**Stent retriever**

A stent retriever is a medical device used to unclog blood clots that can cause strokes. The stent retriever looks like a small metal cage attached to the end of a long wire.

The interaction between the stent retriever and clot is a key factor for recanalization during mechanical thrombectomy.

Imahori et al., retrospectively reviewed 50 patients with acute middle cerebral artery occlusion who were treated with the Trevo stent retriever. Patients were divided into groups that achieved (1st-pass recanalization group, n=21) or did not achieve (non-1st-pass recanalization group, n=29) a modified Thrombolysis in Cerebral Ischemia score of 2b or 3 with the 1st-pass procedure. Patients were also divided into a thromboembolic (n=49) and atherosclerotic (n=11) group by occlusion etiology. We evaluated radiographic findings of the Trevo strut, e.g., degree of stent expansion and filling defect of the thrombus in the strut (in-stent thrombus sign) during the 1st-pass procedure among these groups.

The median stent expansion was significantly greater in the 1st-pass recanalization than non-1st-pass recanalization group (60% versus 34%; P<0.01), and in the thromboembolic than atherosclerotic group (45% versus 31%; P<0.01). The receiver operator characteristic curve shows moderate capacity of the prediction for recanalization and etiology, with an area under the curve of 0.83 and 0.73, respectively. The in-stent thrombus sign was significantly more common in the thromboembolic than atherosclerotic groups (86% versus 10%; P<0.01).

Greater stent expansion was associated with recanalization after thrombectomy. The in-stent thrombus sign may be useful for etiology prediction. These radiographic findings could provide useful real-time feedback during procedure, reflecting the clot-stent interaction.

Intravenous recombinant tissue plasminogen activator had been the only approved treatment for acute ischemic stroke since its approval in 1995. However, the restrictive time window, numerous contraindications, and its low recanalization rate were all limitations of this modality. Under those circumstances, endovascular stroke therapy went through a great evolution during the past two decades of intravenous thrombolysis. The results of the 2013 randomized trials for endovascular stroke therapy were neutral, although they were limited by insufficient imaging screening at enrollment, early-generation devices with less efficacy, and treatment delays. Huge progress was made in 2015, as there were five randomized clinical trials which all demonstrated the safety and efficacy of endovascular stroke treatment. Despite differences in detail patient enrollment criteria, all 5 trials employed key factors for good functional recovery; (1) screening with non-invasive imaging to identify the proximal occlusion and exclude a large infarct core, (2) using highly effective modern thrombectomy devices mainly with stent retriever, and (3) establishment of a fast workflow to achieve effective reperfusion. The results of those trials indicate that modern thrombectomy devices can allow for faster and more effective reperfusion, which can lead to improved clinical outcomes compared to intravenous thrombolysis alone. These advances in mechanical thrombectomy are
promising in the global fight against ischemic stroke-related disability and mortality. Two current mainstreams among such mechanical thrombectomy techniques, “stent retriever thrombectomy” and “direct clot aspiration”, are the topic of this review. Stent retriever thrombectomy using Solitaire and Trevo retriever will be firstly discussed. And, the commonalities and the differences between two major clot aspiration thrombectomy techniques; a direct aspiration first pass technique (ADAPT) and forced arterial suction thrombectomy (FAST), will be additionally explained. Finally, details regarding the combination of direct clot aspiration and stent retriever thrombectomy, the switching strategy and the Solumbra technique, will be described.

Theoretically, stent placement in acute embolic stroke enables entrapment of the thrombus between the stent and the vessel wall to provide fast recanalization and to restore antegrade blood flow. Flow restoration may rapidly reestablish oxygen supply in the ischemic brain region and enhance the efficacy of thrombolytic drugs. In addition to conventional stenting, stent retrievers allow thrombectomy to be performed by pulling back the deployed stent into the guide catheter, whereby the struts of the stent engage the thrombotic material. Particularly advantageous is that the stent is applicable repeatedly and can be used even in small peripheral vessel branches (eg, M2 segments). In contrast with conventional stent systems, stent retrievers require no anticoagulation or antiaggregation treatment as the stent is not deployed permanently.

Primary suction thrombectomy produced higher recanalization and good clinical outcome rates than did stent retriever thrombectomy. Larger-scale studies are necessary that consider factors such as occlusion site, stroke severity, and concomitant use of endovascular devices.

Case series

A retrospective review was performed of 95 consecutive patients with intracranial internal carotid artery or M1 segment middle cerebral artery occlusion treated with stent retriever-based thrombectomy over an 11-month period. Patients were divided into a conventional local aspiration group (traditional group) and those treated with a novel continuous aspiration technique (CAPTIVE group). They compared both early neurologic recovery (based on changes in National Institute of Health Stroke Scale (NIHSS) score), independence at 90 days (modified Rankin score 0-2), and angiographic results using the modified Thrombolysis in Cerebral Ischemia (TICI) scale including the TICI 2c category.

