Clinical Case Report

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Spontaneous thrombosis in main draining veins of unruptured cerebral arteriovenous malformations

A case report

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Abstract

Rationale: Spontaneous obliteration of unruptured arteriovenous malformations (AVMs) is rare. It occurs in <1.5% of cerebral AVMs and only 7 cases have been reported so far. This phenomenon, together with the formation and outcome of cerebral AVMs, remains barely understood. In this work, we presented a case that spontaneous venous thrombosis in main draining veins of an unruptured AVM were confirmed, and reviewed the relevant literature in order to discuss the possible mechanisms.

Patient concerns: Clinical data and treatment of a 33-year-old man with a preliminary diagnosis as right parietal mass with secondary epilepsy.

Diagnoses: The diagnosis of the mass was a right parietal arteriovenous malformation (AVM) that was 3.5 cm in size and supplied mainly by multiple feeders of right middle cerebral artery (MCA).

Interventions: An operation was performed with meticulous hemostasis of the extracranial soft tissue and the AVM was resected completely.

Outcomes: The patient's neurological deficits improved postoperatively and he was subsequently discharged 1 week after surgery.

Lessons: Thrombosis of the draining veins may be due to venous stagnation. Spontaneous venous thrombosis in an unruptured AVM is rare. Spontaneous obliteration of an AVM can occur by 2 mechanisms: occlusion of the feeding arteries or of the draining veins. Surgical or interventional treatment of an unruptured AVM with thrombosed draining veins is highly controversial now. However, we favor an aggressive treatment strategy.

Abbreviations: AP = anterior-posterior, AVM = arteriovenous malformation, CMV = cytomegalovirus, DSA = digital subtraction angiography, EBV = Epstein-Barr virus, HSV = herpes simplex virus, ICA = internal carotid artery, MCA = middle cerebral artery, MRI = magnetic resonance imaging.

Keywords: draining veins, feeding arteries, spontaneous obliteration, unruptured arteriovenous malformations, venous thrombosis

1. Introduction

Arteriovenous malformation (AVM) is an abnormal connection between arteries and veins, without normal anatomy and function which the capillary network should have.[1] This vascular anomaly can appear in any location in human body,[2] however, it is most frequently found in the brain in central nervous system and consequently called cerebral AVM or brain AVM, consisting of a nidus, arterial feeders, and draining veins.[3] Cerebral AVMs have been conventionally described as a congenital anomaly, although an increasing number of studies suggest that the etiology may be multifactorial.[4,5] Its incidence is 0.9 to 1.4 per 100,000 person-years,[3,6] and more than half of patients with cerebral AVM present with intracranial hemorrhage.[4,7] Spontaneous obliteration of unruptured AVMs is rare; it occurs in <1.5% of cerebral AVMs and only 7 cases have been reported so far.[8–10] This phenomenon, together with the formation and outcome of cerebral AVMs, remains barely understood. In this work, we presented such a case in which venous thrombosis and obliteration of an unruptured AVM were noted, and reviewed the relevant literature. The Ethics Committee of The Second Affiliated Hospital, College of Medicine, Zhejiang University approved this study and the patient provided written informed consent form. The ethical approval number was ZEYY20170803.

2. Case presentation

A 33-year-old man was referred to our hospital for counseling. The patient had a history of recurrent and paroxysmal numbness in the left limbs for 2 years. The numbness attacked 2 to 3 times per month; each episode typically lasted 1 to 3 minutes and then

