

## Thrombectomy for delayed basilar stent occlusion with good outcome

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### Abstract

**Abstract**—Neurovascular stents have revolutionized the endovascular treatment of wide-necked and fusiform aneurysms; however, potential in-stent thrombosis—resulting in devastating strokes—complicates their use. Interventionalists using these devices must be aware of treatment options for such events.

We present the case of a 46-year-old man who underwent stent-supported embolization of an incidental basilar aneurysm followed by in-stent thrombosis 6 weeks later. Though he presented at that time after 24 h of symptom onset with complete occlusion of the basilar artery, delayed thrombectomy and thrombolysis resulted in a good clinical outcome.

**IV** intravenous

**ACT** activated coagulation time

**DWI MRI** diffusion weighted magnetic resonance imaging

**IA** intra-arterial

**tPA** tissue plasminogen activator

**ICH** intracranial hemorrhage

**List of proprietary devices cited in text**—Enterprise Vascular Reconstructive Device®, Codman Neurovascular, Raynham, MA

Excelsior SL 10 microcatheter, Target Therapeutics/Stryker, Fremont, CA

Prowler Plus Select microcatheter, Codman Neurovascular

MPD Envoy catheter, Codman Neurovascular

Penumbra .032” Reperfusion catheter, Penumbra Inc., San Leandro, CA

Transend .014” microwire, Target/Stryker

Merci Concentric Retriever®, Concentric Medical/Stryker, Mountainview, CA

### Keywords

aneurysm; coil embolization; stent; stroke; mechanical thrombectomy

### Introduction

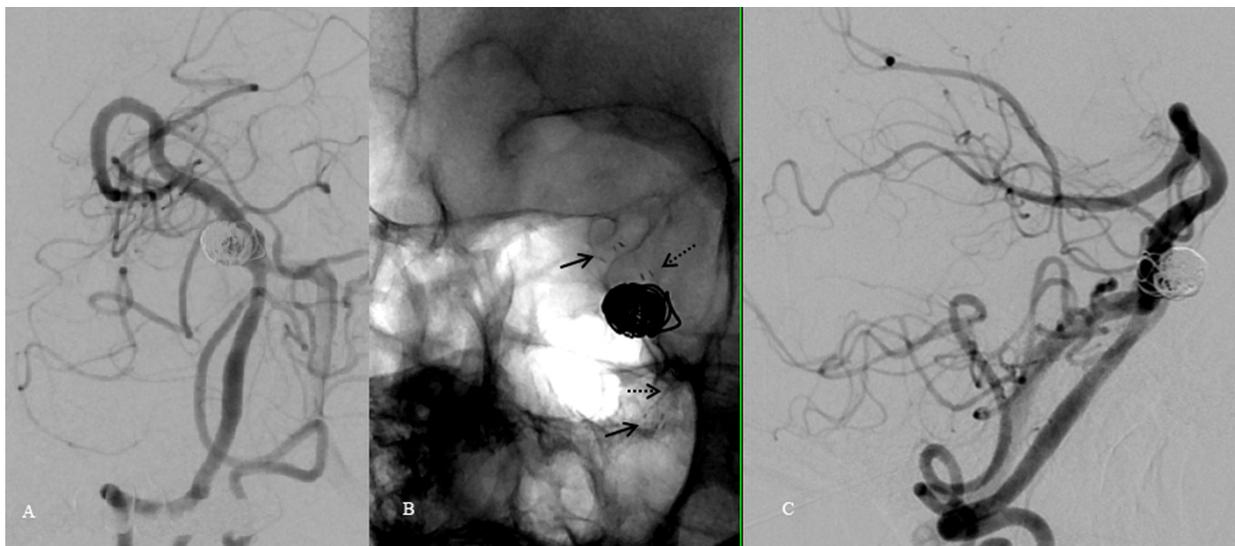
The Enterprise Vascular Reconstructive Device® (VRD, Codman Neurovascular, Raynham, MA), marketed for the treatment of wide-necked, intracranial aneurysms, requires patients to take antiplatelet medications

to prevent in-stent thrombosis [1]. Neurointerventionalists using these devices must be able to manage thrombotic complications, using available neurovascular tools and pharmacotherapy.

