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Technical Note

A technique for sequential, progressive clipping for a giant thrombosed distal anterior cerebral artery aneurysm: Technical note

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Abstract

Background: Giant thrombosed aneurysms often present with thickened walls and a hard thrombus, including in the near-neck aneurysmal sac. These usually make it difficult to achieve complete neck clipping with preservation of local branch patency. Here, we demonstrate a simple but safe and effective technique to overcome these problems in a patient with a 6-cm giant thrombosed distal anterior cerebral artery aneurysm.

Case Description: A 77-year-old-man suffered from loss of volitional activity due to the frontal mass effect. The aneurysm was exposed with unilateral paramedian craniotomy and an interhemispheric approach. The clip was applied to the aneurysmal neck but it slipped onto the parent artery, which caused branch artery occlusion. Intra-aneurysmal thrombectomy was immediately performed near the aneurysmal neck with ultrasonic aspiration. The next clip was added along the aneurysm side of the preceding clip, which was then removed. This procedure was repeated twice so that complete neck clipping was achieved while preserving the branch patency. All the residual thrombus and aneurysmal wall were subsequently removed. Postoperatively, there was no additional neurological deficit. The patient's mental function was significantly improved.

Conclusions: We conclude that the sequential, progressive clipping technique is a robust option for successful neck clipping of giant thrombosed aneurysms.

Key Words: Cerebral aneurysm, distal anterior cerebral artery, giant thrombosed aneurysm, neck clipping, thrombectomy

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INTRODUCTION

Giant thrombosed cerebral aneurysms are rarely treated by direct clipping because of the thickened wall, wide neck, and rich thrombus within the near-neck sac.[9,11,13,15] These problems can cause incomplete obliteration of the aneurysm, neck remnants, and deterioration of local branch patency. Several advanced strategies such as reconstructive clipping[2,7] or proximal occlusion with distal revascularization[14,17] have been recently proposed,

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which require a great deal of special techniques and are not highly versatile. Surgical treatment of giant thrombosed aneurysms located on the distal anterior cerebral artery (DACA) is highly challenging because of the narrow corridor in the interhemispheric space, adhesion between the cingulate gyri, and difficulty in controlling the parent artery.[19] Furthermore, sufficient debulking or resection of the aneurysm is required for treating mass effect. Considering these facts, direct neck clipping with thrombectomy may be the ideal treatment option for such lesion. Although direct clipping with thrombectomy has been described in several cases of giant thrombosed DACA aneurysms,[3,6,8,18] the detailed technical procedures have not been fully described. Here, we report a simple but safe and effective technique using illustrations in a patient with a 6-cm giant thrombosed DACA aneurysm.

CASE REPORT

A 77-year-old-man presented with several months of headache and progressive loss of volitional activity. He had normal language function, normal cranial nerves, normal motor/sensory function, and mild gait disturbance. Noncontrast computed tomography (CT) scan and magnetic resonance (MR) imaging of the head revealed a giant thrombosed DACA aneurysm with thickened calcified walls and significant perifocal edema in the right frontal lobe [Figure 1a and b]. Three-dimensional MR angiography demonstrated that a thrombosed aneurysm with a maximum diameter of 6 cm was located at the left A2–A3 junction [Figure 1c]. The left pericallosal artery (PcaA) and left callosomarginal artery (CmaA) originated from the aneurysmal neck. The surgical strategy for treatment was to first occlude blood flow into the aneurysm by clipping the neck while preserving patency of the left PcaA and CmaA, and then to eliminate the mass effect in the right frontal lobe by removing the intra-aneurysmal thrombus and aneurysmal wall. Prior to surgery, we considered as an alternative clipping aneurysmal resection with the left PcaA-right CmaA side-to-side anastomosis and the left A2-CmaA end-to-end anastomosis.