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remitted spontaneously without any residual effects. One week ago, he went to a local clinic, complaining the worsened numbness. After having the head MR scan performed, the patient was informed of an intracranial mass and referred by the clinic to our hospital. We reviewed the patient history without finding any other symptoms. On examination, the patient was fully conscious, without focal neurologic deficits other than decreased sensation in the left arm and leg. According to the images from the clinic and the clinical findings, the patient was thus admitted to our department with a preliminary diagnosis as right parietal mass with secondary epilepsy. Magnetic resonance imaging (MRI) with contrast showed an approximately 3.5 cm, poorly demarcated mass in the right parietal lobe with severe perilesional edema (Fig. 1). Digital subtraction angiography (DSA) revealed a right parietal arteriovenous malformation (AVM) that was 3.5 cm in size and supplied mainly by multiple feeders of right middle cerebral artery (MCA). Neither a pedicle nor an intranidal aneurysm was detected. Cerebral angiography did not show high-flow or dilated draining veins, but small cortical veins draining the AVM slowly into the superior sagittal sinus were seen during the late venous phase (Fig. 2). Consequently, this represented a Spetzler-Martin Grade II lesion (size: 2 points, eloquence: 0 points, drainage: 0 points). Serologies, including Factor V Leiden and homocysteine, as well as antibodies including lupus like anticoagulant, anti-CMV, anti-EBV, and anti-HSV were all negative. The patient was started on anti-epileptics in preparation for surgical treatment, and then a frontoparietal craniotomy was performed with meticulous hemostasis of the extracranial soft tissue. Upon opening the dura, no obvious draining veins were found on the brain surface. The margin between the AVM and the adjacent brain tissue was developed and the AVM was resected completely (Fig. 3). Two large draining veins were discovered during this process and a lack of blood flow was confirmed with a Doppler ultrasound probe (Fig. 4). Therefore, during resection of the nidus, we confirmed our hypothesis that the patient's AVM presented with spontaneous thrombosis of the main draining veins. His neurological deficits improved postoperatively and he was subsequently discharged 1 week after surgery. Followed up 3 months after surgery, the patient had no neurological deficit and he is with normal neurological function now.

3. Discussion

A cerebral AVM is an abnormal connection between the arteries and veins in the brain, consisting of a nidus, arterial feeders, and draining veins.[1,3] Its incidence is 0.9 to 1.4 per 100,000 person-years.[3,6] Patients typically present with the symptoms caused by intracerebral hemorrhage or steal syndrome.[4,10–12] The size of the nidus typically increases with time, and although spontaneous obliteration is rare, it can occur in <1.5% of all cerebral AVMs.[3,13,14]

Spontaneous obliteration of an AVM can occur by 2 mechanisms: occlusion of the feeding arteries or of the draining veins. The pathophysiological mechanisms of the occlusion of the feeding arteries include mass effect on the feeding arteries from the intracranial hematoma or the provoked edema, atherosclerosis-induced arterial occlusion, thromboembolism, and systemic coagulation disorders.[15] The mechanisms proposed to explain spontaneous thrombosis of the draining veins are venous stagnation due to stenosis of the veins, alteration of the endothelium, thrombophilia or acquired coagulation disorders, and mass effect from the nidus on the main draining veins.[16,17] Based on different pathological mechanisms, some authors propose that the occlusion of feeding arteries could induce angiogenesis to rebuild collateral circulation, resulting in AVM recanalization, whereas the occlusion of draining veins always results in permanent obliteration which is associated with a significantly increased risk of bleeding.[17] In addition, the spontaneous venous occlusion of an AVM seems always occurs in

