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Review article – *Special issue: Acute Ischemic Stroke*

Mechanical thrombectomy: Stent retrievers vs. aspiration catheters

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ABSTRACT

Mechanical thrombectomy, in conjunction with systemic thrombolysis, is currently the standard of care for the treatment of acute ischemic stroke. Mechanical thrombectomy extends the therapeutic window up to at least 8 hours from the time of symptom onset and is more efficient than systemic thrombolytic agents in removing clots resistant to enzymatic degradation. It is also a viable option for patients with various contraindications against the use of systemic thrombolysis. Treatment of patients with acute ischemic strokes using mechanical thrombectomy devices has yielded both higher rates of revascularization as well as superior clinical outcomes when compared with medical therapy with intravenous thrombolytics alone. The use of first-generation thrombectomy devices, most notably the Merci Retriever system (Stryker, Kalamazoo, MI, USA) and the Penumbra Aspiration device (Penumbra Inc., Alameda, CA, USA), achieved high rates of revascularization of occluded large cerebral vessels but did not necessarily result in high rates of favorable clinical outcomes. Second-generation devices, known as stent retrievers, were therefore created with the goal of achieving faster revascularization of occluded vessels and improved rates of favorable clinical outcomes. Stent retrievers, most notably the Solitaire (ev3/Covidien, Irvine, CA, USA) and the Trevo (Stryker), were shown to be superior to first-generation

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Abbreviations: ESCAPE, Endovascular Treatment for Small Core and Anterior Circulation Proximal Occlusion with Emphasis on Minimizing CT to Recanalization Times; EXTEND-IA, Extending the Time for Thrombolysis in Emergency Neurological Deficits–Intra-arterial; ICA, internal carotid artery; ICH, intracranial hemorrhage; IV, intravenous; MERCI, Mechanical Embolus Removal in Cerebral Ischemia; MR CLEAN, Multicenter Randomized Clinical Trial of Endovascular Treatment of Acute Ischemic Stroke in the Netherlands mRS, modified Rankin Scale score; NIHSS, National Institutes of Health Stroke Scale; REVASCAT, Randomized Trial of Revascularization with Solitaire FR Device vs Best Medical Therapy in the Treatment of Acute Stroke Due to Anterior Circulation Large Vessel Occlusion Presenting within Eight Hours of Symptom Onset; SWIFT, Solitaire Flow Restoration Device With the Intention for Thrombectomy; SWIFT PRIME, Solitaire With the Intention For Thrombectomy as PRIMary Endovascular treatment; SYNTHESIS Expansion, Synthesis Expansion: A Randomized Controlled Trial on Intra-Arterial vs. Intravenous Thrombolysis in Acute Ischemic Stroke; t-PA, tissue plasminogen activator; TICI, Thrombolysis in Cerebral Infarction; TIMI, Thrombolysis in Myocardial Infarction; TREVO, Thrombectomy REvascularization of large Vessel Occlusions in acute ischemic stroke; TREVO 2, Trevo vs. Merci Retrievers for Thrombectomy Revascularization of Large Vessel Occlusions in Acute Ischemic Stroke.

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devices in terms of achieving higher rates of favorable clinical outcomes. Aspiration combined with stent retrievers or alone has also shown great promise. Moreover, several recent randomized control trials have demonstrated the superiority of medical therapy with mechanical thrombectomy using stent retrievers over medical therapy alone in achieving good clinical outcome in acute stroke patients. These clinical trials also demonstrated the relative safety of mechanical thrombectomy with stent retrievers compared to the safety of best medical therapy.

Contents

Introduction

The last decade has witnessed rapid and significant advancement in the treatment of acute ischemic stroke, turning it from a purely neurological disease treated with systemic thrombolytic medications into an interventional condition treated with mechanical thrombectomy and in situ vessel revascularization. Mechanical thrombectomy is currently used either as an adjunctive therapy along with intravenous (IV) thrombolytic agents or as a stand-alone treatment modality for acute ischemic strokes. Mechanical thrombectomy has a number of advantages over systemic thrombolysis. Firstly, it extends the therapeutic window beyond the 4.5-hour guideline for thrombolytics, with many trials using 8 hours from the time of symptom onset as the therapeutic window for mechanical thrombectomy [1–4]. Secondly, mechanical thrombectomy is more efficient than systemic thrombolytic agents in removing clots resistant to enzymatic degradation, such as mature fibrin and cross-linked thrombi containing calcium or cholesterol crystals [2,5]. Finally, mechanical thrombectomy is a viable option for patients with various contraindications against the use of systemic thrombolysis. Overall, treatment of patients with acute ischemic strokes using mechanical thrombectomy devices has yielded higher rates of revascularization when compared with intravenous (IV) thrombolytic therapy [6–8]. The first-generation devices for mechanical thrombectomy included the Merci Retriever system (Stryker, Kalamazoo, MI, USA) and the Penumbra aspiration system (Penumbra Inc., Alameda, CA, USA). Second-generation treatment devices included endovascular stent-retrieval devices, such as the Solitaire (ev3/Covidien, Irvine, CA, USA) and the Trevo (Stryker).

First-generation mechanical thrombectomy devices

Merci clot-retrieval system

The initial first-generation mechanical thrombectomy device was the Merci Retriever system, which was approved in 2004 by the United States Food and Drug Administration as the first mechanical thrombectomy device used in patients with acute ischemic stroke. The Merci Retriever system has undergone multiple revisions since its initial approval. The first generation (X5 and X6) was comprised of a helically-tapered corkscrew-like catheter tip. The second generation (L4, L5, and L6) incorporated