The patient was placed in a supine position with a head elevation of 15°. The head was fixed with Sugita Head Holder. A left-side extended bicoronal skin incision was made. A left frontal craniotomy was performed with an extension of 2 cm across the midline to the right side. The dura mater was incised only on the left side. The arachnoid trabeculations and interdigitating gyri of the interhemispheric fissure were opened sharply by microscissors and bipolar technique. The left A2, PcaA, and CmaA were identified. The aneurysm originated just from the left A2–A3 junction and the major part of the aneurysmal dome invaginated into the right frontal lobe. While almost entire lumen of the aneurysm was thrombosed, the near-neck space was nonthrombosed, which was confirmed by pulsed Doppler. First, a bayonet-shaped clip (7 mm) was applied to the neck but it slipped onto the left A2, which caused the reduction of blood flow both in the left PcaA and CmaA. Immediately after this, the aneurysmal wall was incised and the intra-aneurysmal thrombus was evacuated using the cavitron ultrasonic surgical aspiration (CUSA) until the nonthrombosed near-neck space was exposed. This procedure provided adequate pliability and flexibility of the neck for clipping. The second clip was added parallel and adjacent to the first clip on the aneurysm side, and then the first clip was removed. The blood flow of the left PcaA significantly improved but that of the left CmaA was still poor. In the same manner as mentioned above, a third clip was applied closer to the aneurysm and the second clip was removed. Finally, the blood flow of the left CmaA became sufficient. This sequential, progressive clipping technique following intra-aneurysmal thrombectomy is illustrated in Figure 2. All the residual thrombus

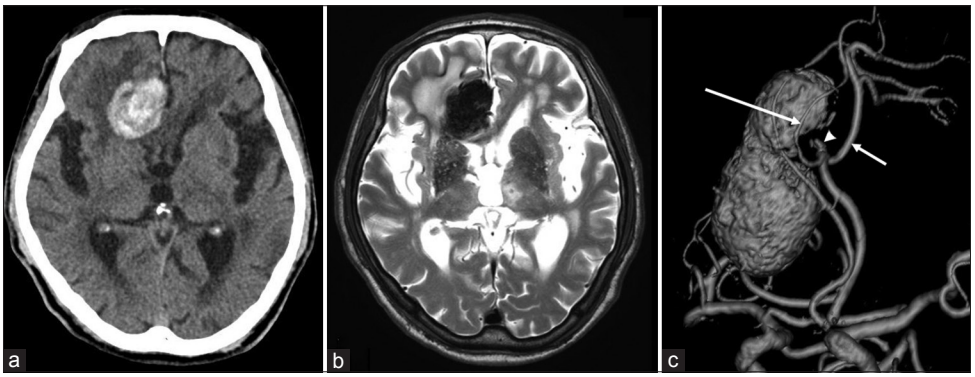

Figure 1: (a and b) Preoperative CT scan and MR imaging showing a giant thrombosed DACA aneurysm with calcified wall and perifocal edema in the right frontal lobe. (c) The oblique view of preoperative 3-dimensional MR angiography demonstrating a 6 cm giant thrombosed aneurysm at the left A2-A3 junction. The left PcaA (short arrow) and CmaA (long arrow) originated from the aneurysmal neck. A non-thrombosed area was present within the near-neck aneurysmal sac (arrowhead)

