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ABSTRACT

Posterior circulation aneurysms are rare in young patients but more common than in adults, tend to be larger and more complex, and often require endovascular treatment. However, in some cases, the aneurysm could occlude naturally, which was commonly defined as spontaneous thrombosis. We report the rapid spontaneous and complete thrombosis of an unruptured posterior cerebral artery aneurysm at the P1-P2 junction in a young patient who presented with blurred vision and consistent headaches. Complete spontaneous thrombosis cannot always be considered a permanent curative event. Its natural history may be associated with risks of recanalization, rupture, and ischemic stroke. Conservative treatment of unruptured aneurysms with spontaneous thrombosis is a safe therapeutic option but requires periodic clinical and imaging follow-up.

INTRODUCTION

The increased use of advanced imaging techniques has determined an overall prevalence of unruptured intracranial aneurysms (UIA) in adult patients of approximately 3.2%–5.4%, with variations depending on the population studied, methodology and location. Spontaneous aneurysmal thrombosis is a well-documented phenomenon and the reported incidence was between 1% and 2%, with the prevalence of thrombosis in giant aneurysms being noted in approximately 30%–50% [1,2,3]. However, this unusual phenomenon has rarely been reported in non-giant and unruptured aneurysms. These completely thrombosed aneurysms are still considered unstable lesions that may grow, compress, recanalize or cause ischemic or haemorrhagic events. We describe a rare case of non-giant, unruptured, totally thrombosed posterior cerebral artery aneurysm and analyze the possible pathogenic mechanisms with the aim of identifying possible factors associated with this phenomenon to improve the management of these patients.

CASE PRESENTATION

A 22-year-old male patient with no previous medical history was admitted to a different local medical institution than ours complaining of blurred vision and consistent headaches for the last 2 days

Keywords
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On neurological examination, the only change found was a partial visual deficit, observed by direct confrontation visual field examination. Later, campimetry examination revealed right homonymous hemianopsia. A native brain computed tomography scan demonstrated a hyperattenuating round lesion with peripheral calcifications located in the left crural cistern (Fig. 1A). The complete blood count laboratory examination showed normal results.

The patient was referred to our clinic a week later for additional paraclinical investigations. The cerebral magnetic resonance imaging (MRI) and computed tomography angiography (CTA) confirmed the presence of a left posterior cerebral artery (PCA) aneurysm positioned laterally with a partially calcified wall but without significant intrasaccular thrombus (Fig. 1D,E). Cerebral angiography 2 days later detailed a 1.4/1.1 cm aneurysm arising from the P1–P2 junction of the left PCA (Fig. 1B,C). P2 segment branches of the PCA arose from the aneurysm.

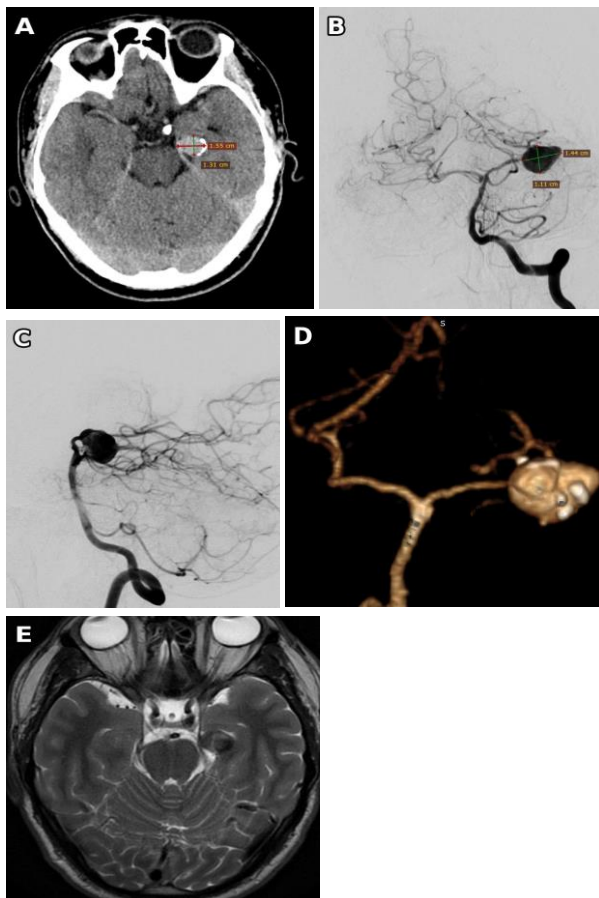
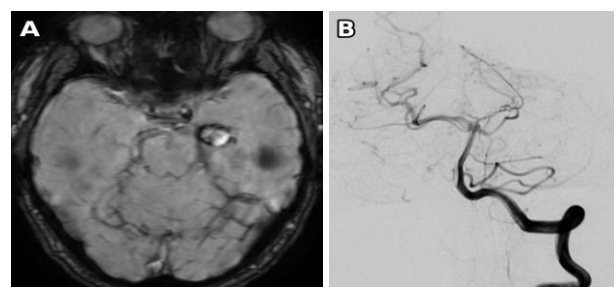