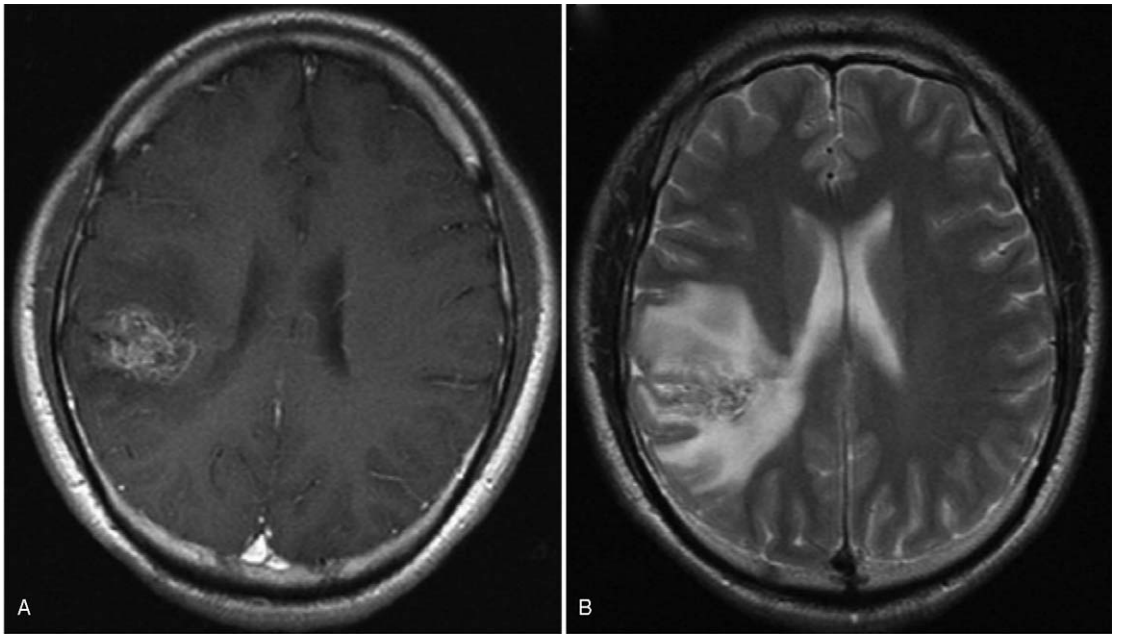

Figure 1. Brain magnetic resonance imaging (MRI) performed on admission. (A) Axial T1-weighted image showing an approximately 3.5 cm poorly demarcated mass in the right parietal lobe. (B) Axial T2-weighted image showing severe perilesional edema.

