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CASE REPORTS

Rescue treatment with tPA for refractory thromboembolism during stent-assisted coiling of a ruptured intracranial aneurysm: A case report

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Abstract

Thromboembolic complications during stent-assisted coiling of ruptured intracranial aneurysms are major complications that can cause serious neurological deficits. Management strategies include medical thrombolysis, mechanical thrombectomy with suction aspiration or stent retrieval, and rescue stenting. The existing literature suggests that tissue plasminogen activator agents should be used cautiously because of the high risk of severe bleeding at the aneurysm. We present the case of a ruptured anterior communicating artery aneurysm. Acute in-stent thrombosis occurred during the stent-assisted coiling of the aneurysm. Rescue therapy with tirofiban, suction aspiration, and rescue stenting was attempted; however, these methods failed. Finally, tissue plasminogen activator infusion was performed, which successfully dissolved the thrombus and restored blood flow. Follow-up brain computed tomography revealed no increase in hemorrhage volume.

Keywords: Thromboembolism, cerebral aneurysm, stent, coiling, tissue plasminogen activator, thrombectomy

INTRODUCTION

Although stent-assisted coiling of wide-necked intracranial aneurysms is safe and feasible, thromboembolic complications in ruptured aneurysms are a major concern, with an incidence of 9.1%.[1] Generally, thromboembolic complication rates of stent-assisted coiling are higher in ruptured aneurysms than in unruptured aneurysms.[2] Causes of blood clot formation include the limited use of preoperative antiplatelet treatment, hypercoagulation after subarachnoid hemorrhage (SAH), presence of a stent, and coil protrusion into the parent artery.[3] Rescue treatments comprise pharmacological therapy, mechanical methods, and increasing the blood pressure to promote collateral circulation. However, refractory occlusions may occur despite these efforts. Some studies reported using tissue plasminogen activators (tPAs) for acute thromboembolism during aneurysm coiling.[4-6] They were case series of unruptured or non-refractory cases.

We present a case of refractory thromboembolism during stent-assisted coiling of a ruptured aneurysm in which several rescue therapies were attempted. The patient achieved recanalization after tPA infusion.

CASE REPORT

A 69-year-old man presented with stupor after 5 days of severe headache. His family were unaware of his past medical history. The Glasgow Coma Scale score was 8 (E1V2M5), and the Hunt and Hess grade was 4. Brain computed tomography (CT) revealed an SAH, intraparenchymal hematoma in the right frontal lobe, and intraventricular hemorrhage with hydrocephalus (Fisher grade 4) (Figure 1a). Cerebral angiography revealed a wide-necked aneurysm with a daughter sac in the anterior communicating artery aneurysm (2.3×1.9 mm in size) (Figure 1b). Stent-assisted coil embolization using the jailing technique under

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general anesthesia was planned for the aneurysm. A Neuroform Atlas stent (Stryker Neurovascular, Fremont, CA, USA) was placed from right proximal A2 to right proximal A1. Following the insertion of the third coil, angiography revealed acute in-stent thrombosis without anterograde compromise (Figure 1c). Coil embolization was continued while intra-arterial tirofiban was injected. Angiography 10 min later showed complete obliteration of the aneurysm; however, thrombus formation was further aggravated. An additional intra-arterial infusion of tirofiban was administered, but the involved artery was completely occluded (Figure 1d).

Mechanical thrombectomy with suction aspiration using the 3MAX reperfusion catheter

