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Intracranial Cavernous Hemangiomas: Neuroradiologic Review of 36 Operated Cases

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Neuroradiologic studies in 36 cases of histologically verified intracranial cavernous hemangiomas were reviewed. Radionuclide brain scans were positive in 17 of 19 examinations. Angiography, performed in 35 cases, usually showed an avascular area with absent or moderate mass effect. Capillary blush and/or early draining veins, often mentioned in single case reports, were observed in only seven cases. Computed tomography (18 cases) usually demonstrated a hyperdense, nodular, or irregular lesion without significant mass effect and always enhancing after contrast injection. The combination of a long clinical history of focal epilepsy with computed tomographic and angiographic findings should suggest the diagnosis of cavernous hemangioma. In all cases of so-called spontaneous hematoma with negative angiography, computed tomography should be repeated after a long interval to exclude the presence of a cavernous hemangioma or other cryptic vascular malformation.

Cavernous hemangiomas of the brain are well circumscribed vascular malformations composed of thin-walled sinusoidal spaces lined with endothelium; they have no elastic membrane, no muscular tissue, and no intervening nervous parenchyma.

Their frequency seemed to be quite low simply because they often remain undiagnosed during life; however, the pathologic material published by McCormick et al. [1] in 1968 demonstrated that they are the second most common cerebral vascular malformation after arteriovenous malformations (AVMs). Furthermore, the possibility of diagnosing them offered by computed tomography (CT) has increased their recognition during life. We reviewed all the neuroradiologic studies performed in a series of 36 intracranial cavernous hemangiomas operated on at the Istituto Neurologico of Milan from 1954 to 1981. The clinical and surgical aspects of the first part of this series (14 patients) were reported by Giombini and Morello [2], and preliminary neuroradiologic review has also been reported [3].

Materials and Methods

Thirty-six cases of histologically verified intracranial cavernous hemangiomas were reviewed. There were 20 males and 16 females. They were 14 months to 61 years old. The cavernous hemangiomas were less common under age 20 (seven cases) and over 50 (six cases), being almost equally distributed in the third, fourth, and fifth decades.

The most common clinical presentation was epilepsy (25 cases), usually focal (21 cases). Focal neurologic signs were present in 12 patients. The clinical presentation was sometimes acute, caused by hemorrhage leading to immediate hospitalization and diagnosis (six cases); however, in three of these cases, the bleeding had been preceded by a long history of focal epilepsy. In one patient, the first episode of bleeding led to the surgical removal of an intracerebral hematoma, but the cavernous hemangioma was found 5 years later during the second hemorrhage. At the time of operation, the average duration of symptoms was 4.3 years, with a maximum of 27 years.

The radiologic studies included skull films in all patients. Radionuclide studies were available in 19 cases. Pneumoencephalograms were obtained in 17 patients; in one case, air ventriculography had been performed. In all but one case, the appropriate angiographic study (carotid or vertebral or both) was performed; in five patients angiography was performed twice. CT scans were available in 18 patients; in 17, both pre- and postcontrast studies were performed; in one, only a precontrast scan was obtained.

Of the supratentorial cavernous hemangiomas, 14 were located in the left hemisphere and 18 in the right hemisphere without preferred localization. In one case the location of the cavernous hemangioma was extradural; the lesion eroded the right lesser wing of the sphenoid, bulging both into the middle fossa and the orbit.

In three cases, the cavernous hemangiomas were located in the posterior fossa. One was in the pons, one in the right cerebellar hemisphere, and the third was attached to the dura and represented an incidental operative finding in a patient with chordoma of the clivus.

These angiomas occurred in association with other lesions in three other instances. One right frontal cavernous hemangioma was a surgical incidental finding in a patient with an astrocytoma. Another patient, in whom a cavernous hemangioma had been removed from the left hemisphere, was readmitted 9 years later with right hemisphere symptoms. Three lesions were found; one in the rolandic area, which had bled, and two very small ones in the temporooccipital region. They were all removed. Histologic examination demonstrated venous dysplasia at the periphery of the hematoma and in the other two locations, without definite aspects of cavernous hemangioma. It is noteworthy that this same patient also had a cavernous fibrohemangioma removed from his leg. A third patient had a coexistent meningioma.

