CASE REPORT

Endovascular rescue treatment through stent positioning after surgical clipping of intracranial aneurysms complicated by parent artery obstruction

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SUMMARY

During aneurysm clipping, ischemic complications may occur and require a rescue treatment, usually surgical. We present two such cases that required urgent rescue treatment, performed through an endovascular route. Our first case presented with a non-ruptured right posterior inferior cerebellar artery (PICA) aneurysm. After permanent clip positioning, occlusion of the PICA occurred. An unsuccessful attempt of clip repositioning was performed. We therefore positioned a stent obtaining complete flow restoration. Our second case was that of a ruptured giant left middle cerebral artery aneurysm with focal critical stenosis of the parent vessel, likely due to an underlying dissection. Initially, the aneurysm was secured through coiling. However, after permanent clip positioning, parent artery occlusion occurred. DSA showed occlusion of the parent artery downstream to the clip and persistence of the preaneurismatic stenosis. We achieved full recanalization through stent positioning. In both cases, there were no ischemic or hemorrhagic complications.

BACKGROUND

Despite technological advancement, the treatment of intracranial aneurysms presents a challenge for specialists in interventional neuroradiology and neurosurgery. Ischemic complications may occur and require urgent rescue treatment, either endovascular or surgical treatment as appropriate.¹⁻⁴

To the best of our knowledge, an endovascular rescue approach to a surgical artery obstruction has not yet been described. We present two unusual cases of endovascular treatment carried out in emergency setting to manage parent artery occlusion secondary to surgical aneurysmal clipping.

CASE PRESENTATION

A 42-year-old woman was referred to hospital for subacute/chronic onset of cervical pain.

Investigations

MRI showed a 9 mm intradural round and smooth-edged mass, located anterolateral to the cervical cord (slightly compressed) at the level of T1, compatible with a partially thrombosed aneurysm originating from a proatlantal type 1 posterior

inferior cerebellar artery (PICA), better displayed on DSA (figure 1).

Treatment

Surgical clipping of the aneurysm was performed through a suboccipital craniectomy, and after permanent clip positioning, an intraoperative Doppler flow study demonstrated occlusion of the PICA with flow inversion downstream to the clip. Repositioning of the clip was unsuccessful in obtaining flow recuperation; thus, the patient was urgently transferred to the adjacent angiography suite.

DSA confirmed the occlusion at the level of the clipping and distal patency was confirmed by a selective injection of the artery distal to the occlusion point (figure 2).

Flow was restored by positioning a stent (Solitaire AB 4–20, ev3 Neurovascular, Irvine, California, USA) at the level of the occlusion, obtaining complete vessel reperfusion (figure 2). During the procedure, aspirin (500 mg IV) and heparin (IV bolus of 3000 IU and 1 IU/mL slow infusion over the main catheter) were administered.

The patient was transferred to the neurointensive care unit, where she was maintained in general

Figure 1 (A,B) Extracranial round mass anterolateral to the bulbomedullary junction, compatible with partially thrombosed aneurysm. (C,D) DSA with selective catheterization of the right vertebral artery confirmed a non-ruptured aneurysm, located in the tonsillomedullary segment of a bihemispheric posterior inferior cerebellar artery (PICA) of C1 origin.

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Figure 2 DSA showing (A) occlusion of the right posterior inferior cerebellar artery (PICA) (black arrow) downstream to the point of clip positioning; (B) selective injection of the PICA, distal to the occlusion point, showing patency of the vessel—to overcome the occlusion point, we used a Prowler Select Plus microcatheter (Codman & Shurtleff, Raynham, Massachusetts, USA) and a Transend EX Soft Tip 0.014' guidewire (Boston Scientific, Fremont, California, USA); (C,D,E) final angiographic results, stent has been released exactly in the point of previous clip positioning (white arrows), with distal flow restoration (*).

anesthesia and administered dual antiplatelet therapy (aspirin 100 mg/day plus clopidogrel 75 mg/day) from the following day.

Outcome and follow-up

The following day, a baseline CT scan showed absence of infarctions in the PICA territory bilaterally and the patient was consequently extubated. On examination, she had a mild deglutitory deficit and was discharged on day 15 with Modified Rankin Scale (mRs)=1. She has had an unremarkable convalescence thereafter.

CASE PRESENTATION

A 64-year-old woman who presented with subarachnoid hemorrhage and World Federation of Neurosurgical Societies (WFNS)

Figure 3 Baseline CT (A,B,C) and CT angiography (D,E) showing subarachnoid hemorrhage with basal ganglia hematoma and a large middle cerebral artery aneurysm.

Figure 4 DSA showing the middle cerebral artery superior division aneurysm in frontal view (A) and demonstrating in lateral view (B) a focal stenosis of the parent vessel (arrow).

grade 5 was transferred to our institution's neurosurgery department, 72 hours from onset, from a referring hospital.