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**Figure 1.** Anteroposterior (AP) and lateral views of right vertebral artery angiogram demonstrate basilar artery aneurysm (arrow) measuring 1.1 cm in length extending from the vertebrobasilar junction to the level of the anterior inferior cerebellar artery origins. Though the bulk of the aneurysm dome is anterior to the basilar artery, there is also dilatation of its posterior aspect, indicative of the fusiform nature of the aneurysm. Note the left posterior cerebral artery is smaller in caliber than the left, having predominant supply from the anterior circulation.

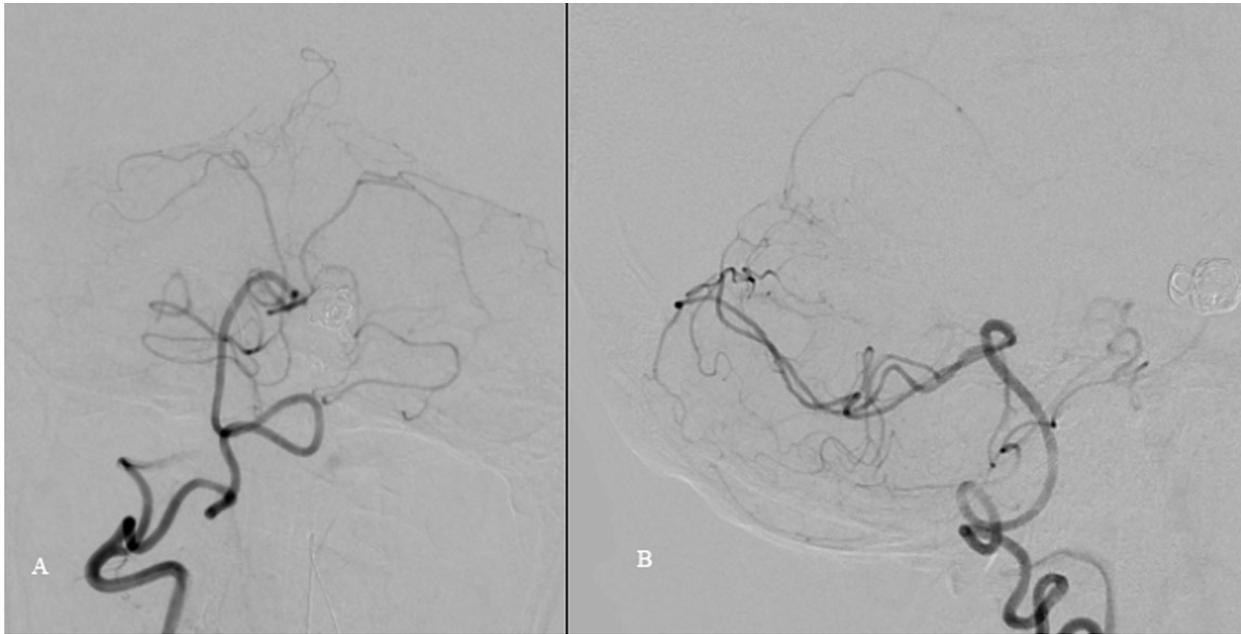
## Case history

### Clinical presentation

A 46-year-old Asian man underwent treatment of an incidental 1 cm wide-necked basilar aneurysm, extending from the vertebrobasilar junction to the mid-basilar segment, at the level of origin of the anterior inferior cerebellar arteries (Figure 1). Given the location, endovascular rather than surgical intervention was preferred. The patient was pretreated with aspirin of 325 mg and clopidogrel of 300 mg. Aneurysm occlusion was performed under general anesthesia. An Excelsior SL 10 microcatheter (Target Therapeutics/Stryker, Fremont, CA) was advanced to the aneurysm and “jailed there” against a Prowler Plus Select microcatheter (Codman Neurovascular) used to deliver an Enterprise® Vascular Reconstruction Device (Codman Neurovascular), via the left vertebral artery. The jailing technique was used as the aneurysm involved at least 270° of the vessel wall, rendering the vessel confines more difficult to visualize after coil placement (coils in the aneurysmal portion overlap with the normal reconstructed lumen of the vessel). It was felt that if the coiling catheter was placed inside the aneurysm prior to delivery of the stent, there could be greater assurance that coils were correctly placed against the aneurysm and vessel wall, outside the lumen of the stent. Two overlapping Enterprise® stents (4 mm × 28 mm and inner 4 mm × 14 mm) were used to provide greater flow diversion. Intraprocedural intrave-