Results

Skull films showed fine granular or coarse calcifications in three cases. Sellar changes consistent with increased intracranial pressure were found in three patients. In one of these, however, they were attributable to a coexistent parasagittal meningioma. In the only extradural lesion, bone erosion of the right lesser wing of the sphenoid was observed.

Radionuclide brain scans were positive, usually with a marked uptake, in 17 of 19 examinations. The negative scans occurred in two small lesions with diameters less than 2 cm.

Pneumoencephalography was abnormal in 11 of 17 examinations; the location of the cavernous hemangioma was usually indicated by mass effect upon the ventricular system. In two cases, local cortical atrophy or focal absence of filling of the sulci in the area of the hemangioma was found.

The only air ventriculogram demonstrated a large right parietal lesion.

Angiography was completely normal, even on retrospective analysis, in seven of 35 cases in which it was performed. In 13 cases, displacement of vessels without pathologic circulation was seen; the displacement was usually mild or moderate. In eight other cases, the pathologic findings were limited to an avascular area visible in the capillary phase (fig. 1). In seven cases, pathologic circulation was seen, generally consisting of a faint capillary blush and/or early draining veins (figs. 2 and 3). In one of these cases, marked

pathologic circulation was supplied by the temporal branch of the middle meningeal artery; at surgery, a left temporal intracerebral cavernous hemangioma, also attached to the dura, was found.

Of the five cases with repeat angiography, two showed some differences. There was an early draining vein in one and pathologic circulation in the other (fig. 3).

CT demonstrated the cavernous hemangioma in 17 of 18 cases in which it was performed. In one case, a very small cortical cavernous hemangioma not seen on CT was an incidental operative finding in a patient with astrocytoma.

On precontrast study, the lesion appeared hyperdense in 11 cases, usually as a nodular area without mass effect (figs. 4 and 5). In three cases, mixed hyperdense and hypodense areas were observed, with a ring pattern in two. In one of these two cases, the hypodensity was well defined and corresponded to a cyst. In three cases, the cavernous hemangioma, isodense, was recognizable only after contrast injection. On postcontrast study, enhancement was observed in all cases, usually nodular, well delineated, and of various intensity.

Calcifications were seen in five cases (fig. 6). In five cases mass effect was present; it was marked in two (fig. 7). In seven cases, poorly defined hypodensity surrounding the lesion was considered consistent with edema or gliosis.

Discussion

Cavernous hemangiomas are peculiar with respect to the other vascular malformations because they do not have intervening brain parenchyma among the vascular spaces that form the malformation. They do not have a true capsule, but appear, on gross pathology, as well delineated brownish or reddish masses, often polylobulated. Cavernous hemangiomas can be extremely small or a few centimeters in diameter, but they do not reach the large size of some AVMs and they bleed less frequently than AVMs [1].

They are the second most common type of vascular malformation, and, in the large pathologic series of McCormick et al. [1], they had a 1:3.6 ratio with AVMs. By contrast, in the neuroradiologic literature, papers related to cavernous hemangiomas have been extremely rare until a few years ago, thus seeming to be less common than published pathologic series suggest. This was probably because this type of angioma often remained undiagnosed even after angiographic examination and was detected only at surgery, after it had bled [4].

In the early 1970s, there were several reports in the neuroradiologic literature. Most comprised single cases or very small series. They indicated a capillary blush and/or an early draining vein as the diagnostic features of the cavernous hemangiomas [5–10]. In the last few years, CT has increased the possibility of detecting these often angiographically occult vascular malformations [3, 11–13].

