



Case Report

# Remarkable shrinkage of a thrombosed giant aneurysm by stent-assisted jam-packed coil embolization

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## ABSTRACT

**Background:** Large and giant aneurysms are known to involve intra-aneurysmal thrombosis and present a poor prognosis because of compression of the surrounding brain tissue with enlargement of the aneurysm. These aneurysms are difficult to cure by endovascular treatment due to involvement of the vasa vasorum in their pathology. We report this technical note to describe stent-assisted jam-packed coil embolization for the treatment of a giant thrombosed aneurysm.

**Case Description:** A 62-year-old man presented with right homonymous hemianopsia, and magnetic resonance imaging (MRI) showed a giant thrombosed aneurysm with poor wall contrast enhancement, which indicates little involvement of the vasa vasorum, at the terminal part of the left internal carotid artery. To block blood flow into the aneurysmal dome, stent-assisted “jam-packed” coil embolization was performed. For this, a braided stent was shortened to enhance metal coverage ratio and tight aneurysmal coil packing was performed using a hydrogel coil. Our technique resulted in complete obliteration of the aneurysm, and MRI performed 1 year later showed remarkable shrinkage of the aneurysm dome.

**Conclusion:** Stent-assisted jam-packed coil embolization technique might be effective in shrinking the dome of giant thrombosed aneurysms with poor wall contrast enhancement.

**Keywords:** Jam-packed embolization, Thrombosed aneurysm, Vasa vasorum, Wall enhancement

## INTRODUCTION

Giant intracranial aneurysms are rare, heterogeneous lesions with complex vascular anatomy.<sup>[5,6]</sup> Approximately half of large and giant aneurysms are associated with intra-aneurysmal thrombosis.<sup>[7,18]</sup> Enlargement of these thrombosed aneurysms might cause symptoms due to the mass effect on surrounding brain tissue,<sup>[14,15]</sup> and result in a poor prognosis despite therapeutic intervention.<sup>[10]</sup> Direct surgical treatments for thrombosed aneurysms require advanced surgical techniques, because they are large and complex in structure.<sup>[15]</sup> Endovascular treatment using flow diverter stents have been reported, although the efficacy of flow diverters for giant thrombosed aneurysms has not been proved because flow diverters do not obliterate the blood supply to the aneurysmal wall from the vasa vasorum and take some time to eliminate intra-aneurysmal blood flow.<sup>[2]</sup> In this technical note, we demonstrate a case of a giant

thrombosed aneurysm that underwent remarkable shrinkage following stent-assisted jam-packed coil embolization, which immediately blocks blood flow into the aneurysm. Written informed consent was obtained from the patient before the intervention.

## CASE REPORT

### History and examination

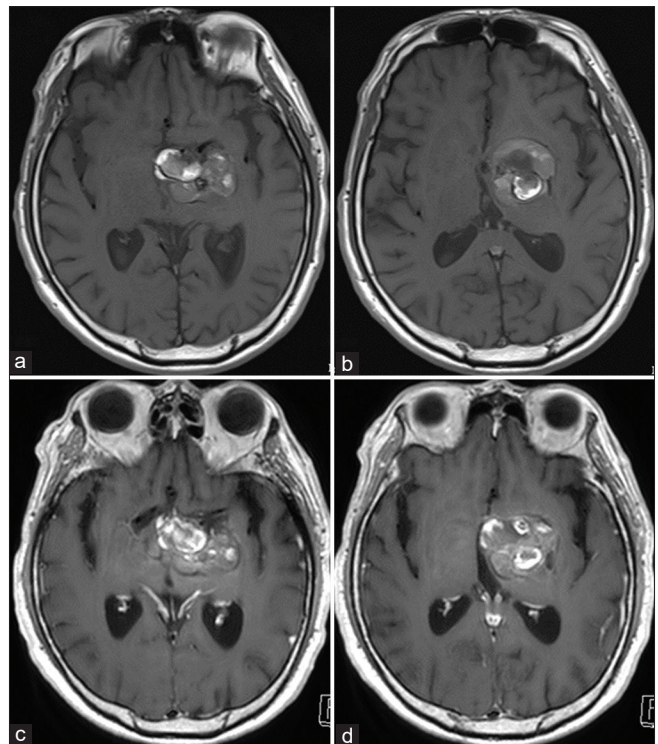
A 62-year-old man with a history of hypertension and dyslipidemia became aware of visual field impairment and right upper limb weakness. 5 months later, he underwent a check-up at the hospital ophthalmology clinic, where he was diagnosed with right homonymous hemianopsia. Computed tomography (CT) showed an intracranial mass lesion, for which he was referred to the neurosurgical department of the same hospital. At that time, he had symptoms of the right homonymous hemianopsia and weakness of the right upper limb (manual motor test: 4/5).

