Identification of a brain stone as calcified hemangioma

Case report

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A 71-year-old woman with progressive hemiparesis had a large cerebral calculus (brain stone) removed from the temporal lobe. Her condition thereafter improved remarkably. The differential diagnosis and specific methods to determine the angiomatous nature of this almost acellular mass are discussed. Reticulin impregnation, elastic tissue stain, and electron microscopy were of greatest value.

KEY WORDS □ angioma □ cerebral arteriovenous malformation □ cerebral calcification

Cerebral calculi (brain stones) have long been known. Etiological possibilities include calcified tumors, abscesses, granulomas, hematomas, metabolic calcifications, and angiomatous malformations. This paper deals with a patient who had progressive hemiparesis secondary to a calcified hemangioma. She recovered almost completely after removal of the mass. Hematoxylin and eosin stains revealed dense laminated calcification, but absence of diagnostic cells. Reticulin impregnation, elastic tissue stain, and electron microscopy demonstrated the specific nature of this lesion.

Case Report

This 71-year-old woman was admitted because of increasing difficulty in walking for 4 to 6 weeks. She progressively lost coordination in the right arm and leg, but did not have headaches or seizures. She had had a corneal scar and consequent amblyopia since childhood. The right eye was normal.

Examination. Motor examination showed a moderate right spastic hemiparesis and severe impairment of gait. Sensation of pain and touch was decreased on the right. The arm and leg on the same side were hyperreflexic, and a Babinski sign was present.

Roentgenograms of the skull revealed a dense calcification, 1.5 × 2.5 cm in size, just above the left petrous tip (Fig. 1). Computerized tomogram (CT) localized the density within the brain substance near the left cerebral peduncle (Fig. 2). The mass was denser than bone, and was considered most likely a meningioma.

Densities on the CT scans before and after infusion of contrast material did not differ. Cerebral angiography demonstrated inferior displacement of the posterior cerebral artery without tumor staining.

Operation and Postoperative Course. A craniotomy was performed because the right hemiparesis was progressive. The dense mass was in the medial part of the temporal lobe, and was not attached to the meninges. The postoperative course was uncomplicated. She was discharged with improvement in strength and coordination. Five months later, she was walking without assistance, and had almost complete resolution of the hemiparesis.

Pathological Examination. The surgical specimen consisted of multiple pieces of a hard brown mass with rough surfaces. Portions were decalcified and processed for light microscopic examination. Representative sections were stained with hematoxylin and eosin (H & E). In addition, reticulin impregnation, periodic acid-Schiff (PAS), elastic tissue stain, and the phosphotungstic acid-hematoxylin method (PTAH)
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were used. The tumor was mainly composed of spherical hyalin structures resembling psammoma bodies (Fig. 3 left). Most spherites were calcified. A few minute foci of spindle cells and a moderate number of hemosiderin-laden macrophages were scattered in the stroma. Silver impregnation revealed

FIG. 1. Lateral x-ray film showing a dense, egg-shaped mass (arrows).  

FIG. 2. Computerized tomograms demonstrate the location of the mass adjacent to the tentorium and left cerebral peduncle.

FIG. 3. Photomicrographs of the surgical specimen. Left: Numerous calcified spherical bodies are widely disseminated in the connective tissue stroma. A few spindle cells (arrow) are not clearly seen because the tissue was decalcified. H & E, X 150. Right: Fine reticulin fibers surround circular calcified structures and are scattered in the stroma. The vessels are irregular in size and shape. Reticulin impregnation, X 360.
Fig. 4. Photomicrograph showing proliferated and redundant layers of elastic tissue in an abnormal artery. Note the remnant of wavy elastica (arrow). Verhoeff, × 400.

fine reticulin fibers surrounding these laminated spherites and in the stroma (Fig. 3 right). Elastic tissue stain demonstrated a wavy elastic lamina in scattered arteries (Fig. 4). The PAS stains were difficult to interpret, but basement membranes were seen. The PTAH stain disclosed brown connective tissue fibers in some vessels, but these were not clearly shown.

For electron microscopy, 1-mm fragments of formalin-fixed tissue were washed and refixed in 2.5% buffered glutaraldehyde. The tissue was embedded in Araldite. Sections 1 μ thick were stained with toluidine blue for correlative light microscopy. Thin sections were collected on coated copper grids, stained with an aqueous saturated solution of uranyl and lead acetate, and examined in a Phillips 300 microscope.