Reviewing our series, previously common studies such as pneumoencephalography and ventriculography appeared to be of little value, and they are not discussed here.
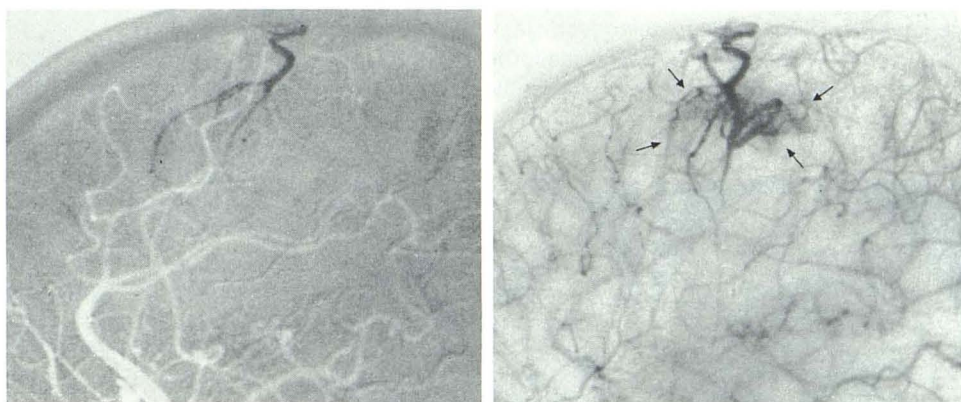
Fig. 1.—Primarily "avascular" lesion. Cavernous hemangioma in left frontal lobe. Carotid angiogram. Avascular area with minimal displacements more evident in late arterial or capillary phase (arrows).
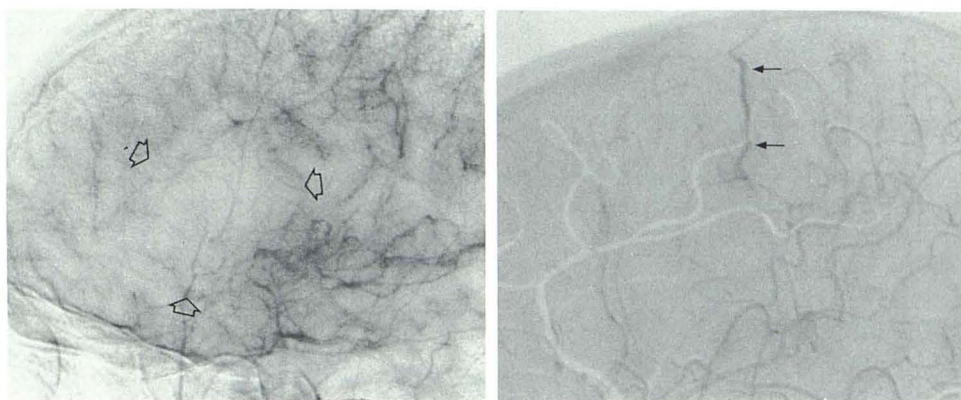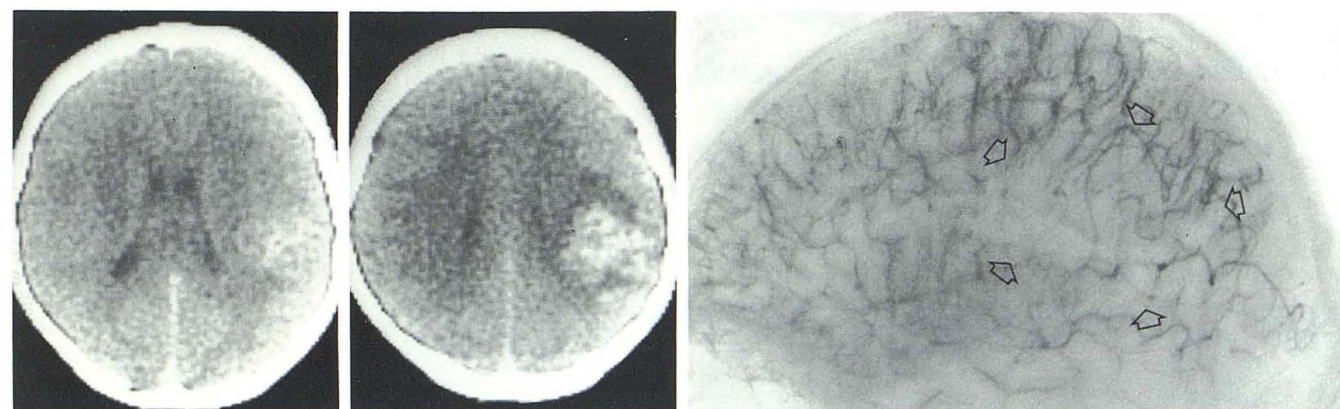
Fig. 2.—Occult hemangioma. Carotid angiogram, sequential subtraction. Early draining vein (arrows) is only pathologic finding.

