“Y-stent retriever”: a new rescue technique for refractory large-vessel occlusions?

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Long-awaited positive trial data have shown the efficacy of endovascular treatment in patients with ischemic stroke who arrive at the hospital within the first 6 hours with large-vessel occlusion of the anterior circulation. With the introduction of stent retrievers (SRs) for mechanical thrombectomy, efficient and safe large-artery recanalization treatment can be achieved. However, sometimes there are patients who do not attain complete flow restoration following attempts with traditional maneuvers. The authors present the case of a 57-year-old man with acute ischemic stroke due to an M₁ embolus that extended into both M₂ trunks. This patient was successfully treated with an innovative technique in which a Solitaire SR (Covidien) and a Catch SR (Balt) were used in a “Y” configuration, for which the authors coined the term “Y-stent retriever.”

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FIVE new randomized clinical trials with Class 1A evidence appeared in the last year: MR CLEAN,¹ ESCAPE,⁴ EXTEND-IA,² SWIFT PRIME,¹⁰ and REVASCAT.⁵ These trials changed the paradigm of treatment of ischemic stroke, clearly demonstrating the efficacy of endovascular treatment in the first 6 hours for stroke patients with occlusion of large vessels of the anterior cerebral circulation. In spite of considerable recanalization rates there are still patients with insufficient recanalization after standard stent retriever (SR) mechanical thrombectomy.¹ Many different techniques have been used for these cases, such as aspiration, stent placement, or intraarterial fibrinolysis. In this article, we describe a refractory thrombus treated by a novel technique in which a double-stent retrieval was used in a “Y” configuration, passing one stent through the cells of the other one, for which we coined the term “Y-stent retriever.”

Case Report

History and Examination

A 57-year-old man with a history of hypertension and

dyslipidemia presented with a right middle cerebral artery (MCA) stroke syndrome with left-sided facial palsy, right gaze deviation, and left-sided weakness; he had a National Institutes of Health Stroke Scale (NIHSS) score of 12. The patient underwent noncontrast CT and CT angiography of the brain demonstrating an Alberta Stroke Program Early CT score (ASPECTS) of 10; the CT angiogram showed a right M₁ occlusion with little collateral circulation. The patient had an exclusion criterion for intravenous thrombolysis, so given his early arrival and favorable imaging it was decided to perform a thrombectomy.

Treatment

Under conscious sedation, the right common femoral artery was accessed and a 6.5-Fr sheath was introduced. A right carotid arteriogram showed complete occlusion of the right M₁ with a Thrombolysis in Cerebral Infarction (TICI) score of 0. There was also a suprabulbar atheroma plaque with 40% stenosis (Fig. 1).

A 6-Fr Chaperon guide catheter (MicroVention-Terumo) was then placed in the right internal carotid artery (ICA).

ABBREVIATIONS AIS = acute ischemic stroke; ICA = internal carotid artery; MCA = middle cerebral artery; NIHSS = National Institutes of Health Stroke Scale; SR = stent retriever; TICI = Thrombolysis in Cerebral Infarction.

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FIG. 1. Frontal projection of right ICA angiogram. An occlusion at the level of the right proximal MCA-M₁ is detected (TICI Score 0).

A Headway 27 microcatheter (MicroVention-Terumo) over a Traxcess 14 guidewire (MicroVention-Terumo) was advanced into the occluded M₁ artery. The first retrieval attempt was made with a 4 × 20-mm Solitaire FR revas-

cularization device (Covidien), which was unsheathed and the microcatheter was removed in its entirety while syringe aspiration was applied to the guide catheter; 1 clot was attached to the stent and some were found in the aspiration syringe. However, follow-up angiography demonstrated ongoing occlusion with no restoration of flow. A second attempt was made with a 4 × 20-mm Solitaire SR (Covidien); it was deployed from the right superior M₂ artery to M₁, and another small clot was attached to the stent without evidence of recanalization. Finally, a third attempt was made, deploying a 4 × 20-mm Solitaire SR from the right inferior M₂ artery to M₁, and despite 2 very small clots recovered in the aspiration syringe, there was no recanalization (Fig. 2).

At this point, 4 hours 20 minutes had passed since the onset of symptoms, so we attempted recanalization once again, but this time implementing a novel technique. With the use of the same catheter guide, the Headway 27 microcatheter was navigated into the occluded vessel, and a 4 × 20-mm Solitaire SR was deployed from the right superior M₂ branch to M₁. Once deployed, the microcatheter was removed to allow more space in the lumen of the catheter guide for another system and for more effective aspiration. Although the delivery wire is not exchange length, distal purchase with the deployed SR provides sufficient anchorage to allow removal of the microcatheter without requiring access to the wire itself. A second microcatheter, a Headway 21, was advanced through the interstices of the Solitaire and into the right inferior M₂ artery. Once in

FIG. 2. Illustration of the "Solcatch" technique with schematic illustrations to depict the procedure. **A:** A Headway 27 microcatheter was navigated into the occluded vessel. **B:** A 4 × 20-mm Solitaire SR was deployed from the right superior M₂ branch to M₁. **C:** The microcatheter is removed to leave more space in the lumen of the guide catheter for another system and for more effective aspiration. Another system is navigated using a Headway 21 microcatheter and is advanced to the right inferior M₂ artery, passing through the interstices of the stent previously deployed. **D:** Once in this "Y" configuration, a 4 × 20-mm Catch SR is deployed from the right inferior M₂ artery to M₁, leaving the proximal tip of the Catch SR inside the Solitaire SR. **E:** Both devices are slowly recovered by simultaneously pulling them together into the guide catheter under continuous aspiration and fluoroscopic imaging control. Copyright Alyssa Pierce. Published with permission. Figure is available in color online only.

this “Y” configuration, a 4 × 20-mm Catch SR (Balt) was deployed from the right inferior M₂ artery to M₁, leaving the proximal tip of the Catch SR inside the Solitaire SR. Control angiography was performed after unfolding the SRs and reestablishment of flow was evidenced. Both SRs were left deployed temporarily. Finally, both devices were slowly recovered by simultaneously pulling them together into the guide catheter under continuous aspiration and fluoroscopic imaging control. After recovery, both stents were intertwined with a large and organized thrombus, and additional clot burden was found in the aspiration syringe. This last attempt resulted in complete recanalization of the branch with normal antegrade flow (TICI Score 3).