**Figure 2.** Anteroposterior right vertebral artery subtracted angiogram (A), native view (B) and lateral view (C) demonstrating aneurysm status post coil embolization. Solid arrows delineate proximal and distal markers of 4x28 mm Enterprise® VRD. Dashed arrows delineate markers of 4x14 mm stent. Though there is some contrast opacification centromedially within the aneurysm sac, there is also overlap in this segment with the basilar artery.



**Figure 3.** Diffusion weighted magnetic resonance imaging demonstrates scattered areas of ischemia in bilateral cerebellar hemispheres and peduncle and right greater than left brainstem (arrows). Note aneurysm coils artifact left anterior brainstem.

nous (IV) heparin was administered to achieve activated coagulation time (ACT) of 380 s and post-operative regimen of aspirin 325 mg and clopidogrel 75 mg was prescribed. The patient was discharged 1 day later and seen in follow-up 2 weeks later in good neurological condition.

Further, six weeks postoperatively, the patient presented to an outside hospital with vomiting and dizziness. During evaluation, he suffered a syncopal event. Transfer was initiated 1 day later. Upon arrival, neurological examination revealed drowsiness, a left sixth nerve palsy, left facial weakness, dysarthria, left hemiparesis, and ataxia. Diffusion weighted magnetic resonance imaging (DWI MRI) showed scattered lesions in the cerebellum and brainstem (Figure 3). Repeat angiography demonstrated slow flow through the bilateral vertebral arteries with complete occlusion of the basilar artery (Figure 4), and minimal retrograde filling through the posterior communicators. Subsequent history obtained from the patient's wife revealed medication noncompliance over 50% of the time.