A few capillaries were seen in the thick sections. Calcium had deposited around blood vessels, in vascular walls, and within lumina. Erythrocytes were also noted outside blood vessels. Ultrastructurally, these vessels contained numerous needle-shaped crystals within the lumina (Fig. 5). The electron-dense crystals were bound mainly to collagenous fibrils. The vessels were nonfenestrated, and lined by a single layer of endothelium. The endothelial cells were flat, and the nuclei caused the cell surface to bulge slightly into the lumen. The cytoplasm contained many micropinocytotic vesicles and cytoplasmic filaments; a few microvilli projected from the luminal surface. The basal surface of the endothelium was invested by a delicate basement membrane. Intercellular gaps were joined by tight junctions. The widened perivascular spaces contained many collagen fibers and a few electron-dense particles. Large calcareous deposits also were located extracellularly around the blood vessels.

Discussion

The diagnosis of angioma in this case was unsuspected clinically, and was not apparent on macroscopic and microscopic examination using routine H & E stains. The finding of a calcified mass suggested many possibilities, including heavily calcified meningioma, craniopharyngioma, and some gliomas. Location of the mass within the temporal lobe, its lack of meningeal attachment or connection to the pituitary region, and its noninvasive character were evidence against these diagnoses. The presence of fine reticulin fibers surrounding the laminated calcospheres suggested a vascular origin. The demonstration of an elastic layer indicated that some of the abnormal vessels were arterial. Thick and thin sections for electron microscopy confirmed the diagnosis of angioma by disclosing mainly calcified capillaries and veins. The finding of microvilli projecting into the lumen, micropinocytotic vesicles, and thin basement membrane corroborated the presence of endothelial cells. These cells were united at the plasma membrane by tight junctions.

The terms "brain stone" and "cerebral calculus" have been used by investigators to designate large, solitary or multiple, abnormal intracerebral calcifications. The origin in some cases is difficult to determine. Many authors have described these brain stones as calcified hematomas, but evidence from roentgenographic studies or routine stains alone is not sufficient, and some workers have not reported the histological findings.

Various types of brain tumors may calcify. The prevalence of calcification in intracranial neoplasms was 13.1% in the series studied by Martin and Lemmen, who found calcium in most tumors, except hemangioblastoma and schwannoma. The blood vessels in neurilemoma may be calcified in some instances, but this finding is more frequent in vascular lesions such as Sturge-Weber disease and intracranial angioma. Calcified angiomas may be solitary or multiple. Most lesions in the reported cases were composed of both large and small vascular spaces. One patient described by Penfield and Ward (their Case 3) had many calcified capillaries with some endothelial cells lining the thin walls as in our case. The angiomatous vessels in other examples have been identified on the basis of H & E stains alone, and occasionally confirmed by special stains such as Verhoeff-van Gieson and Laidlaw's connective tissue preparations. The difficulty in determining the origin of the mass in our case was resolved by silver impregnation, elastic tissue stain, and electron mi-
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evidenced by the finding of hemosiderin-laden macrophages may also be associated with calcium deposits as a result of tissue necrosis.

Some authors have described osseous tissue admixed in calcified angiomas. The presence of crystals within the lumen of blood vessels and in vascular walls in our case suggests that the calcium was deposited primarily in the blood vessels rather than the parenchyma. These crystals are similar to the hydroxapatite observed in psammoma bodies of meningioma and in bone. Formation of these crystals may be a step in the path toward ossification of the lesion.

Reported cases of calcified angiomas usually have occurred in persons between the ages of 16 to 63 years. Our patient was 71 years old. The masses may be associated with epilepsy, but caused only hemiparesis in this case. The complaint of motor weakness was probably the result of pressure by the mass. The remarkable degree of recovery from the neurological deficit after surgical removal of the lesion supports this view, although it is difficult to explain the late and brief onset.

With regard to roentgenographic findings in calcified angiomas, arteriograms usually disclose an avascular mass as noted in our case. Furthermore, the pre- and postcontrast densities on the CT scan were identical. Although small amounts of blood may flow into the narrow lumen of some vessels as evidenced by the presence of a few erythrocytes outside the vascular spaces, the minimal patency of the calcified vessels was not sufficient for the radioactive materials to accumulate.

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References


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