Figure 1. (A) Native brain CT: hyperattenuating round lesion with peripheral calcifications in the left crural cistern. (B, C) Cerebral angiography: 1.4/1.1 cm aneurysm at the P1–P2 junction of the left posterior cerebral artery. (D, E) CTA reconstruction and MRI showing the left PCA aneurysm.

After a multidisciplinary discussion at our institution, occlusion of the aneurysm was not considered possible without possible sacrifice of the parent artery. Due to the considered high risk of aneurysm rupture, occlusion of the aneurysm with possible sacrifice of the parent artery using endovascular techniques was recommended. Due to concerns about the risks of treatment, the parents opted for conservative treatment and a second microsurgical opinion. After these consultants agreed with the initial recommendation, the parents returned to our clinic a month later agreeing to proceed with the proposed endovascular treatment. A cerebral MRI scan was performed and showed a lesion with heterogeneous signal, suggesting a totally thrombosed aneurysm of the left PCA (Fig. 2A). Given this result, digital subtraction angiography done the next day confirmed total occlusion of the aneurysm with preservation of the parent artery and its branches (Fig. 2B,C). Conservative treatment and planning of imaging follow-up to verify whether or not spontaneous recanalization occurs at 6 months, 1 year and 2 years were the options chosen for the completely thrombosed unruptured aneurysm of the left PCA in this patient.

Total remission of the visual impairment was observed at the 6-month follow-up. During the 2-year follow-up, the patient did not experience any focal neurological deficits. Re-evaluation was also carried out using native CT and 3D TOF-MRA, with the results still demonstrating the completely thrombosed aneurysm of the left PCA with no recanalization and no infarction, as shown in Fig. 2D,E. He is at present on regular clinico-radiological follow-up.



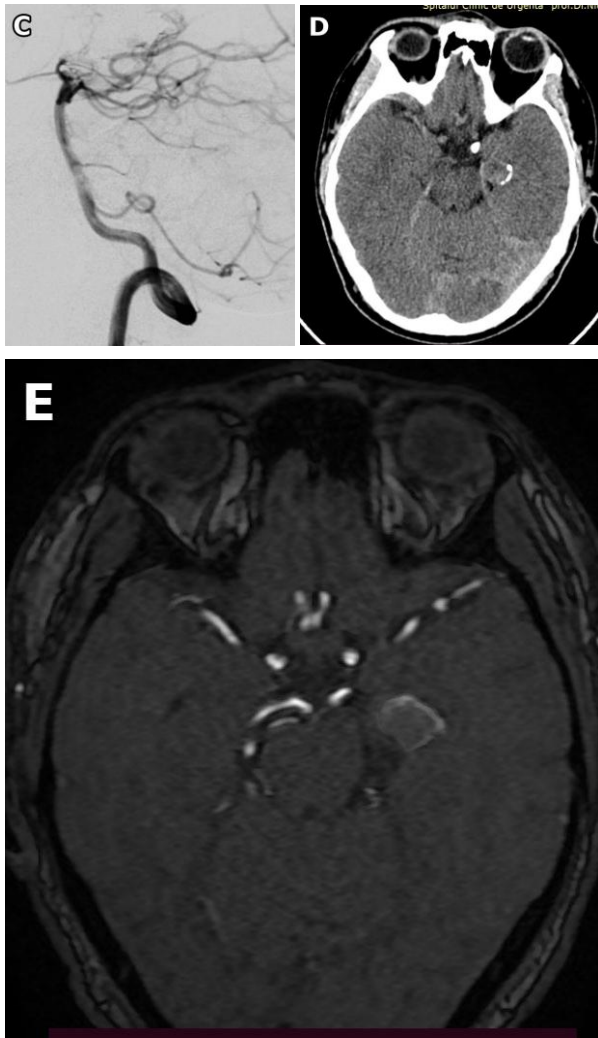


Figure 2. (A) MRI one month later: heterogeneous signal suggesting a totally thrombosed aneurysm. (B, C) Digital subtraction angiography: complete occlusion of the aneurysm with preservation of the parent artery and its branches. (D, E) Two-year follow-up native CT and 3D TOF-MRA: thrombosed aneurysm without recanalization or infarction.