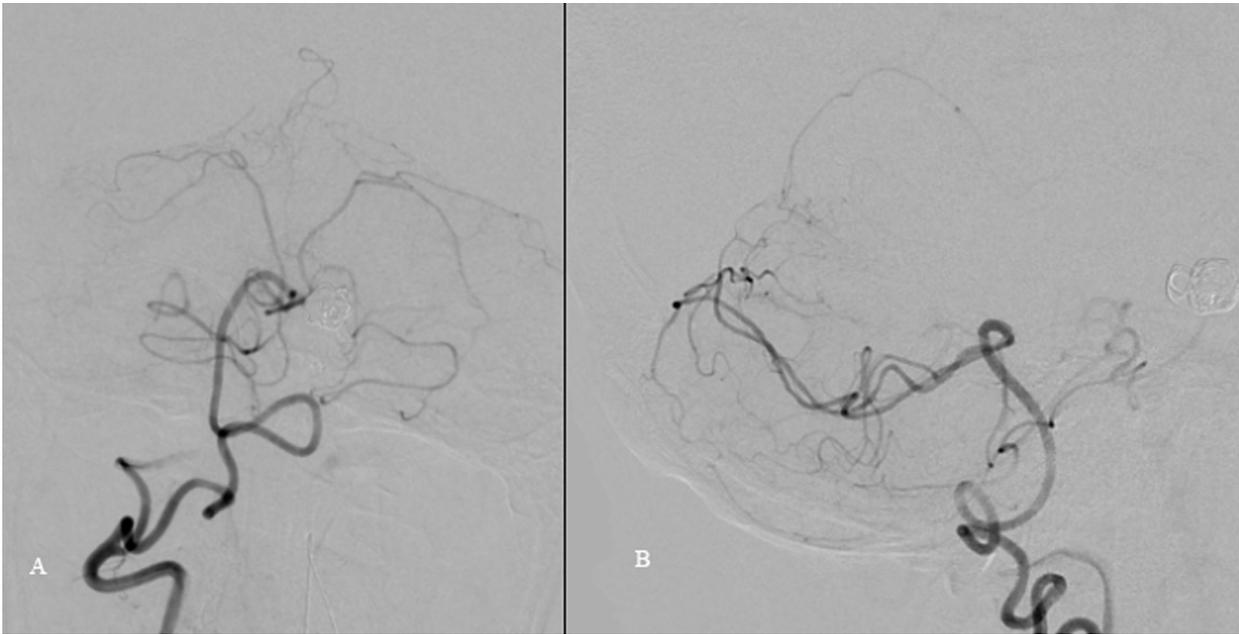
#### Interventional procedure

The patient was reloaded with aspirin of 325 gm and clopidogrel of 300 mg. IV heparin 3000 U and additional bolus doses of 1000 U per hour were administered for an ACT of 328 s. Conscious sedation was performed

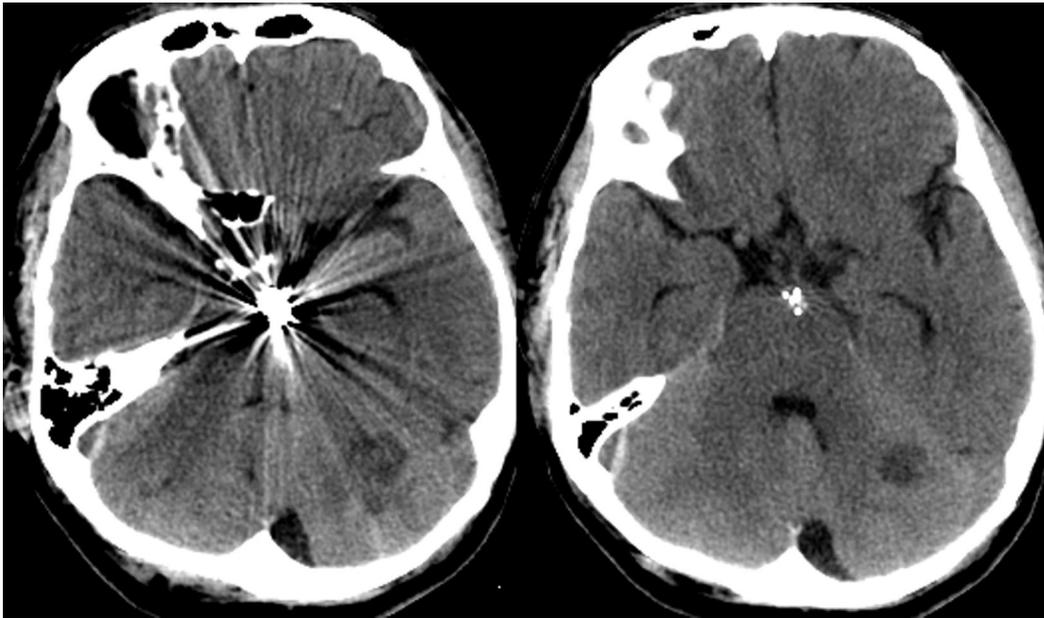
with Fentanyl 25 mcg IV. A 6 French MPD Envoy catheter (Codman Neurovascular) was advanced through the left vertebral artery. Next, a Penumbra .032" Reperfusion catheter (Penumbra Inc., San Leandro, CA) was advanced over a Transend .014" microwire (Target/Stryker) to just within the region of the proximal stent markers. Aspiration thrombectomy was performed for 5 min with some recanalization in the proximal basilar artery. This afforded sufficient visualization to enable advancement of the catheter further within the stent segment. Subsequently intra-arterial (IA) tissue plasminogen activator (tPA), reconstituted as 10 mg in 20 mL of normal saline, and abciximab, reconstituted as 5 mg in 30 mL of normal saline, were administered in aliquots of 3 mL. Interval angiography was performed after each aliquot to assess for recanalization, which when achieved after 20 mg of tPA and 4 mg of abciximab, concluded the procedure.