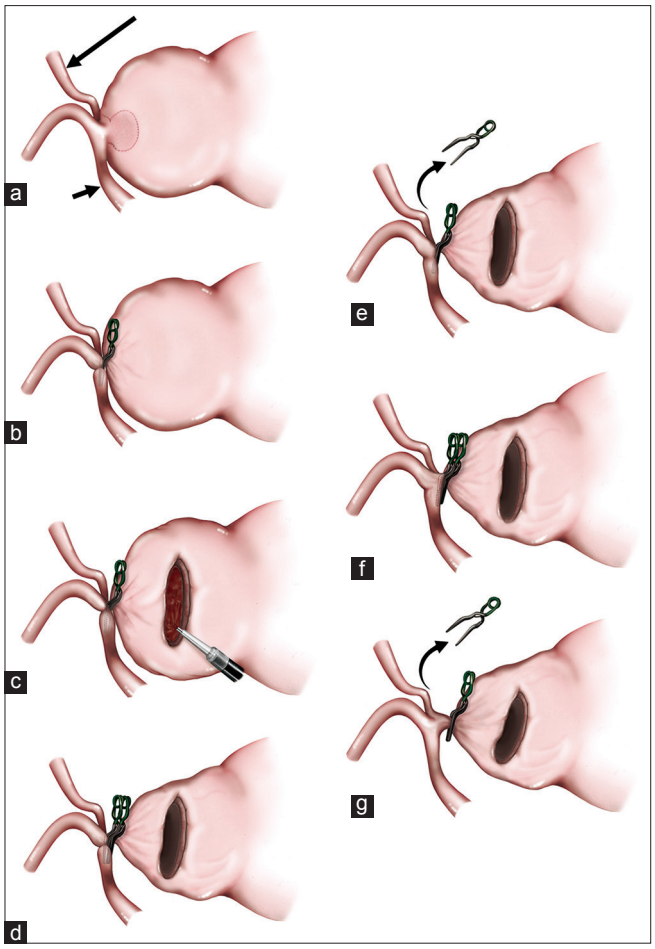

Figure 2: Illustrations of the sequentially shifting clipping technique following intra-aneurysmal thrombectomy. (a) The interhemispheric approach exposed the left A2, PcaA (short arrow), and CmaA (long arrow). The near-neck space (surrounded by a dotted line) was non-thrombosed. (b) A bayonet-shaped clip was applied to the neck, but slipped onto the left A2. (c) The aneurysmal wall was incised and the intra-aneurysmal thrombus was evacuated using CUSA. (d) Once adequate pliability and flexibility of the neck for clipping was obtained, the second clip was added parallel to and adjacent to the aneurysm side of the first clip. (e) The first clip was removed. The blood flow of the left PcaA significantly improved, but that of the left CmaA was still poor. (f) In the same way as in D), the third clip was applied. (g) The second clip was removed. The blood flow of the left CmaA became sufficient. The complete obliteration of the aneurysm was also accomplished

and aneurysmal wall were subsequently removed. Hemosiderin deposits were found in the removal cavity of the right frontal lobe, indicating that there was prior subclinical rupture of the aneurysm. After carefully checking for hemostasis, the closure was performed in the usual fashion.

The patient had no additional neurological deficits immediately after surgery. Postoperative CT scan and MR imaging demonstrated no residual aneurysm and resolution of the right frontal edema [Figure 3a and b]. A postoperative digital subtraction angiogram showed complete neck clipping of the aneurysm with preservation of all branches [Figure 3c]. The patient's gait and volitional activity significantly improved. An angiogram at 2 months revealed no recurrent aneurysm and good flow in both the left PcaA and CmaA. The patient continues to do well 6 months after operation.

DISCUSSION

Here, we introduce the sequential, progressive clipping technique following intra-aneurysmal thrombectomy as a robust option for surgical treatment of giant thrombosed aneurysms. Performing this technique requires the following: (1) applying at least two clips, finally using a single clip; (2) adequate thrombus evacuation within the near-neck aneurysmal sac by CUSA; and (3) evaluation of hemodynamics on both the local branches and the aneurysmal lumen by pulsed Doppler. The clip is preferably bayonet-shaped. The angle of the bayonet clip allows us to safely occlude the aneurysm with a thickened wall because of the high visibility of the blade tip. The shank of the bayonet clip also makes it easy to arrange two adjacent clips in parallel. The CUSA can evacuate the toughly organized thrombus and its efficacy has been reported for giant thrombosed aneurysms.[1,4] We recommend the use of low-power CUSA and not rubbing the tip of CUSA on the aneurysmal wall to keep it intact. However, resection of the aneurysmal walls was not necessarily essential. Debulking of the intra-aneurysmal mass allows the remainder to be gradually reabsorbed. This can avoid any possible trauma to the frontal lobes associated with the dissection necessary for complete resection of the aneurysmal walls. Pulsed Doppler is suitable for confirmation of the arterial blood flow because of its sensitivity to increased blood flow velocity associated with stenosis. It can also be used for evaluation of the thrombosed and nonthrombosed areas in the aneurysmal lumen. Indocyanine green videoangiography may be another option to visualize real-time blood flow in the aneurysm and local branches.