DISCUSSION

PCA aneurysms are a rare occurrence, representing approximately 1.4% of all intracranial aneurysms, and are often large or giant in size. These rare aneurysms can be technically challenging to treat due to their deep location and proximity to critical brain structures. Spontaneous thrombosis of cerebral aneurysms is a well-documented phenomenon occurring in up to 50%–60% (partial) and 13%–20% (complete) of large and giant lesions, but the occurrence of long-term stable complete thrombosis in non-giant unruptured aneurysms has been rarely reported. The most common sites for

aneurysmal thrombosis included MCA (41%), Pcomm (15%), and PICA (11%) [1,3,4].

Various biophysical and dynamic factors have been described to influence the spontaneous thrombosis of intracranial aneurysms, most importantly size, location, and biological status. Complete aneurysm thrombosis is more unusual [3,5,6] and is exceptionally rare in a short period of time (1 month) [2,4]. However, it was reported as occurring even within a few days.

Thrombosis was associated with the morphological features of aneurysms; thus, the dome-to-neck size ratio has been considered the main factor for thrombus formation because of hemodynamic disturbance. The larger the volume relative to the neck, the more turbulent and slow the blood flow inside the aneurysm, promoting blood flow stagnation. This causes a low shear rate that, combined with the suppression of pulsatile flow, stimulates a proinflammatory and procoagulant microenvironment in the aneurysm wall leading to thrombosis. Some studies of computational fluid dynamics demonstrated a volume-to-area quotient (≥ 25) and the existence of a shear-rate threshold below which spontaneous thrombosis could appear in an aneurysm [6,7].

The contrast medium used in the angiographic procedure is another factor in spontaneous aneurysm thrombosis. Although the mechanisms underlying the relationship between the contrast medium used and the coagulation mechanism have not been fully understood, it is believed that both nonionic and ionic media can interact with coagulation by platelet and red blood cell aggregation. This phenomenon, associated with the presence of slow flow, endothelial damage, or spasm of the parent artery, can induce intraaneurysmal thrombosis [5,8].

Various biophysiological factors such as increased blood coagulability, age of the aneurysm, hemodynamics in the parent artery, direct distortion of the parent artery by the aneurysmal sac, turbulent flow in aneurysms, endothelial damage and increased platelet aggregation have also been proposed [2,3,9].

Various biophysiological factors such as increased blood coagulability, age of the aneurysm, hemodynamics in the parent artery, direct distortion of the parent artery by the aneurysmal sac, turbulent flow in aneurysms, endothelial damage and

increased platelet aggregation have been described [2,10,11]. Based on Virchow's triad for vascular thrombosis, most of the factors related to spontaneous intra-aneurysmal thrombosis have been stated, including stasis, hypercoagulability, and endothelial damage [6]. Factors such as hypotension induced during anesthesia, cessation of blood flow during angiography, and local compressive effects can induce spontaneous thrombosis. Similar to neovascularization of the bleeding membrane of chronic subdural hematomas, the occurrence of intramural thrombosis can be generated by repeated bleeding into the subadventitial inner wall of the fragile vasa vasorum surrounding the giant aneurysm. Spontaneous thrombosis was also associated with the presence of calcification within the atherosclerotic aneurysm wall and loss of the elastic lamina [9].

The literature review shows that complete intra-aneurysmal thrombosis cannot be considered a curative event, as it may be associated with growth, recanalization, rupture and ischemic events. Because even completely thrombosed non-giant aneurysms could be unstable, careful clinical and imaging monitoring should be maintained for these patients. A number of authors have stated several absolute conditions to be met regarding spontaneous healing of aneurysms: good neurological results; disappearance of the aneurysm with patency of the parent artery documented by angiography at least 3–6 months after the initial diagnosis; and absence of cerebral infarction. Concerning antiplatelet treatment, literature studies report safe use in small unruptured intracranial aneurysms, as it demonstrates a decrease in aneurysmal growth rate and wall inflammation, while it should be avoided in thrombosed aneurysms larger than 20 mm [5,8,9]. Also, there is no consensus about the ideal management of such lesions. A noninterventionist management approach is possible but requires strict follow-up, including serial imaging examinations.

CONCLUSIONS

Complete spontaneous thrombosis of a non-giant aneurysm is a rare event that should be considered a possibly dynamic state. The patient in this report had a total spontaneous thrombosis of an unruptured PCA aneurysm followed by a noninterventionist management approach. This

provided a permanent benefit to the patient. Therefore, even a completely thrombosed non-giant aneurysm can potentially be life threatening and requires periodic evaluation and vigilant monitoring.

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