Red Cerebral Veins

A Report on Arteriovenous Shunts in Tumors and Cerebral Scars*

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There is no firm anatomical evidence for the existence of direct connections between arteries and veins in the normal human brain. But at operation for a variety of lesions, cerebral veins are sometimes seen to be partly or wholly filled with a stream of red arterial blood. Such red veins are usually single or few in number, remaining restricted to the area around the lesion, and are readily distinguished by their contrasting color from nearby normal-appearing veins.7

In addition to their obvious presence in arteriovenous malformations, where they have long been familiar to neurosurgeons, red cerebral veins have now been noted in association with benign as well as malignant brain tumors, cerebral cysts and scars, and local areas of epileptogenic cortex.

Penfield15,16 first reported this phenomenon in patients undergoing operations for epileptic seizures, during which veins were temporarily filled with red blood after spontaneous or induced attacks. He interpreted this as a postictal reactive hyperemia following upon the relative ischemia of the cerebral cortex during the seizure. In studies with von Sántha and Cipriani18 on changes in local cortical blood flow, he presented evidence to support this view.

A distinction was made between the appearance of red blood in a vein draining a local region involved in focal epileptic discharge and the widespread reddening of cortical veins following a convulsion. Erickson4 was able to reproduce this generalized reddening in experimental animals by temporary vascular or respiratory obstruction.

In two examples of red veins near cystic scars, also described by Penfield,16 this interpretation of postictal hyperemia did not seem applicable, since the red color of the veins was observed as soon as the dura mater was opened, and appeared independently of seizures.

In their discussion on early venous filling in angiography of malignant tumors, Tönnis and Walter27 mentioned, without further comment, that they had observed "das helrote Blut in den Venen im Bereich eines Glioblastoms."

In 1954, two striking examples of red cerebral veins—one in a vascular glioma (Case 5) and another associated with a parietal infarct from carotid thrombosis (Case 9)—aroused renewed interest in this problem. Over the past 10 years similar examples at operation have been noted in detail and photographed in color. Since the original observations of Penfield, there has been little reference in the neurosurgical literature to red cerebral veins. We wish to direct attention to their occurrence, to describe selected examples and to consider these in relation to regional changes in blood flow through the brain.

Circumstances in which we have observed red veins can be outlined for the purpose of discussion into two main groups.

(1) Structural Arteriovenous Shunts. These lesions, with abnormal blood vessels providing direct connections between arteries and veins, include arteriovenous malformations, hemangiomas, vascular meningiomas, vascular gliomas and some metastatic tumors.

(2) Metabolic Arteriovenous Shunts. Red
blood appears in veins that drain a local region of brain that utilizes oxygen inadequately.

This may be transient, as in the post-convulsive period, or present as a persistent change when red veins drain a local zone of permanently abnormal tissue, such as a necrotic tumor, an infarct, a scar or the region about a cyst.

**Case Reports**

1. **Structural Arteriovenous Shunts**

   **Case 1.** G.S., aged 20 years, 3 days before admission had sudden headache, weakness and numbness of the left arm, and poor vision. Examination showed stiffness of the neck, a left hemianopia and impaired sensibility of the left side of the body. On rapid serial angiographic films, an early-filling vein in the posterior parietal region leading from a small spiral vessel indicated an arteriovenous malformation (Fig. 1).

   At operation (October 1961) when the tense dura mater was reflected a vein of medium size and several of smaller size in the midparietal region were bright red. They lay on the cortex which appeared yellow and bulging over an area 5 cm. in diameter. Four cc. of old fluid blood were aspirated from this region and a moderate amount of blood clot was removed through a small incision in the overlying thin cortex. The veins below and in front of the hematoma were of normal color.

   **Comment.** In this instance, in addition to the small arteriovenous communication there was undercutting, thinning and compression of the cortex by the intracranial hematoma. These features, characteristic of an angiomatous shunt, will also be apparent in other types of lesions to be described subsequently in which the presence of a structural arteriovenous connection was less obvious.

   **Case 2.** E.W., aged 45 years, suffered from sub-occipital headaches and vomiting for a month. She showed cerebellar signs and early papilledema. Vertebro angiography showed a vascular blush in the distribution of the left posterior inferior cerebellar artery. No definite venous drainage could be made out on the angiogram.

   At operation (December 1960) a small well-circumscribed hemangiblastoma was present in the left cerebellar hemisphere near the midline. Lateral to it was a cyst containing 10 cc. of yellow fluid under moderate pressure.

   A vein coming from the superior pole of the tumor was red. Another on the opposite cerebellar hemisphere which appeared to drain the deep aspect of the tumor was also red. Two smaller veins from the inferior pole of the cerebellum and cerebellar tonsils running up in the midline were blue.

   **Comment.** This vascular tumor was also associated with a cyst which had produced undermining and compression of the cerebellar cortex.

   **Case 3.** U.C., aged 59 years, had progressive difficulty in speech, right-sided weakness and hemianopia for 2 months.

   On the serial angiogram the arterial phase showed abnormal blood vessels in the sylvian region (Fig. 2A). The later arterial phase showed early filling of two veins corresponding to those noted to be red at operation. Another film clearly demonstrated laminar flow for a distance of several cm. along the large rolandic vein (Fig. 2B).

   At operation (October 1961) abnormal tortuous vessels formed a tangled mass over the temporal cortex (Fig. 4). The vein of Labbé and a large rolandic vein were red. A cyst extended deep to the cortex in the posterior sylvian region. The tumor was a malignant glioma.