Neck clipping with thrombectomy should be the best strategy for giant thrombosed aneurysm, especially those in which neck is not involved by thrombus.[10] Direct clipping with thrombectomy has been reported in several cases with giant thrombosed DACA aneurysms.[3,6,8,18] However, their technical procedures were not described in detail. Sugita *et al.* previously reported direct clipping after thrombectomy using brief occlusion of the parent artery for a giant thrombosed middle cerebral artery aneurysm.[15] Although their technique showed good outcome, our sequentially shifting clipping technique should be more beneficial because parent artery occlusion is unnecessary. If the aneurysmal neck is severely calcified or if the thrombus exists in the aneurysmal neck, an alternative treatment such as vascular reconstruction should be considered. Matsushima *et al.* recently demonstrated that the proximal PcaA-CmaA end-to-end anastomosis

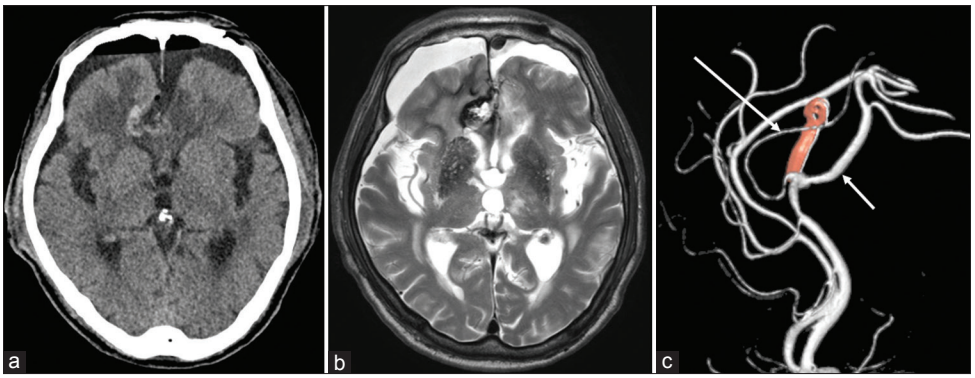

Figure 3: (a, b) Postoperative CT scan and MR imaging showing no residual aneurysm and resolution of the right frontal edema. (c) Postoperative 3-dimentional digital subtraction angiogram demonstrating complete neck clipping of the aneurysm with preservation of all branches (PcaA, short arrow; CmaA, long arrow)

with aneurysm resection was an effective treatment for a case with giant thrombosed DACA aneurysm.[12] We also considered aneurysmal resection with the left PcaA-right CmaA side-to-side anastomosis and the left A2-CmaA end-to-end anastomosis as another treatment option. However, the fact that the present clipping was feasible notwithstanding moderate calcification and thickening of the aneurysm suggests that our technique would be worth considering even in such cases. Under meticulous evaluation of intraoperative findings, our technique could be a more simple, safe, and effective way.

A similar technique has been reported by Giannotta as the "stacking-seating" technique using differently shaped and sized clips which are progressively apposed and eventually removed until obtaining exclusion of the aneurysmal sac.[5] Spetzler *et al*. recently published their elaborate clipping procedures relating to our technique for giant posterior inferior cerebellar artery aneurysm and previously coiled giant anterior communicating artery aneurysm.[16] This technique is also useful when treating previously coiled recurrent aneurysms because the coil mass in the dome initially prevents the application of the clip without compromising the parent vessel, perforators, and perilesional branches.

CONCLUSIONS

For patients with giant thrombosed aneurysms with mass effect, both complete obliteration and resection of aneurysms should be required. Our sequential, progressive clipping technique may be considered as a robust treatment option for such patients. We also hope that this report will be a reminder of what can be done with thoughtful clipping for challenging giant aneurysms in the era of endovascular treatment.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that name and initial will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

Consent

The patient provided informed consent to the publication of this report.

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Conflicts of interest

There are no conflicts of interest.

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