CT imaging revealed a multilobular heterogeneous density mass with a diameter of 38 mm × 33 mm × 23 mm, which compressed the ipsilateral basal ganglia. CT angiography showed unremarkable enhancement of the mass lesion. Head magnetic resonance (MR) T1-weighted imaging showed a heterogenous mixed intensity mass buried in the left basal ganglia, and compression of the optic nerve on the contralateral side. MR T2-weighted images showed findings suggestive of partial aneurysm wall hemorrhage, with no remarkable perifocal edema in the vicinity of the dome. Contrast-enhanced MR imaging (MRI) demonstrated poor contrast enhancement of the aneurysm wall which indicates little involvement of the vasa vasorum [Figure 1]. Digital subtraction angiography (DSA) showed small contrast depiction at the vicinity of the neck of the aneurysm with a diameter of 6.5 mm × 6.5 mm × 4.5 mm at the terminal part of the left internal carotid artery (ICA) [Figure 2]. Perforators originating from the vicinity of the aneurysmal neck were depicted and the terminal part of the ICA. The patient was diagnosed as having a symptomatic, giant, partially thrombosed left ICA aneurysm compressing the visual pathway and the posterior limb of the internal capsule.

In such cases, the treatment strategy of direct surgical decompression of the aneurysm can be expected to immediately improve the symptoms caused by the mass effect. However, the procedure is associated with difficulty in securing the perforators in the vicinity of the aneurysm. Hence, we decided to perform stent-assisted “jam-packed” coil embolization with the purpose of interrupting the blood supply to the dome as soon as possible.

### Endovascular procedure

Aspirin (100 mg/day) and clopidogrel (75 mg/day) were administered a week before the procedure. An 8-Fr long sheath was placed in the right femoral artery under general anesthesia with motor evoked potential (MEP) monitoring. Heparinization was performed to maintain the activated clotting time at over 300 s. An 8-Fr guide catheter and 6-Fr distal access catheter were introduced into the left ICA, along with microcatheters for stenting (Headway 21, Terumo, Tokyo, Japan) and coil embolization (SL-10, Stryker, US). An LVIS stent (3.5 mm × 17 mm; Terumo, Tokyo, Japan) was deployed from the MCA proximal to the ICA with 25% shortening to enhance metal coverage ratio. using the push technique [Figure 3]. Intra-aneurysmal flow stagnation was seen after stent deployment, and coil embolization was subsequently performed by tightly packing the aneurysm with hydrogel coils over 50% coil length (Hydrocoil, Terumo, Tokyo, Japan). Complete obliteration of the aneurysm was confirmed after the procedure without a change in MEP. This stent-assisted jam-packed coil embolization technique, shortening of braided stent to enhance metal coverage ratio of the neck and tightly-packing coil embolization using



**Figure 1:** Preoperative magnetic resonance (MR) T1-weighted imaging showed a giant heterogeneous thrombus in the aneurysm with a maximum diameter of 38 mm (a and b). Contrast-enhanced MR imaging showed no remarkable contrast enhancement of the aneurysm wall (c and d).

hydrogel coils, can immediately block blood flow into the aneurysm.