#### Post-operative course

Post-operatively eptifibatid, 135 mcg/kg bolus IV followed by 0.5 mcg/kg/min infusion, for 20 h was also administered [2] while continuing aspirin of 325 mg daily. Because of a concern for resistance to clopidogrel [3], cilostazol 200 mg daily was also administered [4] till the results of clopidogrel resistance testing returned negative, at which time this, at a dose of 75 mg, was substituted for cilostazol. Head computed tomography



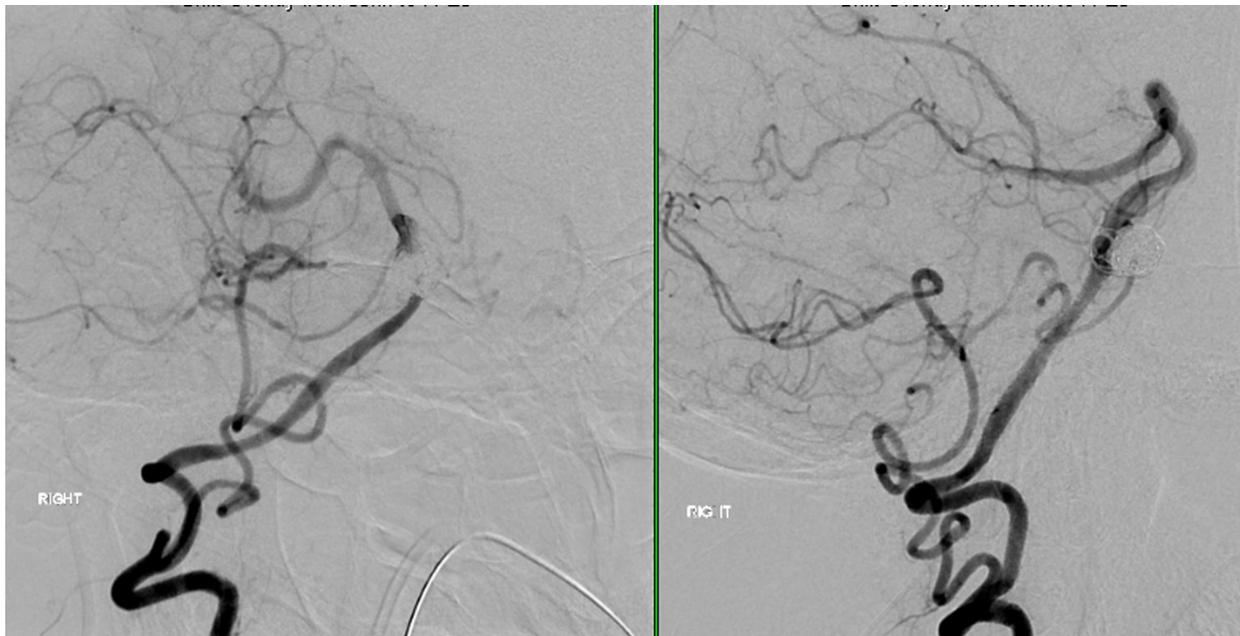
**Figure 4.** Anterior-posterior (A) and lateral views (B) demonstrate filling through the vertebral artery and posterior inferior cerebellar artery with collateralization to the superior cerebellar artery.