Investigations

CT and CT angiography showed modified Fisher grade 3 subarachnoid hemorrhage associated with a left basal ganglia hematoma (figure 3), and a large non-saccular left middle cerebral artery (MCA) aneurysm originating from a dominant superior division. DSA better displayed a proximal stenosis of the parent vessel, possibly suggesting a dissecting etiology (figure 4).

Treatment

Surgery was considered unfeasible and a decision was made to secure the aneurysm from rebleeding by performing a loose coiling to overcome the hyperacute phase. On day 21, CT and DSA showed enlargement of the aneurysm's remnant and a surgical approach was decided. Through a frontoparietal craniectomy, the aneurysm was exposed and opened to remove the coils, and then remodeled by temporary clipping. Intra-operative Doppler sonography of the parent artery always showed the presence of flow, while the MCA inferior division was occluded since the first examination. After permanent clip positioning, a final Doppler flow check demonstrated parent artery occlusion that was confirmed by indocyanine green angiography (figure 5). The patient was transferred to the adjacent angiography suite, where DSA confirmed occlusion of the parent artery distal to the clip (figure 6). A selective

Figure 5 Microscopic view before (A) and after (B) indocyanine green angiography during surgery displaying occlusion of the left middle cerebral artery (MCA) superior division. ACA, anterior cerebral artery; CA, carotid artery.

Figure 6 DSA confirming the parent vessel occlusion (A). A coil fragment (arrow) is also visible. Selective injection through the occlusion point (B,C) shows absence of thrombosis downstream—we navigated through the parent artery using a Headway 21 microcatheter (MicroVention, Tustin, California, USA) and a Transend EX Soft Tip 0.014' guidewire.

injection distal to the occlusion point displayed patency of the arterial lumen downstream, without evidence of thrombosis (figure 6). Eventually we positioned a stent (Solitaire AB 4–30) achieving flow restoration (figure 7).

During stent implantation the patient received a 0.4 µg/kg/min loading dose of tirofiban for 30 min, followed by a 0.10 µg/kg/min; dual antiplatelet infusion (100 mg/day of aspirin and 75 mg/day of clopidogrel) was started from the next day.

Outcome and follow-up

The patient was extubated and discharged on day 45 to a rehabilitation program facility with mRs=5.

She too had an unremarkable convalescence. A follow-up DSA performed 6 months after showed permanent exclusion of the aneurysm and patency of the parent artery (figure 8).

DISCUSSION

There are several reports about rescue procedures performed to solve ischemic complications occurring during aneurysm treatment,^{1–4} but none describing an endovascular treatment of a surgical adverse event. Our experience, even if limited to two cases, encourages the consideration of an endovascular attempt in selected scenarios.

In our cases, the most probable cause of parent vessel obstruction was a dissection, whether secondary to surgical manipulation during the clip placement or pre-existing. In fact, there was no evidence of thrombosis and this assumption provided the rationale for stent implantation.

Figure 7 Final angiographic result (A,B,C) after stent positioning (white arrows) displaying flow restoration.

Figure 8 Angiographic follow-up 6 months after the procedure (the patient was awake, bedridden and hemiplegic, with tracheostomy decannulated and almost closed) demonstrating stability of the vessel patency.

Surgical treatment of these complications, when possible, is based on the execution of an extracranial–intracranial or intracranial–intracranial flow replacement bypass, which is more widely accepted as rescue treatment of surgical complications,^{3,4} but it is burdened by a few aspects. The execution of a bypass is time-consuming, especially if not previously planned and prepared, and is even more challenging in an acute/subacute setting. Besides, in patients undergoing bypass procedure, the anesthetic management implies some precautions that add complexity to the intervention, such as brain relaxation, the maintenance of a perfect stability of arterial blood pressure and use of barbiturates (pentothal) to avoid secondary ischemia and adjunctive mild hypothermia (to minimize the risk of coagulopathy and arrhythmia).⁵ Also, some anatomic variants (eg, a bihemispheric PICA) could make surgical approach challenging from a technical point of view.

On the other hand, it should be pointed out that serious potential risks are associated with navigating through a small vessel that is at least in part mechanically obstructed by an aneurysm clip (eg, perforation or laceration) and cases should be carefully selected: in the first case, the PICA aneurysm was well distal to the brainstem; therefore even a parent vessel occlusion at this location would likely have been well tolerated, as shown by previous authors⁶; however, PICA sacrifice is still controversial,⁷ especially in anatomic variants such as dominant PICA.⁸

It must also be stressed that even if the stent implantation forced the administration of dual antiplatelet therapy in patients who were just surgically treated, no rebleeds occurred during the convalescence and both patients made a good recovery. The proximity of the angiography suite to the operating room is a further important factor to consider planning the rescue treatment.

Learning points

Our experience, about ischemic complications during aneurysms clipping, emphasizes the following:
Endovascular rescue treatment as an alternative to surgical treatment should be considered in selected cases.
It should be considered that hemorrhagic complications related to dual antiplatelet therapy, even if administered just after surgery, may not occur.
The proximity between the surgical theater and the angiography suite is a crucial additional factor to consider.

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