The time from emergency room arrival to groin puncture was 95 minutes, and the total time to recanalization from symptom onset was 4 hours 30 minutes. The catheters were then removed and hemostasis was achieved with manual compression over the right femoral puncture (Figs. 2–4).

Postoperative Outcome and Follow-Up

The patient was transferred to the intensive care unit for routine postoperative care for 2 days. His NIHSS score at 1 hour was 4, improving to 0 at 6 hours. A follow-up noncontrast CT scan was performed at 48 hours, showing no infarct or hemorrhage. An echocardiogram was obtained and showed no abnormalities. Aspirin was started and the patient was discharged to home neurologically intact 6 days after the episode.

Discussion

Long-awaited positive trial data are establishing neurothrombectomy as the first new treatment in 20 years with proven benefit for patients with acute ischemic stroke (AIS). Optimism for the technique has sprung from the recent publication of the MR CLEAN trial as well as the expected positive results from other halted studies.¹¹ Although intravenous tissue plasminogen activator (tPA) has

FIG. 3. Angiographic imaging of the “Solcatch” technique procedure. **A:** Frontal projection showing a 4 × 20-mm Solitaire SR already deployed from the right superior M₂ branch to M₁. Another system is advanced to the right inferior M₂ artery, passing through the interstices of the stent previously deployed. **B:** Once in this “Y” configuration, a 4 × 20-mm Catch SR is deployed from the right inferior M₂ artery to M₁, leaving the proximal tip of the Catch SR inside the Solitaire SR. **C:** Anteroposterior view showing the SRs in place. **D:** Large thrombus is extracted. Figure is available in color online only.

FIG. 4. Frontal projection of right ICA angiogram. This last attempt resulted in complete recanalization of the branch with normal antegrade flow (TICI Score 3).

remained the standard treatment for most AISs, its benefits for large-vessel occlusions have remained limited, and abundant new evidence suggests that mechanical embolectomy performed with third-generation devices including SRs is able to afford profound long-term functional benefits to patients with ischemic stroke who have large-vessel occlusions.⁷

Compared with earlier mechanical devices, SRs have the advantage of easy handling and almost immediate restoration of antegrade flow after deployment of the device, independently of successful thrombectomy,³ thus potentially saving time for the interventionalist and the brain.⁸ With the introduction of SRs for mechanical thrombectomy, efficient and safe large-artery recanalization treatment can be achieved. However, sometimes there are patients in whom complete flow restoration is not achieved after trying with traditional maneuvers.⁹ In these refractory cases we suggest using the combined Solitaire and Catch stents (“Solcatch”) technique. The interaction between device and thrombus is influenced by multiple factors: device mechanical characteristics, device behavior during retrieval, and thrombus biomechanics and consistencies. Machi et al. made an evaluation of the mechanical properties and effectiveness of SRs and reached the conclusion that all SRs slide over large white thrombi, with the clot failing to be retrieved. Moreover, white, small, and medium thrombi are not permanently engaged by the stent struts but roll between it and the vessel wall during retrieval.⁶ Perhaps in these cases the “Y-stent retriever” technique can be a rescue alternative. The combination in a “Y” configuration between the Solitaire and Catch stents in refractory occlusions that involve a bifurcation may enable entrapment of the thrombus between both stents and the vessel wall, to provide fast recanalization and to restore antegrade blood flow as well as reduce the risk of thrombus migration.

Our choice of the 2 specific stents was entirely arbitrary; these were the only 2 devices available to us at the time. No particular characteristic of each stent makes them essential for “Y” stenting. Therefore this rescue technique for refractory occlusions can be carried out using 2 Solitaire SRs, 2 Catch SRs, or both. We had no technical complications. Access with both stent-delivery systems was easy, and the entire thrombus was covered sufficiently. After stent retrieval there was neither occlusion nor vessel lesions. This experience with this new innovation of simultaneous use of 2 different SRs in a “Y” configuration is encouraging due to its feasibility to achieve effective recanalization in cases refractory to traditional techniques. The clinical outcome of the patient was also encouraging, showing no neurological deficit (NIHSS Score 0) 6 hours after the procedure.

Despite the excellent results we had in this case, we suggest trying this technique only in refractory cases, because using a double SR system is more technically demanding. With this in mind, until more evidence of the use of the “Solcatch” technique comes to light, we advise practitioners to proceed with caution when applying it.

Conclusions

The “Solcatch” is an endovascular technique to consider for the treatment of AIS in occlusions that are refractory to traditional procedures, especially with thrombi at arterial bifurcations.

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Disclosures

Dr. Spiotta reports ownership in Blockade Medical and Penumbra, Inc. He is a consultant for Penumbra, Stryker, and Pulsar Vascular.

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Conception and design: Crosa, Spiotta, Negrotto. Acquisition of data: Negrotto. Analysis and interpretation of data: Crosa, Spiotta, Negrotto. Drafting the article: Crosa, Spiotta, Negrotto. Critically revising the article: Crosa, Spiotta. Reviewed submitted version of manuscript: Crosa, Spiotta. Administrative/technical/material support: all authors. Study supervision: Crosa, Spiotta, Negrotto.

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