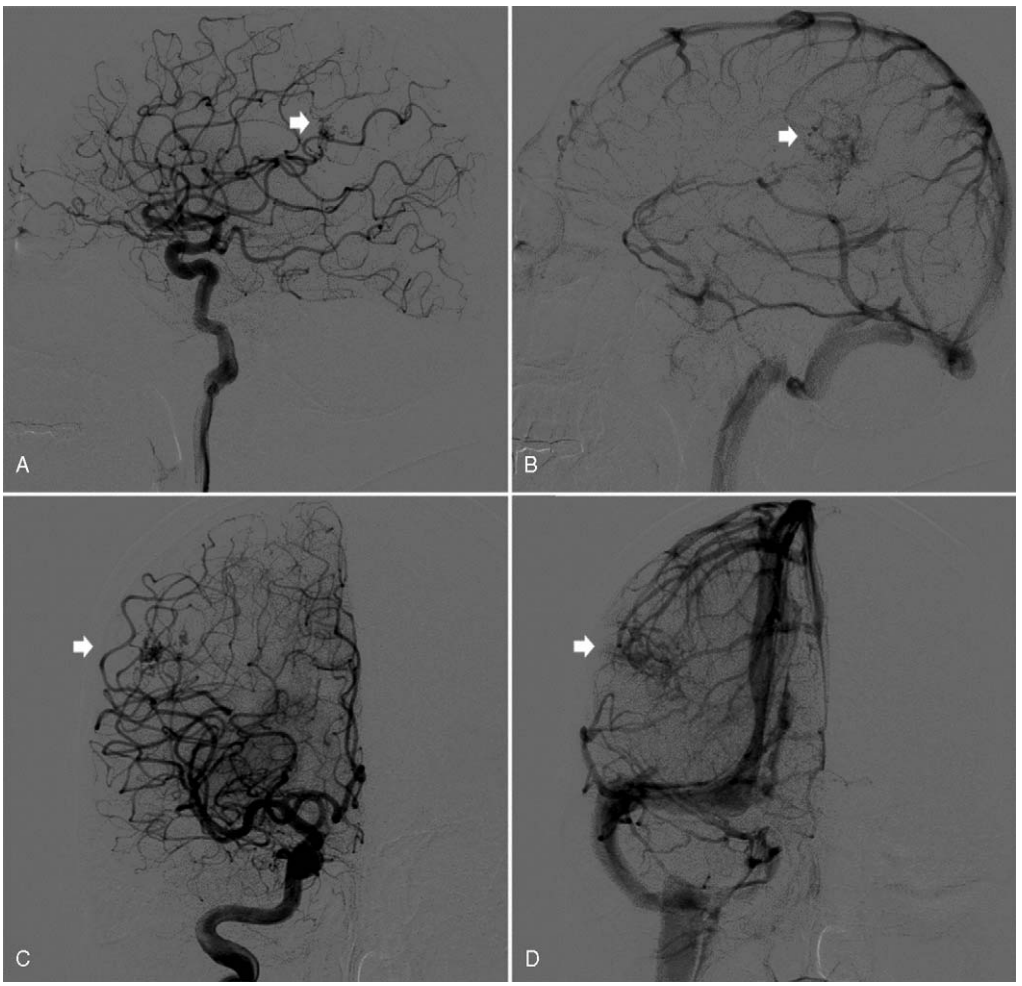

Figure 2. Selective DSA of right internal carotid artery (ICA) performed at hospital day 2 showing: lateral projections during (A) arterial phase and (B) late venous phase; anterior-posterior (AP) projections during (C) arterial phase and (D) late venous phase. The nidus is seen in the right parietal lobe (arrows). The AVM was supplied mainly by multiple feeders of middle cerebral artery (MCA), with some small cortical veins draining the AVM slowly into the superior sagittal sinus.

that having one or more dominant draining veins, which might be a contributory pathological feature.

Most reports of spontaneous obliteration of AVMs have similar clinical manifestations with the conventional subtype. In a review of previous literature, the main symptoms were related to intracerebral hemorrhage and seizures.[3,18–20] In 75% of such cases, the cerebral AVMs occlude after symptomatic intracerebral or subarachnoid hemorrhage.[16] It seems due to mass effect from the expanding hematoma that compresses the draining veins near the nidus. Furthermore,

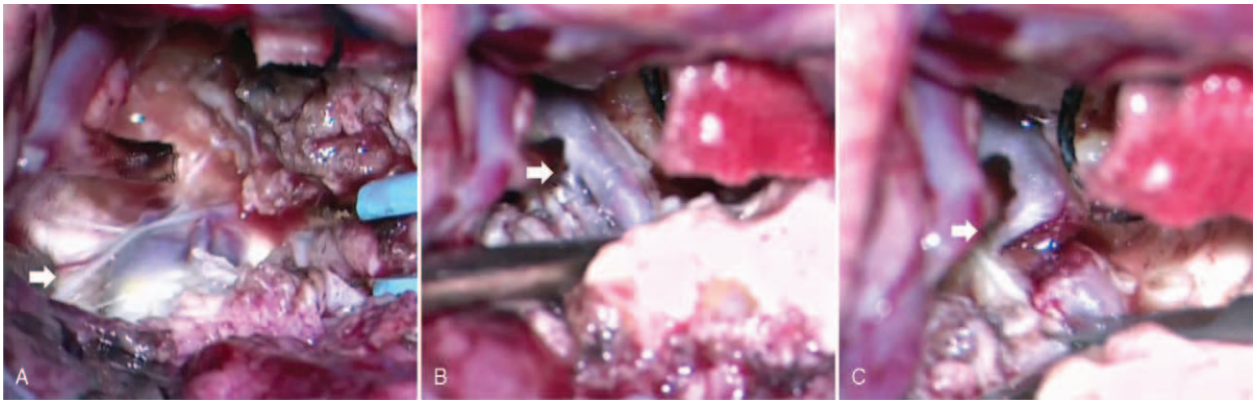

Figure 3. Postoperative DSA illustrating complete resection of the AVM. Lateral projections during (A) arterial phase and (B) late venous phase. AP projections during (C) arterial phase and (D) late venous phase. AP = anterior-posterior, AVM = arteriovenous malformation, DSA = digital subtraction angiography.