Fig. 3.—Hemangioma with blush in epilepsy patient. A, Early draining vein. B, 22 months later. Early capillary blush also evident (arrows).

Fig. 4.—Hyperdense, yet "avascular," lesion. A and B, Precontrast CT scans. Hyperdense large lesion without mass effect. C, Carotid angiogram. Avascular area without displacement in late arterial phase (arrows).

Skull films also were of little help, because calcifications are better detected by CT.

The value of radionuclide brain studies has also greatly diminished since the introduction of CT. Nevertheless, it was negative in only two cases. In one of these, the lesion was remarkably small and not recognizable even on CT. We believe that radionuclide scanning should now be considered a complementary study [11], useful in cases of heavily calcified lesions. In fact, in one case appearing as a "brainstone," in which enhancement on postcontrast CT

was doubtful because it was masked by the heavy calcifications, the radioisotope study demonstrated a readily detectable pathologic uptake.

Review of the angiographic studies in our series reveals that the reports from the early 1970s are misleading. Capillary blush and early draining veins are an infrequent feature in cavernous hemangiomas (figs. 2 and 3); the most frequent findings are mild mass effect and an avascular area in the parenchymatous phase of the angiographic series (fig. 1). Angiography's efficacy is limited even considering the technical improvements that have occurred. Cavernous hemangiomas usually appear as avascular areas even with subtraction, 2:1 magnification, and stereo views. In addition, the capillary blush and the early draining vein are very nonspecific findings, compatible with neoplastic, ischemic, and inflammatory lesions [13, 14]. Considering other types of vascular malformations, an early draining vein may be observed also in capillary telangectasias [15], in largely thrombosed AVMs, and in venous malformations [16, 17]. In venous malformations, however, the veins are more prominent than those seen in cavernous hemangiomas, and their visualization may persist in late venous phase.

A peculiar finding described by Namaguchi et al. [18], and observed by us only in a 14-month-old girl, is sedimentation of contrast medium in the large cavernous spaces of the angioma (fig. 6c). This is probably caused by slow circulation because of small feeding vessels and the large vascular bed within the malformation. However, this feature was not detected in five cases, in which 15 ml of contrast medium was injected slowly, as was suggested by these authors. Sedimentation of contrast medium is much more common in cavernous hemangiomas of the orbit; we observed it in more than half of the cases in this location after normal injection of the usual amount of contrast medium [19].

CT detected the lesion in all the cases (except the one found incidentally at surgery), and in one case it also demonstrated two additional asymptomatic vascular malformations. There are no pathognomonic features of cavernous hemangiomas, but the most common and characteristic findings are slightly hyperdense areas with enhancement after intravenous contrast injection, without significant mass effect [11]. CT was superior to angiography in defining the exact boundaries of the lesions. In a few cases, followed for years and studied by angiography before the advent of CT, the neurosurgeon felt safe in operating on high-risk areas only after CT demonstration of the limits of the lesion [3].

In two cases in our series, the cavernous hemangioma caused a hematoma, but the hemangioma was not found at the time of surgery. Only after the second episode of bleeding was the hemangioma removed. Therefore, in all cases of so-called "spontaneous hematoma" in which angiography fails to show a vascular malformation, CT should be repeated after a long interval, after the disappearance of the hyperdensity of the hematoma and of its enhancing peripheral rim, because of the possibility of detecting the pathologic nodule.