There were 56 patients in the traditional group and 39 in the CAPTIVE group. Median age and admission NIHSS scores were 78 years and 19 in the traditional group and 77 years and 19 in the CAPTIVE group. Median times from groin puncture to recanalization in the traditional and CAPTIVE groups were 31 min and 14 min, respectively (p<0.0001). While rates of TICI 2b/2c/3 recanalization were similar (81% traditional vs 100% CAPTIVE), CAPTIVE offered higher rates of TICI 2c/3 recanalization (79.5% vs 40%, p<0.001). Median discharge NIHSS score was 10 in the traditional group and 3 in the CAPTIVE group; this difference was significant. There was also an increased independence at 90 days (25% traditional vs 49% CAPTIVE).

The CAPTIVE embolectomy technique may result in higher recanalization rates and better clinical outcomes.
Case reports

2017

A man who developed severe vasospasm in a long segment of the extracranial internal carotid artery after mechanical irritation by a stent retriever inserted for the treatment of acute cerebral ischemia. A 47-year-old right-handed man presented with sudden-onset right-sided weakness and difficulty speaking. The patient's National Institutes of Health Stroke Scale score was 6 and he had an Alberta Stroke Program Early Computed Tomography Score of 9. The patient was started on intravenous alteplase therapy, and an acute thrombectomy was performed. Left internal carotid digital subtraction angiography showed narrowing of the left common and internal carotid arteries and occlusion of the proximal left M1 segment of the middle cerebral artery. A stent retriever was retracted into a guiding catheter placed at the left carotid bulb under continuous suction. Recanalization of the middle cerebral artery was not achieved and there was significant narrowing in a long segment of the extracranial internal carotid artery associated with exacerbation of the patient's aphasia. The cervical vasospasm improved after nicardipine infusion via the catheter. We encountered vasospasm in a long segment of the extracranial internal carotid artery after mechanical irritation by a stent retriever. If a stent retriever is used in a patient with a narrow extracranial internal carotid artery, consideration should be given to using a Penumbra or smaller guiding catheter located in the distal internal carotid artery to prevent irritation to the cervical vessel wall.

2016

A 79-year-old woman developed cardiogenic embolization of the distal middle cerebral artery (M2). The deployed stent retriever bent because of vessel tortuosity. After withdrawal of the stent with strong resistance, complete revascularization was achieved, but an extravasation was detected at the site. Eight hours after disappearance of the extravasation, re-bleeding occurred with aneurysm-like pooling of contrast media. Direct surgical observation confirmed a pseudoaneurysm formation. The pseudoaneurysm was likely formed by avulsion of a fine vessel during withdrawal of the stent retriever at a tortuous vessel.

A paper reports the first case of successful stent-retriever embolectomy for acute MCA occlusion via the patent posterior communicating artery (PComA) by using Trevo XP ProVue stent-retriever in a patient with acute MCA stroke and chronic occlusion at the origin site of the ipsilateral ICA.

2014

An 82-year-old woman developed sudden left hemiparesis and aphasia during an urgent cardiac catheterization procedure for a non-ST elevation myocardial infarction. She had a baseline National Institutes of Health Stroke Scale (NIHSS) score of at least 10 and no improvement with intravenous administration of tissue plasminogen activator (tPA). Cerebral angiography was performed with conscious sedation, confirming an occlusion of the superior division of the right middle cerebral artery (MCA). Using standard technique, a Trevo thrombectomy device was deployed across the clot. Post-thrombectomy control angiography demonstrated complete revascularization of the right MCA. The device was then gently withdrawn without difficulty. Immediately afterward the patient's blood pressure showed a sudden and significant elevation. Immediate posttreatment angiography demonstrated active extravasation from the posterior wall of the communicating segment of the right internal carotid artery. Rapid cessation of bleeding was achieved with intravenous administration of protamine and induced hypotension. Immediate neurological assessment was performed, which showed motor improvement. An immediate postintervention CT scan confirmed a moderate-sized...
subarachnoid hemorrhage and contrast in the prepontine cistern. The patient was discharged home on postoperative Day 3 with an NIHSS score of zero. At 6-month follow-up in the neurointerventional clinic, her NIHSS and modified Rankin Scale scores were both zero. Endovascular stent retriever devices are increasingly being used as first-line thrombectomy devices in acute embolic strokes. A unique and previously undescribed complication is vessel perforation during withdrawal of a stent retriever. Conservative treatment options and reversal of anticoagulation should be the first line of treatment for such complications. In the authors’ case, performing the procedure without anesthesia was helpful in assessing the patient's neurological status.


