Collateral Circulation to a Parietal Arteriovenous Malformation Following Bilateral External Carotid Artery Ligation

Case Report

ROBERT C. CANTU, M.D., ERNEST J. FERRIS, M.D., AND EDWARD P. BAKER, JR., M.D.
Departments of Neurosurgery and Radiology, Boston City Hospital, Boston, Massachusetts

Arteriovenous malformations of the brain located above the tentorium are supplied, for the most part, by the internal carotid system. It is rare for the external carotid system to supply exclusively a supratentorial arteriovenous malformation. Recently, however, two cases of intracranial supratentorial arteriovenous malformations with "purely external carotid contribution" have been reported. In each of these cases the lesion was treated by bilateral ligation of the external carotid system. The authors state: "The importance of such a demonstration of an enlarged feeding artery cannot be over-emphasized; it may prevent an unnecessary craniotomy." They furthermore report that bilateral ligation of the external carotid system gave good results in each of their two patients. A similar result was reported by Ciminello and Sachs following ligation of the feeding artery to a posterior fossa intradural arteriovenous malformation. However, in none of these "good results" was a postoperative angiogram performed.

We are reporting a case of an intracerebral supratentorial arteriovenous malformation to stress the need for postoperative angiography and to disprove the concept that ligation of the arterial supply to an arteriovenous malformation will necessarily eliminate it.

Case Report

This 74-year-old woman entered the hospital after having experienced two grand mal seizures which began in the left leg and arm. She had been hospitalized 26 years previously with a subarachnoid hemorrhage.

Examination. The patient was semicoma- tose, and showed no evidence of external trauma. There was no stiff neck nor lateralizing motor, sensory, or reflex abnormalities. Plantar reflexes were extensor, bilaterally. The optic discs were flat and no retinal hemorrhages were present. There was no bruit. Skull films disclosed a calcified lesion in the right parietal occipital region (Fig. 1). After the emergency administration of intravenous Valium and Dilantin, a right carotid arteriogram localized the calcium within a large arteriovenous malformation (Figs. 2 A and B), and eliminated the possibility of an associated intracranial hematoma. Lumbar puncture revealed an opening pressure of 180 mm; the cerebrospinal fluid was clear and colorless.

Over the next 24 hours the patient gradually regained consciousness and was found to have a complete left hemonomous hemianopsia and a moderate left-sided sensory loss. Subsequently, left carotid (Fig. 3) and right brachial angiograms were done.

Operation. Because it appeared that the lesion was supplied exclusively by the external carotid, first the right and then the left external carotid arteries were ligated.

Postoperative Course. The patient tolerated the procedures well. Prior to discharge a four-vessel study disclosed that the lesion was

Fig. 1. Plain skull x-ray shows an ovoid calcific density (arrows) in association with large vascular grooves in the calvarium.
now supplied by an anastomosis from the vertebral artery to the external carotid artery above the ligation (Fig. 4). The patient was discharged asymptomatic on Dilantin. She has had no seizures in the 6 months since discharge and leads a vigorous, active life.

Discussion

According to Olivecrona,\(^6\) angiomias, including arteriovenous malformations, capillary and venous angiomata, cavernous angiomias, and capillary telangiectasea, comprise approximately 4\% of all brain lesions. The generally accepted etiology of non-traumatic arteriovenous malformations is well stated by Kaplan, et al.:\(^5\) “The underlying lesions appear to represent a perpetuation of a primitive arteriovenous communication, a shunt which normally would be replaced by intervening capillary network.” If an arteriovenous malformation is present, arteriograms will usually show:

1. One or more large feeding arteries which, as they enlarge in diameter, also increase in length and become tortuous
2. One or more communications between an artery and a vein
3. Large draining veins with abnormally early opacification.\(^9\)

Our case supports Elkin’s opinion that “ligation without excision usually results in a recurrence, since the fistula will be re-established rapidly by collateral vessels.”\(^3\) The vascular supply to the lesion that existed following occlusion of both external carotid arteries was not visualized by preoperative angiography. It seems likely that a major

---

**Fig. 2 A.** Preoperative anteroposterior view of right common carotid angiogram illustrating a large arteriovenous malformation (upper arrow). The external occipital division of the external carotid artery is hypertrophied (lower arrow).

**Fig. 2 B.** Right lateral selective external carotid angiogram, arterial phase. There is hypertrophy of the superficial temporal artery (upper black arrow), the posterior division of the middle meningeal artery (middle black arrow) and the external occipital artery (lower black arrow), all of which supplied the arteriovenous malformation (clear arrow).

**Fig. 3.** Preoperative anteroposterior view of left common carotid angiogram. The arterial emptying phase shows that the left intracranial carotid system fills the arteriovenous malformation (arrow).