Even if CT findings of cavernous hemangiomas are not specific, the long clinical history of epilepsy and the absence of mass effect are quite helpful in differentiating them from tumors. In the 14-month-old girl mentioned above (fig. 6),
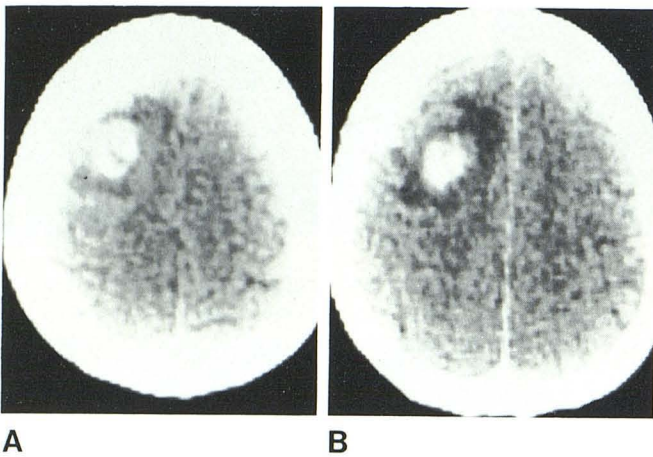

A   B

Fig. 5.—A, Precontrast CT scan. Markedly hyperdense nodular lesion. B, Postcontrast scan at slightly lower level. Enhancement of lesion, which is surrounded by hypodensity.