Figure 1. A 67-year-old man with a ruptured anterior communicating artery aneurysm
The headache started a few days earlier. Hunt and Hess grade: 4. (a) An initial non-enhanced CT scan showed acute ICH in the frontal lobe and minor IVH with hydrocephalus (arrow). There was scanty SAH. (b) Cerebral angiography revealed a ruptured aneurysm at the anterior communicating artery (arrow). (c) Dung the stent-assisted coiling of the aneurysm, acute in-stent thrombus developed (arrow). (d) Coil embolization was continued while intraarterial tirofiban was injected. Despite the use of tirofiban (total 1 mg), an angiogram taken 10 min later showed total occlusion of the anterior cerebral artery. (e) Mechanical thrombectomy using a 3 MAX aspiration catheter could not reach the thrombus (arrow). (f) A Neuroform atlas stent was deployed at the occlusion site, and a post-stenting angiogram showed partial recanalization (arrow). (g) Immediately, 0.5 mg intra-arterial tirofiban was infused. However, the ACA was reoccluded. (h) After infusion of intravenous tPA (0.6 mg/kg over 60 min), the ACA was recanalized. Follow-up angiography performed 20 min later revealed no thrombus growth and flow patency. (i) Non-contrast CT 1 day after the procedure showed no increase in ICH, and an angiogram showed no in-stent thrombus (arrow).

(Penumbra, Alameda, CA, USA) was planned. However, reperfusion catheter navigation was infeasible because of acute A1-A2 angulation and stent deployment (Figure 1e). Subsequently, rescue stenting using a self-expendable stent was performed to recanalize the occluded anterior cerebral artery (ACA). The Prowler Plus Select microcatheter could not be navigated to the distal ACA over the deployed stent. Thus, the Excelsior SL-10 Microcatheter was navigated through the thrombus, and the Neuroform Atlas stent was deployed. After stenting, ACA flow partially recovered (Figure 1f). Despite the immediate infusion of 0.5 mg intra-arterial tirofiban, the ACA was completely re-occluded (Figure 1g). As a last resort, intravenous 42 mg tPA (0.6 mg/kg, 15% as a bolus and 85% as an infusion over 1hour) was started, and flow restoration was partially achieved in the ACA after 10 min (Figure 1h). The small remnant thrombus did not increase in size and the ACA was still patent after 20 min. The timeline of the case is presented in the Figure 2.

The following day, brain CT revealed no increase in the hematoma size, and angiography showed good ACA recanalization without in-stent thrombosis (Figure 1i). Diffusion-weighted imaging revealed no acute infarction. The patient's clinical symptoms gradually improved, and he was without neurological deficits 12 months after discharge.

DISCUSSION

Thromboembolic complications during stent-assisted coiling of ruptured intracranial aneurysms are challenging for neurointerventionists. There are two major concerns regarding this practice: rescue therapies are associated with aneurysm rebleeding and are not always feasible.

Pharmacologic treatments for thromboembolic complications include thrombolytic agents or glycoprotein (GP) IIb/IIIa inhibitors.[4-10] A meta-analysis reported higher recanalization rates (72% vs. 50%) and lower perioperative (11% vs. 29%) and long-term (16% vs. 35%) morbidity with GPIIb/IIa inhibitors than with thrombolytic agents.[11] Specifically, tirofiban has a short half-life (2 h), resulting in more controlled drug administration, lower rebleeding rates, significantly fewer post-procedural neurological complications.[12] Although rescue treatment with tirofiban is generally effective for thromboembolism, concerns regarding recanalization failure and procedure-related hemorrhage remain in patients with SAH.[13] In our case, despite using tirofiban as first-line rescue therapy, thrombus formation was further aggravated, leading to complete occlusion of the involved artery.

Local intra-arterial fibrinolysis with urokinase or recombinant tPA may be a treatment option for thromboembolism. Although successful recanalization occurred after tPA injection in our case, thrombolytic agents should be used cautiously because of the high risk of severe

