CASE REPORT

Spontaneous thrombosis of a recurrent clipped intracranial aneurysm

Thrombose spontanée d’un reliquat anévrismal intracrânien post-chirurgical


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Summary
Spontaneous thrombosis of an intracranial aneurysm is a rare event. It is predominantly observed with aneurysms that are large and have relatively narrow necks. We report here a case of a 48-year-old woman presenting with subarachnoid hemorrhage (SAH) due to rupture of a 2-mm aneurysm of the anterior cerebral artery treated by microsurgical clipping. Six months after treatment of the aneurysm, the patient presented with severe headache. SAH was excluded, but computed tomographic angiography (CTA) revealed the recurrence of a large aneurysm (7 mm) that was confirmed by cerebral angiography (DSA). Endovascular treatment was scheduled for several days later, but DSA also revealed spontaneous occlusion of the recurrent aneurysm. On the control CTA performed one week later, the recurrent aneurysm had again reappeared, again confirmed by DSA, and was subsequently treated by coil embolization.

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Case report

Clinical presentation

A 48-year-old woman was admitted to the district hospital for severe headache, confusion and generalized convulsions. She had a past history of hypertension, hypothyroidism and depressive syndrome. A computed tomography (CT) scan of the brain revealed subarachnoid hemorrhage (SAH) of Hunt and Hess grade III. Her Glasgow coma scale (GCS) upon arrival at our university hospital was 10. CT angiography (CTA) excluded the presence of an intracranial aneurysm, and absence of an aneurysm was confirmed by cerebral digital subtraction angiography (DSA). The patient was admitted to the neurosurgical intensive care unit and treated conservatively. The clinical course was uneventful, although transcranial Doppler (TCD) showed mild vasospasm. DSA was...
repeated 4 weeks after the SAH, as TCD showed no residual vasospasm. The second DSA disclosed an aneurysm on a common trunk of the A2 segments of the anterior cerebral arteries (ACA) (Fig. 1a and b). Retrospectively, this aneurysm was visible on the initial DSA, and measured $2 \times 2$ mm with a 2-mm neck. Neurosurgical clipping of the aneurysm was the selected treatment option after a consensus agreement between the attending neurosurgeon and neuroradiologist.

Aneurysm clipping

The surgical approach to the aneurysm was via a right anterior frontal bone flap. The dissection exposed the superior aspect of the optic chiasma, allowing visualization of the right and left A1 segments of the ACA, as well as the common trunk of the right and left A2 segments of the ACA. The distal end of the common trunk showed a small aneurysm insinuated between the origins of both A2 segments and slightly closer to the left side. The aneurysm sac was superiorly directed, measuring about 2 mm in diameter. No livid discoloration of the vessel walls was noted. Complete exclusion of the aneurysm was technically impossible due to tight adherence of the right surface of the sac and the A2 distal segment. Major difficulties were encountered during dissection of the sac, including rupture of the sac while attempting to dissect the neck away from the surrounding vessels. The aneurysm was clipped with a titanium mini straight aneurysm clip (Yasargil type), placed about 1 mm above the neck, which could not be totally dissected. Postoperative DSA showed a small residual aneurysm measuring about 1 mm, with a large neck (2 mm; Fig. 1c). At discharge, the patient presented with a minor psychomotor deficit. Neurological examination was normal 4 months later, and a control DSA was scheduled for one year after the surgery.

Aneurysm recurrence

However, six months after surgery, the patient was readmitted via the emergency department with severe headache. Cerebral CT and a lumbar puncture were negative for subarachnoid blood. On CTA, recurrence of a 7-mm aneurysm with a 3.5-mm neck was diagnosed and subsequently confirmed by DSA (Fig. 2a and b). Endovascular treatment was scheduled for the third day after the initial diagnosis of the aneurysm recurrence. DSA of the left internal carotid artery (ICA) at the beginning of the endovascular procedure showed obliteration of the recurrent aneurysm (Fig. 2c and d). The non-enhanced CT scan of the brain confirmed the hypothesized thrombosis of the recurrent aneurysm that might have explained the severe headache upon presentation.

On CTA performed one week later, recanalization of the recurrent aneurysm was demonstrated, and confirmed by DSA (Fig. 3a and b). Endovascular treatment was rescheduled and, this time, the recurrence was visualized and treated by endovascular coil embolization (Fig. 4).