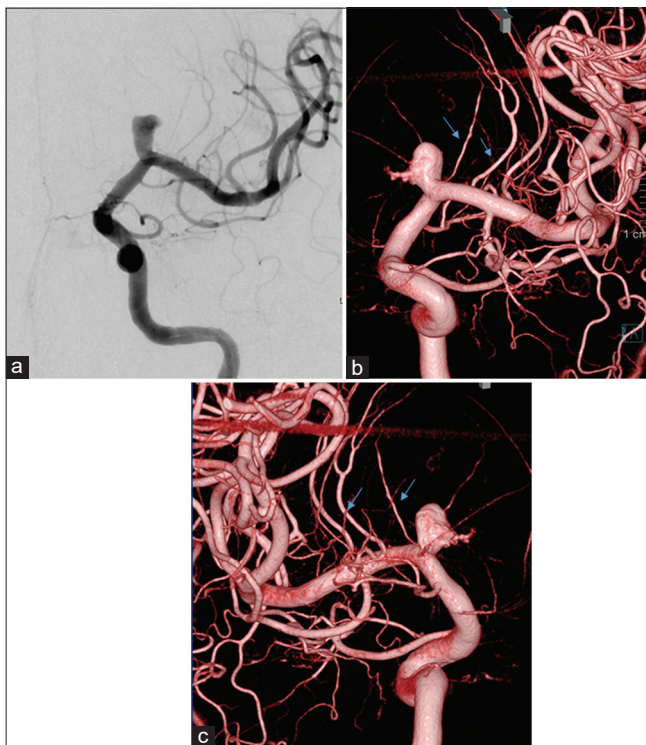
### Outcome and follow-up

Postoperative diffusion-weighted imaging showed no new ischemic lesions and no new neurological symptoms. In addition, his preexisting symptoms were alleviated and he was subsequently discharged. 3 months after the treatment, his symptoms had completely recovered and DSA showed complete obliteration of the aneurysm and stent endothelialization. MRI performed 13 months after the treatment demonstrated remarkable shrinkage of the aneurysm [Figure 4].

### DISCUSSION

Reportedly, 67% of enlarged thrombosed aneurysms present with serious neurological symptoms,<sup>[14]</sup> and 10% of such aneurysms develop subarachnoid hemorrhage under conservative follow-up.<sup>[12]</sup> Therefore, a poor clinical prognosis has been reported, with a mortality rate of 4–11% and morbidity of 7–20% even with surgical or endovascular intervention.<sup>[10]</sup> More than half of the direct surgical treatments require parent artery occlusion with an advanced bypass technique.<sup>[8]</sup> In contrast, simple endovascular coil

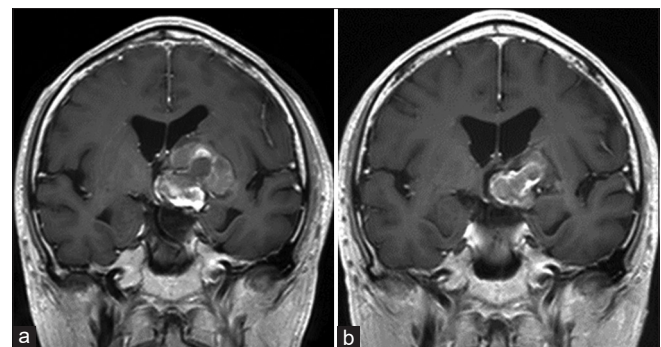
embolization is associated with a relatively high risk of recurrence,<sup>[16]</sup> and endovascular parent artery occlusion carries a high risk of infarction due to involvement of perforators originating in the vicinity of the aneurysm. Recent studies reported that flow diverter treatments for large and giant aneurysms achieved complete obliteration in 95.2% of cases in 5 years.<sup>[1]</sup> However, flow diverter treatment requires about 6 months to a year to obtain complete aneurysmal obliteration. In addition, there are no reports of the long-term clinical outcomes of flow diverter treatment in giant thrombosed aneurysms. In our case, therefore, we performed stent-assisted jam-packed coil embolization using



**Figure 2:** Preoperative left internal carotid artery angiogram showed small contrast depiction at the vicinity of the neck of the aneurysm (a). Three-dimensional angiography showed perforators originating in the vicinity of the aneurysm neck (b and c).