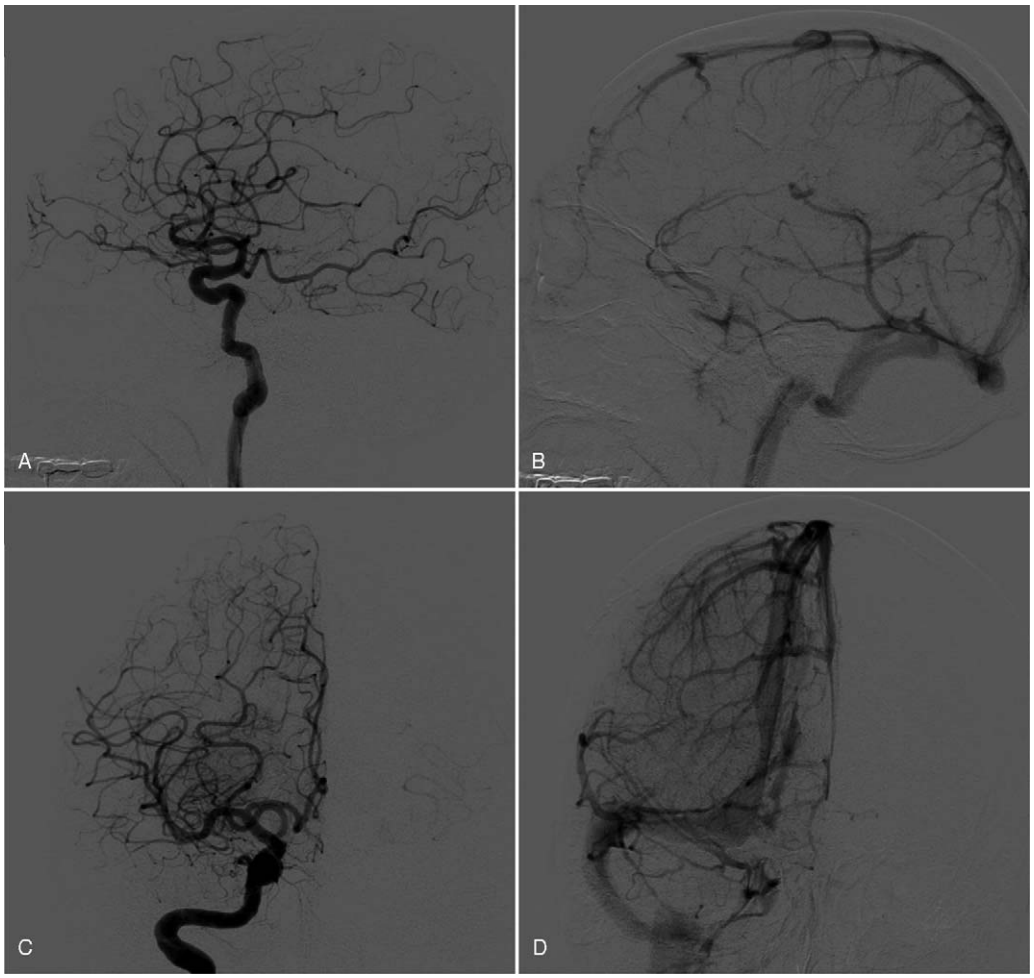

Figure 4. Intraoperative images depicting 2 thrombosed draining veins (arrow) of the AVM. AVM = arteriovenous malformation.

the blood flow into the nidus may be compromised by vasospasm triggered by associated subarachnoid hemorrhage. DSA is considered the gold standard for diagnosing and classifying AVMs, while the diagnosis of spontaneous occlusion of a cerebral AVM is based on the MR scan or the dynamic morphological changes seen on serial DSA studies, or the imaging results combined with intraoperative findings and pathologic specimens. In this case, the presenting symptom was a seizure, and the DSA showed that the malformation was supplied by the distal branches of right MCA with small cortical venous drainage. Thrombosis of the larger draining veins was found intraoperatively, which suggested the possibility of spontaneous occlusion of the AVM. Without evidence for prior hemorrhage or hypercoagulable state, we hypothesized that thrombosis of the draining veins was due to venous stagnation.