Discussion

This was a case of spontaneous thrombosis of a recurrent clipped aneurysm of the anterior cerebral artery in a 48-year-old female patient. This major aneurysm recurrence was diagnosed six months after microsurgical clipping of a ruptured aneurysm located on the fused A2 segments of the ACA. Endovascular coil embolization was the agreed-upon treatment, but spontaneous thrombosis of the recurrent aneurysm occurred between the DSA and the endovascular coil embolization scheduled for three days later. The aneurysm recurrence reappeared on angiographic controls performed one week later and was subsequently treated by endovascular coil embolization.
Spontaneous thrombosis of ruptured intracranial aneurysms has a low incidence of 1—2%, rising to about 3% in patients previously treated with antifibrinolytic agents [1]. It appears to be related to arterial hypotension, vasospasm or local damage to the arterial wall [1,2]. Spontaneous thrombosis of unruptured aneurysms is less common and has generally been reported with giant aneurysms (> 2.5 cm) [3], which represent about 55% of the cases described in the literature [1,2]. However, complete spontaneous thrombosis of giant aneurysms is less common than partial thrombosis, and is estimated to represent about 13—20% of reported cases [1,2]. Spontaneous thrombosis of smaller unruptured aneurysms is unusual.

The discrepancy between the incidences of spontaneous thrombosis in giant and small aneurysms has been explained by various factors that are probably related to an imbalance between thrombogenesis and thrombolysis within the aneurysm cavity. An important contributing factor appears to be the dome-to-neck ratio, with aneurysms that present a relatively narrow neck being more liable to spontaneous thrombosis. This has been attributed to slowed blood flow and stagnation, and increased blood viscosity, thus promoting platelet deposition and aggregation [1,4—7]. Black and German suggested that a ratio of aneurysm volume (in mm³) to neck surface (in mm²) greater than 28:1 is associated with spontaneous thrombosis [2,7]. Roach suggested

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**Figure 2**  DSA 6 months after microsurgical clipping of the ruptured ACA aneurysm, performed after an episode of severe headache. A. Frontal view during DSA shows the recurrent ACA aneurysm (black arrow). B. 3D reconstruction of dynamic DSA reveals the recurrent aneurysm (white arrow), measuring about 7 mm at its maximum diameter, with a relatively narrow neck of 3.5 mm lying under the clip (arrowhead). C. DSA performed at the beginning of the endovascular procedure reveals almost complete spontaneous thrombosis of the aneurysm with neck opacification (black arrow). D. 3D reconstruction of dynamic DSA confirms the spontaneous thrombosis of the aneurysm with a small residual neck (white arrow) and the position of the surgical clip (arrowhead).

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**Figure 3**  DSA performed 1 week later (A, B) shows partial recanalization of the recurrent ACA aneurysm. A. Frontal view during DSA shows recanalization of the ACA aneurysm (black arrow) with an irregular wall. B. 3D reconstruction of dynamic DSA confirms recanalization of the clipped ACA aneurysm (white arrow) beneath the clip (arrowhead). Note the fluid—fluid level indicating low flow velocity within the aneurysm.
that aneurysms with a dome-to-neck ratio > 4 were prone to thrombosis, while those with a dome-to-neck ratio < 2.5 tended to rupture [2, 8].

Another factor that may play a role in spontaneous thrombosis of aneurysms is the contrast media used in angiography. Although the underlying mechanism is not well understood, some consider that non-ionic contrast media may interfere with clotting (endothelium, platelets and red blood cells) so as to cause activation of coagulation and thrombosis. Others explain spontaneous thrombosis of intracranial aneurysms by intermittent vasospasm caused by the contrast agent [1, 5, 6, 9—13]. Krapf et al. reported a giant posterior communicating artery aneurysm in a 9-month-old infant that had completely disappeared after diagnostic angiography [5, 9]. Benndorf et al. reported a giant anterior communicating artery aneurysm with complete thrombosis 4 weeks after diagnostic angiography [5, 10]. Additional factors that may lie behind spontaneous aneurysm thrombosis are turbulent flow in saccular aneurysms, responsible for endothelial injury, and increased platelet aggregation. Other factors might be a general increase in blood coagulability, age of the aneurysm, hemodynamics in the parent artery and direct distortion of the parent artery by the aneurysm sac [1, 2, 6].

In the present case, spontaneous obliteration of the recanalized clipped aneurysm appears to be unexplained by any morphological characteristics. The dome-to-neck ratio of the recurrent aneurysm — measuring 7 mm with a neck of 3.5 mm — was 2, which is below the ratio of 4 that, according to Roach, favors spontaneous thrombosis. The volume of the recurrent aneurysm measured 180 mm³, and the orifice area was around 9 mm², resulting in an aneurysm volume-to-orifice-area ratio of 20 which, according to Black and German, is below the cutoff point of 28, the ratio that favors spontaneous thrombosis. A thorough review of the literature suggests that the reported spontaneous thrombosis of the recurrent aneurysm is most likely attributable to the diagnostic DSA performed 3 days before the intended endovascular coil embolization of the aneurysm recurrence.

References