**Figure 3:** A braided stent was deployed from the middle cerebral artery proximal to the internal carotid artery, along with shortening of the stent for enhancing the flow diversion effect (a); the contrast-enhanced cavity was tightly packed with hydrogel coils (b and c).



**Figure 4:** Comparison of the aneurysm size before (a) and after (b) treatment. The aneurysm size was significantly reduced 13 months after stent-assisted coil embolization.

the techniques mentioned above to immediately block blood flow to the aneurysm dome, to reduce the mass effect at an early stage.

The mechanisms of thrombosed giant cerebral aneurysm growth have been speculated in the previous literature. Ollikainen *et al.* pathologically reported the involvement of vasa vasorum,<sup>[19]</sup> and, using a 7-tesla high resolution MRI, Matsushige *et al.* reported that aneurysm growth occurred from the layered structure of the aneurysm wall.<sup>[17]</sup> It is considered difficult to cure thrombosed giant aneurysms by endovascular treatment if mainly the vasa vasorum are involved in aneurysmal growth. Recent reports proved that a wall-enhancement pattern of thrombosed aneurysms on contrast-enhanced MRI correlated with aneurysm instability.<sup>[13,14]</sup> In our case, since the thrombus existed inside the aneurysm and acute intramural bleeding was observed in the thrombosed aneurysm, enlargement of the aneurysm was considered to have occurred due to repeated intramural bleeding.<sup>[14]</sup> However, a previous report showed that a two-layered contrast effect of the blood vessel wall can be observed with thrombosed aneurysms using 7-tesla MRI. Histological evaluation proved that inner-wall enhancement correlates with neovascularization of the inner wall layer and the adjacent thrombus, and growth is estimated to be due to repeated dissection of the inner wall of the aneurysm.<sup>[21]</sup> In contrast, outer-wall enhancement might be involvement of vasa vasorum in the outer-wall layer, with thrombosis associated with growth, inflammation and rupture of the vasa vasorum resulting in aneurysm growth.<sup>[21]</sup> No remarkable contrast enhancement was seen in the present case, suggesting that aneurysmal growth was probably predominantly due to inner-wall angiogenesis supplied by intra-aneurysm blood flow. Therefore, remarkable shrinkage was observed by blocking the blood supply to the dome using stent-assisted coil embolization.

Flow diverter treatment for large and giant aneurysms has been previously reported, and a meta-analysis proved a high rate of aneurysm occlusion with the treatment.<sup>[4]</sup> Flow diverter stent has a high metal coverage ratio, although it requires a certain amount of time to achieve aneurysm occlusion. Foreman *et al.* also reported the efficacy of flow diverter stents for partially thrombosed aneurysms, although complete aneurysm occlusion was observed in only 58.8% of cases in which over 50% of the aneurysm was occupied by thrombus, which could be related to the slow aneurysmal obliteration.<sup>[11]</sup> In contrast, stent-assisted jam-packed coil embolization technique results in immediate blocking of blood flow into the aneurysm. In the treatment of partially thrombosed aneurysms, there is reportedly a 20–75% chance of recanalization and aneurysm growth due to implantation of the coil in the thrombus.<sup>[9,10]</sup> Hydrogel coils have been shown to have a higher occlusion rate due to gain volume

embolization ratio<sup>[3]</sup> and shortening of the braided stent can enhance the metal coverage ratio.<sup>[20]</sup> In the present case, we packed the coils in the enhanced cavity as tight as possible using hydrogel coils to reduce blood flow into the aneurysm. Furthermore, flow stagnation was observed immediately after stent placement by shortening the stent to enhance the metal coverage ratio. These technical efforts resulted in remarkable shrinkage of the thrombosed aneurysm. However, there are only few reports of the clinical utility and long-term prognosis of stent-assisted jam-packed coil embolization for partially thrombosed aneurysms, and further studies involving a large number of cases are required in future to confirm the efficacy of this technique.

## CONCLUSION

Stent-assisted jam-packed coil embolization technique might be effective for shrinking the dome of giant thrombosed aneurysms to immediately blocks blood flow into the aneurysm.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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