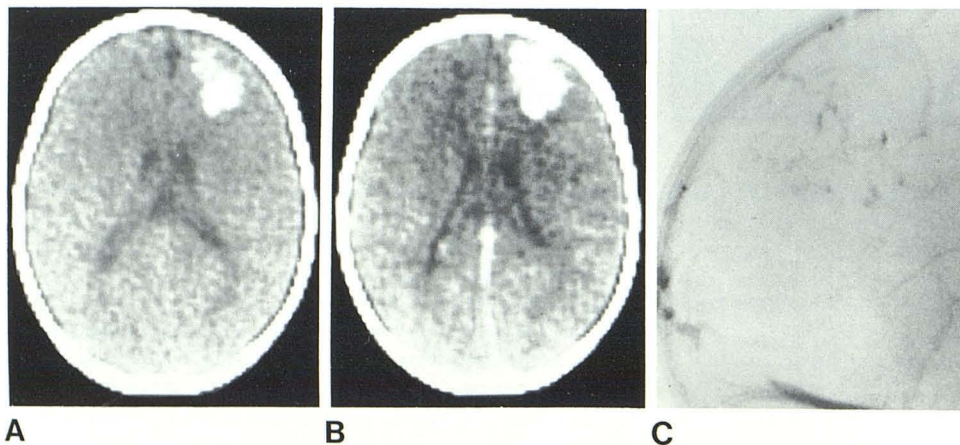A   B   C

Fig. 6.—Frontal cavernous hemangioma in 14-month-old girl. A, Precontrast CT. Calcifications without mass effect. B, Postcontrast CT. Marked enhancement surrounding calcifications. C, Carotid angiogram. Pooling of contrast medium in late venous phase.
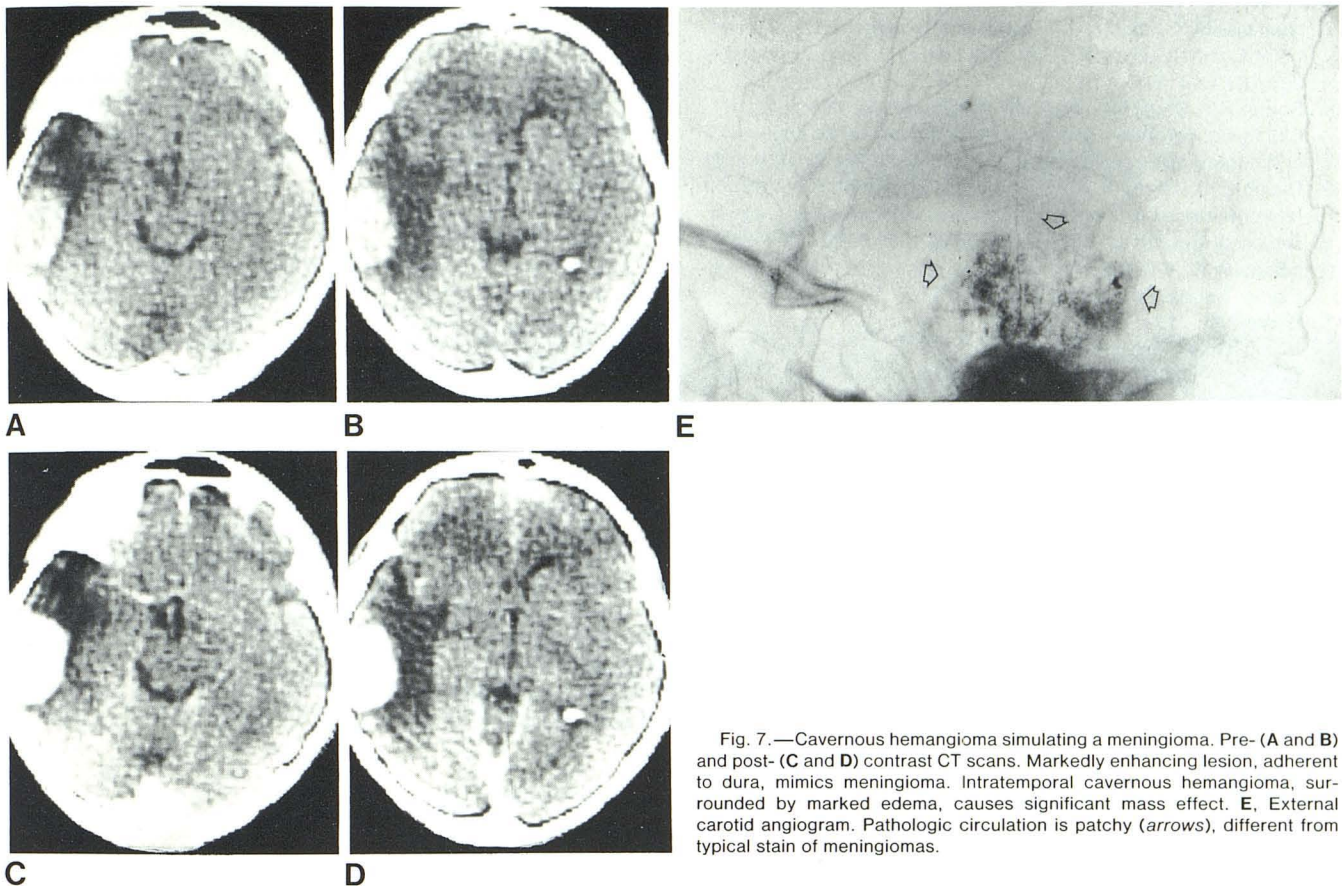
Fig. 7.—Cavernous hemangioma simulating a meningioma. Pre- (A and B) and post- (C and D) contrast CT scans. Markedly enhancing lesion, adherent to dura, mimics meningioma. Intratemporal cavernous hemangioma, surrounded by marked edema, causes significant mass effect. E, External carotid angiogram. Pathologic circulation is patchy (*arrows*), different from typical stain of meningiomas.

reactive or neoplastic astrocytic tissue was found, surrounding and intermixed with the cavernous hemangioma. A 4 year follow-up, however, did not show recurrence of tumor. This case may represent a hamartoma or an angioglioma such as described by Fischer et al. [20].

In the group of vascular malformations, thrombosed AVMs may have similar CT features and may be indistinguishable from cavernous hemangiomas except on histologic examination [12]. In the differential diagnosis from capillary and venous vascular malformations, which may have similar features on angiography (i.e., a group of draining veins reaching a single larger collector), CT is very helpful in showing the nodular component of the cavernous hemangioma. This has important clinical implications. The venous malformations, in which CT may only demonstrate the venous channels [17, 21], should not be operated on because they rarely bleed and because the presence of normal intervening nervous tissue among the vascular channels carries a higher risk of postoperative damage. The capillary telangectasias are rare, and usually occur in the brainstem, which is not accessible to preventive surgery; surgery, therefore, is justified only for the evacuation of a hematoma.

The best demonstration of the impact of CT in demonstrating angiographically occult vascular malformations is offered by the distribution over the years of the cavernous

hemangiomas operated on at our institute; 18 were removed in the 22 years before CT, and 18 were removed in the only 6 years since CT became available.

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