Spontaneous venous thrombosis in an unruptured AVM is rare; only 7 published cases were found during our survey.[8–10] The reported cases were concerning 4 male patients and 3 women, with a mean age of 51.1 years (range, 31–67, Table 1).

Table 1

Literatures review of spontaneous venous thrombosis in an unruptured AVM, 7 cases.

Citation	Age/Sex	Symptoms/Signs	Image	Location	Size	Draining vein		
						Location	Number	Thrombosis
Sawlani[9]	44/M	Seizure/(−)	MR	Parieto-occipital	Small	Superficial	Multiple	Yes
Kim[10]	63/M	Headache/(−)	MR	Frontal	Small	Mixed	Multiple	Yes
Kim[10]	67/M	Headache/FND	MR	Parietal	Small	Superficial	Single	Yes
Kim[10]	42/F	Seizure/(−)	MR	Frontal	Medium	Superficial	Single	Yes
Kim[10]	45/F	Headache, seizure/(−)	MR	Parietal	Small	Superficial	Single	Yes
Kim[10]	66/F	(−)/PND	CT	Occipital	Medium	Mixed	Multiple	Yes
Cao[8]	31/M	Headache, aphasia, hemiparesis/FND	MR	Parietal	Small	Superficial	Single	Yes

(−) = none or negative, AVM = arteriovenous malformation, CT = computed tomography, FND = focal neurological deficit, MR = magnetic resonance, PND = progressive neurological deficit.

There were no pregnant or post-partum women. The clinical symptoms were headache (3/7), seizure (3/7), aphasia (1/7), or hemiparesis (1/7). For signs noted in the physical examination, 1 patient had a progressive focal deficit, and 2 suffered from parietal lobe signs. Among 7 AVMs, 71% (5/7) were small (<3 cm) and 29% (2/7) were medium in size (3–6 cm). All the AVMs were found in a supratentorial location. The venous drainage was superficial in 71% of the cases (5/7) and a mixed type (both superficial and deep) in the remaining 29% (2/7), with a unique draining vein observed in 57% (4/7). None of the patients had coagulation disorders.

Surgical or interventional treatment of an unruptured AVM with thrombosed draining veins is not obligatory. For patients with a low risk of bleeding or without obvious clinical symptoms, conservative treatment with a long-term follow-up has been suggested, though early interventional therapy or surgical resection is recommended if those conditions are not met. A retrospective literature study showed that 3 patients were managed conservatively (3/7) while the other 4 being treated by surgery (1/7) or interventional embolization (3/7). Previous research indicated that the only reliable factor suggesting a high risk of rupture was a low-flow venous outlet.[16] In that case, the preoperative DSA showed that the cortical venous drainage was through smaller channels without a main draining vein, which was suggestive of a high risk of AVM rupture. The clinical manifestations of our patient in this study were attributed to secondary epilepsy, progressive for 1 week. The malformation was supplied by the distal branches of right MCA, which was difficult to embolize using interventional therapy. The nidus was compact, thus surgical resection was recommended for this case. Alternatively, conservative management may be a viable option in AVMs with adequate venous drainage despite spontaneous thrombosis since there are a few cases of complete regression secondary to progressive spontaneous occlusion of the draining veins, according to the literature.[3] Some authors suggest that anticoagulation therapy would help the unruptured AVMs which are confirmed to have thrombosed draining veins to reach a satisfactory clinical resolution with a relatively low risk of bleeding due to the prevention of progressive venous hypertension. However, since most of the AVMs with spontaneous occlusion will present with intracranial hemorrhage, we favor an aggressive treatment strategy to prevent the malignant sequelae from the possible hemorrhagic events.

Author contributions

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Formal analysis: Jingwei Zheng.
Writing – original draft: Jun Yu.
Writing – review & editing: Xianyi Chen, Xiaoyang Lu, Feng Yan.

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