 cases of communication between the external carotid system and the intracranial venous system reported herein emphasize the need for exact knowledge of the arterial supply if these anomalies are to be corrected. These vessels are difficult to visualize because they are obscured by the upper cervical part of the spinal column and by the mastoid process. This report also emphasizes the value of the television-subtraction method in addition to selective carotid angiography.

REPORT OF CASES
Case 1. A 49 year old woman had as her principal neurologic symptom nocturnal, mild, intermittent, dull headache of 1 year's duration. The pain was located over the mastoid bone behind the left ear, with "thumping" in the same area also being noted. A mechanical, continuous bruit was heard over the left posterior mastoid region which was obliterated by pressure over the carotid artery. The skull roentgenograms were normal. A left common carotid angiographic examination showed an anomalous arteriovenous communication between the left occipital artery and the left transverse sinus about 2 cm. lateral to the torcular Herophili and another arteriovenous communication between the left posterior auricular branch of the left external carotid artery and the sigmoid sinus (Fig. 1, A and B; and 2, A and B).

After high ligation of the left external carotid artery (above the level at which the twelfth cranial nerve crossed the artery), the patient no longer heard the noise in the left ear and no bruit could be heard.

Case II. A 28 year old man came to this clinic with the chief complaint of proptosis of the right eye of 5 months' duration. He also had had pain in the right frontal region and around his right eye. These symptoms occurred about once a month, were throbbing in nature, and lasted for 10 to 15 minutes. The pain was relieved by aspirin.

Physical examination revealed right proptosis with engorgement of the eyelid and pulsation of the upper lid; a bruit was heard over the orbit. The bruit and pulsation of the lid were reduced by occlusion of the carotid artery. No venous engorgement was noted inside the eye. The plain skull roentgenograms were normal. Right common carotid and selective internal carotid angiograms demonstrated arteriovenous

* From the Mayo Clinic and Mayo Foundation: Section of Roentgenology (Dr. Holman) and the Mayo Graduate School of Medicine (University of Minnesota), Rochester: Resident in Radiology (Dr. Takekawa).

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communications between a branch of the right external carotid artery, probably the auricular branch, and the jugular vein just at the jugular foramen, with retrograde filling of the sinus communication with the jugular bulb and the cavernous sinus. The cavernous sinus thus received arterial blood from the external carotid artery and the ophthalmic vein was distended (Fig. 3, A, B, C and D).

After ligation of the right external carotid artery, the retinal artery pressures were reduced in the right eye and the proptosis was less severe. The bruit disappeared as did the pulsation of the eyelid.

Two months later right proptosis recurred. A right retrograde brachial angiogram was made at another institution and was reported to show a carotid-cavernous fistula. Apparently, other communicating channels had developed. A left carotid angiogram made at the same time was negative.

Case III. The patient, a 39 year old man, had had grand mal type seizures for 10 years and had been taking diphenylhydantoin (dilantin). He complained of throbbing headaches involving the upper occipital region for 2 years. These were partially relieved by analgesics. The routine skull roentgenograms were normal.
A right common carotid angiogram showed an anomalous arteriovenous communication between two branches of the posterior occipital branch of the right external carotid artery and an anomalous intracranial vein. The lesion extended through the right temporal fossa (Fig. 4, A and B).

It was thought that the lesion was too extensive to be removed, and it was suggested that he continue on medical management.

**COMMENT**

In these 3 cases of communications between a branch of the external carotid artery and the intracranial venous system, the appearances were similar to those of other arteriovenous malformations. Selective angiography, usually by a catheter technique, is important in order to determine the exact nature of the anomaly.
Embryologically, emissary veins are all formed as channels that primarily drain extracranial structures medially into the sinuses and later anastomose with tributaries of the external jugular system. The condylloid emissary vein connects the sigmoid sinus or the marginal (occipital) sinus, when present, or both with the vertebral deep cervical veins or both. The mastoid emissary vein connects the sigmoid sinus with the posterior auricular (or occipital) veins. These two emissary veins, together with the hypoglossal, sphenoid, and inferior petrosal emissary veins, explain the important collateral channels now known to exist between venous sinuses and the extensive group of veins surrounding the vertebral column.

The arteriovenous anomalies described herein may be the result of connection between branches of the external carotid artery and important basal emissary veins. Since these communications are most frequently located in the basal portion of the skull and in the upper cervical part of the spinal column, they are therefore often obscured in angiograms by the dense basal bone of the skull, especially in the mastoid region of the temporal bone. Our experience has been that some kind of subtraction method is very useful in making an exact diagnosis of such an anomaly and, because it is necessary to study many sequential roentgenograms, it is convenient to use the rapid television method. The magnification technique applied to the television system also aids materially in visualizing these anomalous communications.

**SUMMARY**

Three cases of anomalous communications between the external carotid artery and intracranial veins are reported and the value of the technique of television-subtraction as applied to the carotid angiograms is demonstrated.

The Mayo Clinic
Rochester, Minnesota

**Fig. 4.** Case III. Television-subtraction pictures of angiograms. (A) Anteroposterior view of right common carotid angiogram. (B) Lateral view of right common carotid angiogram. Note anomalous arteriovenous communication between two branches of the posterior occipital branch of the right external carotid and the anomalous intracranial vein. The lesion extended through the right temporal fossa.

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