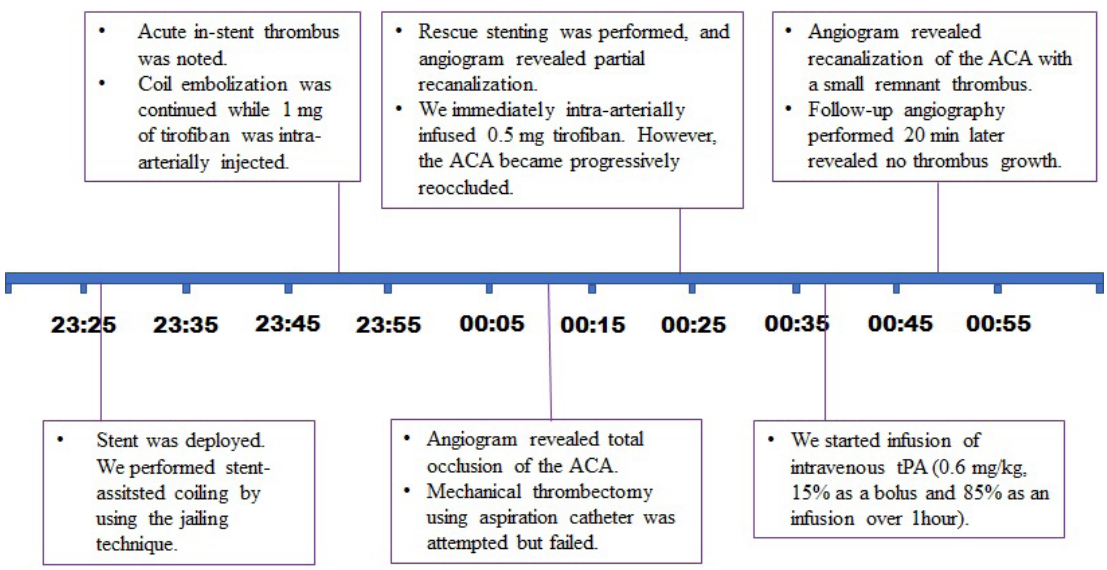

Figure 2. Case report timeline

aneurysmal bleeding. Feng *et al*. reported the intra-arterial infusion of tirofiban and urokinase for thromboembolic complications during coiling for ruptured aneurysms; one patient died due to aneurysmal rupture.[14] Koebbe et al. reported the outcome of thrombolysis using urokinase or tPA in five patients, two of whom experienced significant SAH.[4] Uneven distribution of the coil masses and spontaneous resolution of a thrombus among the strands of coils by the fibrinolytic action of thrombolytic agents could be possible mechanisms of rebleeding.[15]

Thus, the decision to apply thrombolytic agents should be based on the coil packing density of the aneurysm, involved vascular territory, and blood flow pattern, including the collateral blood supply. In the present case, the ruptured aneurysm was occluded with coils, and a thrombolytic agent was used as a last resort, judging that serious neurologic sequelae would occur if the occluded vessels were not recanalized due to poor collateral circulation. Although there is controversy about the efficacy and safety of tPA below the standard dose, we infused a low dose of tPA because of the risk of secondary hemorrhage in patients with SAH, especially in relation to concomitant tirofiban use.

The delayed effect of tirofiban may be related to recanalization. However, recanalization did not occur when only tirofiban was used, suggesting that tPA played a crucial role in recanalization. The use of intra-arterial urokinase may be an option for refractory thrombus in patients with acute ischemic stroke.[16,17] However, urokinase has been discontinued in our country and was unavailable at that time.

Several mechanical thromboembolism approaches have been reported as alternative treatments, including suction aspiration, stent retrieval, and rescue stenting.[18-20] Kang *et al*. reported four cases of successful recanalization after suction thrombectomy using the Penumbra system for refractory thromboembolism.[15] In the current case, a 3MAX aspiration catheter was used to approach the occlusion site in the proximal ACA after failed tirofiban treatment. The catheter could not reach the lesion because of acute ACA angulation. Rescue stenting failed to recanalize the occluded vessels.

Mechanical thrombectomy with a stent retriever was not considered in our case because pulling the retriever through an already deployed stent for coiling may cause stent migration or deformation, and coil dislodgement.

In conclusion, there are no definitive guidelines for treating thromboembolism during stent-assisted coil embolization for cerebral aneurysms. The benefits of thromboembolism treatment must be balanced against the increased hemorrhage risk, which can cause fatal outcomes. Rescue tPA infusion for thromboembolism can be considered the last resort for treating refractory occlusion.

DISCLOSURE

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Conflict of interest: None

Ethics: This case report was approved by our Institutional Review Board, and the requirement for written informed consent was waived.

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