**Figure 5.** Post-operative head computed tomogram shows areas of infarction in the left cerebellar hemisphere, with no evidence of intracerebral hemorrhage. Coil embolization material artifacts the picture.

24 h postoperatively showed no intracerebral hemorrhage (ICH, Figure 5). Follow-up angiography at 72 h confirmed persistent patency of the basilar artery (Figure

6). Over the next few days, he significantly improved with only left abduction palsy at 2-month follow-up.



**Figure 6.** Post-stroke intervention angiogram shows recanalization of basilar artery. Note the area of prior contrast opacification within the aneurysm sac is no longer seen. The left posterior cerebral artery fills predominantly from the anterior circulation (not shown).

## Discussion

Although the extent of thrombosis was severe and symptoms were established for well over 24 h, revascularization of the occluded artery yielded good clinical outcome. Risk of hemorrhagic conversion increases with extent of ischemia, which is traditionally felt to be related to its duration [5]. Therefore, revascularization efforts are often withheld in cases of longstanding symptoms. However, we felt that without recanalization, his prognosis would be poor, given his continued decline. In this circumstance, though he had several areas of DWI abnormality, they were relatively small and restricted, in the posterior fossa, which perhaps lent safety to our efforts [6]. With the patient's constellation of neurological symptoms felt to be out of proportion to his radiological demonstration of infarction, we were guided by his "clinical-diffusion" mismatch, which has been described as a marker of patients prone to progress and who may potentially be revascularized safely to prevent this progression [6–8].

Though acute and delayed thromboses are known complications after stent-assisted aneurysm embolization, limited descriptions of mechanical thrombectomy as a treatment option exist [9]. Most reports of thrombectomy for embolic complications during endovascular aneurysm treatment are limited to the acute setting. One such series described modified use of the Penumbra sys-

tem (forced aspiration through the reperfusion catheter, without advancement use of the separator) [10]. We felt the Penumbra system would be safer than the Merci Concentric Retriever® (Concentric Medical/Stryker, Mountainview, CA), to blindly navigate through the occluded stented segment, since it is used from the proximal point of the clot rather than distally [11]. Furthermore, we sought to minimize aggressive movement of instruments within the stented segment. After a small channel opened, the predominant mode of recanalization was with IA thrombolytics and abciximab [12], based on the premise that the inciting process was likely platelet aggregation. Though post-operative treatment with IV eptifibatide may have increased the risk of hemorrhage, we were concerned that he may not have adequate antiplatelet agents to prevent rethrombosis, given the consideration of possible clopidogrel resistance, and opted for this strategy under close clinical monitoring.

The duration of dual antiplatelet therapy post-stent implantation to prevent thrombotic complications is not well known, but events up to 6 months from stent placement have been noted among patients who discontinue antiplatelet agents [1]. Placing two overlapping stents in this case may have added to the risk of remote thromboembolism. In such instances, as with any case of stent implantation, it is imperative that physicians closely follow patients and extensively query them and significant

others for medication noncompliance. Variation in the CYP2C219 gene may exist in up to 50% of Asians [3], placing them at increased risk for clopidogrel resistance; therefore, pre-procedure testing for this should also be considered in this and other at-risk populations. In certain circumstances, in-stent thrombosis may occur despite all precautions.

Neurointerventionalists who treat aneurysms may consider thrombectomy and aggressive intra-arterial thrombolysis as a treatment option for patients who suffer delayed in-stent thrombosis, taking into consideration the clinical syndrome and progression as well as extent of ischemia, as ascertained by high quality imaging studies, ideally DWI MRI. Post-intervention medication regimen must be considered carefully to weigh the risks and benefits of preventing rethrombosis with the development of ICH.

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