Dense Calcification in a Large Cavernous Angioma
Case Report

J. B. Runnels, M.D., D. B. Gifford, M.D., P. L. Forsberg, M.D., and J. W. Hanbery, M.D.
Departments of Surgery (Division of Neurosurgery) and Radiology, Stanford University School of Medicine, Palo Alto, California

Cavernous angiomas are important vascular malformations in the central nervous system in that, as space-occupying lesions, they may produce a wide range of clinical symptoms, or, as vascular anomalies, they may spontaneously and catastrophically rupture. They are potentially curable by surgical removal, with less surgical risk from interruption of cerebrovascular supply than most other vascular malformations, since there are no large feeding arteries or draining veins. The variation in size, location, and radiological findings make the diagnosis of cavernous angiomas confusing.

Case Report
A 30-year-old unemployed farm laborer was transferred to the Palo Alto Veterans Administration Hospital in July, 1967, for evaluation of left leg tremor. In 1947, at the age of 10 years, the patient had a severe, acute, febrile illness with headache, stiff neck, and coma for about 7 days. Recovery had been slow but complete, and a diagnosis of meningitis had been made.

In 1961, 14 years later, the patient developed progressive contracture of the left leg until he was walking on his left tiptoes. In January, 1963, focal seizures in this leg led to hospitalization at Fresno, California. Significant findings at that time were left calf atrophy, a coarse resting tremor and spasticity of the left leg, a visual field defect, and retinal scarring consistent with old chorioretinitis, a right frontotemporal electroencephalographic focus, and calcification in the right temporal region (Fig. 2). A pneumoencephalogram was unsuccessful. A right carotid arteriogram was interpreted as normal. A ventriculogram was performed, with visualization of the left but not the right ventricle. He was then discharged to receive physical therapy as an outpatient and declined further investigation.

Over the ensuing 4 years the tremor became an explosive and disabling phenomenon. In June, 1967, he was admitted to the Fresno Veterans Administration Hospital and was subsequently transferred to Palo Alto for neurosurgical investigation.

Examination. The patient was a husky, slow speaking, but alert and intelligent man in no apparent distress except for inability to halt a violent tremor of the resting left leg. Bilateral posterior parietal burr holes were palpable. Left visual acuity was impaired to 20/40, and the left visual field was markedly constricted with preservation of only central and some inferior vision. There was moderate scarring in the left retina with pigmented deposits medially and about the disc margins, and fresh hemorrhages at the inferotemporal disc margin. There was marked left leg and thigh atrophy with left Achilles shortening. There was generalized hyperreflexia and hypertonia, more marked on the left, without clonus or extensor plantar sign. The left leg tremor stopped during purposive movement, when attention was diverted, and during sleep. There was a mild left central facial paresis.

A brain scan with 7 mc of Technetium /sup99m revealed a very large area of increased uptake (11 × 11 × 9 cm) in the right frontotemporoparietal region (Fig. 2); rapid sequence scintiphotos showed well-defined major arteries on the left but a very poorly-defined right middle cerebral artery on the right. Also, there was markedly diminished flow seen both early and late on the right side, with no paradoxical late filling (Fig. 3). Skull x-rays revealed an extensive area of calcification in the right temporoparietal...
region (Fig. 1 right). Electroencephalography (EEG) showed slow waves over the entire right hemisphere, with focal abnormality in the right frontotemporal region; there appeared to be no consistent relationship of the involuntary movements of the left leg to the focal EEG abnormality; when the patient was asleep the left leg tremor was absent, but the focal EEG abnormality was unchanged.

Bilateral carotid arteriograms revealed a shift of the anterior cerebral artery system 3 mm to the left, and a large avascular deep frontal mass (Fig. 4 left). A pneumoencephalogram was performed with an opening pressure of 250 mm; spinal fluid protein was 76 mg%. The third ventricle was displaced 13 mm to the left. There was some filling of the right occipital horn and partial interventricular foraminal obstruction with no filling of the right temporal horn. The left lateral ventricle was dilated. The right lateral ventricle was extremely narrowed, and the right cisterna ambiens was compressed (Fig. 4 right).

Operation. On July 26, 1967, a right frontoparietal craniotomy was performed. A calcified, rubbery, purplish-brown, knobby, subcortical right frontotemporoparietal mass was found extending into the right lateral ventricle and basal ganglia. Although the mass appeared to be adherent to the surrounding neural tissue, it could be rather easily separated from it by blunt dissection. An estimated 75% subtotal removal was accomplished with the cutting electrocautery loop and curettage; hemorrhage was difficult to control, and at one point responded only

Fig. 1. Skull x-rays showing increase in punctate calcifications of right deep frontal region between November 1962 and July 1967. Left: Fresno County General Hospital, November, 1962. Right: Palo Alto Veterans Administration Hospital, July, 1967.

Fig. 2. Brain scan, Tc99m, right lateral view, showing a very large area of increased uptake in the frontotemporal region.
to application of bone wax. A conservative estimate of the dimensions of the mass at surgery was 9 × 9 × 7 cm.

Postoperative Course. The patient had fever and headache for 4 weeks but remained alert, coherent, and oriented. An initial left hemiparesis resolved completely. There was no evidence of abnormal involuntary tremor or motion of any kind, nor has this recurred. A left gastrocnemius release, neurectomy, and skin grafting provided him with a near-normal gait. In January, 1968, he returned to his previous work of driving a tractor. Follow-up skull x-rays showed residual calcification in the deep inframedial frontotemporal region.

Pathological Examination. The gross specimen consisted of multiple ragged fragments of dark red friable tissue, with multiple tiny calcified spicules on sectioning. The aggregate weighed 42 gm. The microscopic examination revealed numerous blood channels of varying size lined by thin, flat, single-layered endothelium (Fig. 5 left). The walls of these channels consisted of dense collagen and showed only rare elastic fibers. These vascular channel walls were closely contiguous, especially centrally, and con-

Fig. 3. Left: Rapid sequence scintiphoto taken at the 15–17 second interval after intravenous ante-cubital injection of Technetium. This anteroposterior view demonstrates diminished middle cerebral arterial blood flow to the right cerebral hemisphere. Right: Schematic superimposition of internal carotid arterial system on scintiphoto to show anterior and middle cerebral artery shifts in relation to the distribution of radioactivity.

Fig. 4. Left: Right carotid arteriogram, lateral view, with subtraction. There is downward displacement of the posterior cerebral arteries, elevation of the arteries of the Sylvian triangle, and a wide sweep of anterior cerebral arteries. No tumor vessels or abnormal feeding or draining vessels are noted. Right: Pneumoencephalogram showing marked distortion of right lateral ventricle with shift of the midline structures to the left.
tained hemosiderin deposits, calcium, and numerous irregular bone trabeculae which appeared to be occasionally surrounded by or containing osteoblasts (Fig. 5 right). Thrombosis was present in many of the spaces in different stages of organization (Fig. 6 left). At the edge of the lesion the brain showed marked astrocytic proliferation and numerous blood capillaries with ferrugination (Fig. 6 right). Lymphocytic infiltration around a few larger vessels was also noted. There was no evidence of malignancy. The final diagnosis was cavernous hemangioma of the cerebrum.

Discussion

Although this case demonstrates some unusual features, such as dense radiological calcification, very large mass, ossification, and clinical presentation as resting involuntary tremor, the value of the report lies in the recognition of the characteristic features of a typical cavernous angioma.

According to Russell and Rubinstein,15 cavernous angioma is a vascular malformation comprised of a honeycomb of dilated contiguous vascular spaces of varying sizes, filled with blood and separated by thin layers of fibrous tissue. The vascular lumens are lined with a single layer of endothelial cells with no adjacent cellular stroma, while the walls are lined with collagen of varying thickness. There may be considerable thrombosis in different stages of organization; histological calcification is common, and even osseous formation may occur. Hemosiderosis and gliosis are usually found within surrounding neural tissues. The malformation is well defined and circumscribed, although generally not encapsulated. The essential histological feature that distinguishes the cavernous angioma from all other vascular hamartomas is that there is no intervascular neural tissue.10,15

Cavernous angiomas are relatively rare in the central nervous system, comprising about 5% of non-aneurysmal vascular malformations.15 The most common site is the frontoparietal area, and focal epilepsy, frequently Jacksonian, is the most common presenting symptom. The next most common sites are the basal ganglia and pons, although we
could find no other report of involuntary tremor as the presenting symptom. Clinical symptoms may be produced by spontaneous subarachnoid hemorrhage, intracerebral hematoma formation, or by pressure as a slow-growing intracerebral or intraventricular mass. Dandy found that symptoms usually are present over 5 years and usually begin before the age of 30. Cavernous angiomas may vary in size from microscopic to massive.

A large cavernous angioma may be radiologically calcified but more commonly is not, nor is there any characteristic pattern of calcification. According to Planiol and Akerman, it is characteristically seen as a densely vascular lesion on brain scan (RIHSA), but with a slower uptake than the arteriovenous malformations; it is often misdiagnosed as a meningioma. On rapid sequence scintiphotography, there may actually be decreased flow to the side occupied by the cavernous angioma. An electroencephalogram may show focal seizure foci or slow wave abnormalities. Air encephalography will reveal abnormal shifts and distortions of ventricular structures consistent with a parenchymal or intraventricular mass. Angiography does not demonstrate a vascular blush or tumor stain; there are no abnormal feeding arteries or draining veins. Thus, angiographically, a cavernous angioma is typically an avascular mass lesion. This may also be true of capillary and venous angiomas, and the tendency of these lesions to form extensive thromboses has been cited as an explanation for their lack of opacification on cerebral angiography.

Summary

We have reported a case of a large, densely calcified intracerebral cavernous angioma with a typical history including a probable cerebral hemorrhage at a young age, followed by slowly progressive focal neurological deficits related to an expanding intracranial mass. The characteristic histological finding of extensive thromboses was present, but also the rarer finding of osseous formation and extensive calcification. The combination of radiological calcification, a delayed but dense uptake on brain scan, and
an angiographically avascular mass lesion is typical of a cavernous (or capillary-venous) angioma. It is important to diagnose these lesions because they are potentially curable by surgical removal. 16

References