



REVIEW / *Neuroradiology*

Stent retriever thrombectomy for acute ischemic stroke: Indications, results and management in 2015



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Abstract The functional benefit of stent retriever thrombectomy in acute ischemic stroke has been clearly demonstrated in recent positive MR CLEAN, ESCAPE, EXTEND-IA, SWIFT PRIME, REVASCAT and THRACE trials. Thrombectomy, in association with intravenous thrombolysis, should now be offered to patients with documented occlusion of the distal internal carotid or proximal middle cerebral arteries, with a relatively normal unenhanced computed tomography (CT), and within 6 hours after the onset of symptoms. Thrombectomy results in a mean absolute decrease in handicap of 22% (14 to 31%). Of the 3 up to 8 patients treated, 1 is independent at 3 months according to the initial selection. In case of a contraindication to thrombolysis, early primary thrombectomy should be considered. In acute basilar artery occlusion, thrombectomy should be performed alone or combined with thrombolysis. In an effort to increase the number of patients treated, a very rapid transfer to interventional neuroradiology centers is mandatory. In the future, thrombectomy should be evaluated in patients with distal arterial occlusion, or beyond 6 hours after the onset of symptoms, or when the time of symptoms onset is unknown.

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The goal of treatment in the acute phase of ischemic stroke is to obtain rapid and complete arterial recanalization, [1] in order to reperfuse the parenchyma, which is in the ischemic penumbra, and prevent progression to cellular necrosis [2]. Intravenous (IV) thrombolysis with the tissue plasminogen activator (alteplase, t-PA) has been the only proven treatment for the first 4 h 30 after the onset of symptoms [3]. A meta-analysis including 6756 patients showed that IV thrombolysis administered within the first 4 h 30 after the onset of symptoms significantly improved the clinical outcome, the earlier it was administered, the better (odds-ratio [OR] = 1.75; 95% confidence interval [95% CI] = 1.35–2.27) [4]. However the efficacy of IV thrombolysis is limited by the low rate of recanalization in proximal arterial occlusions (30% for an M1 occlusion of the middle cerebral artery [MCA] and 8% for occlusion of the internal carotid artery [ICA]) [5], a narrow window of time and a number of contraindications (recent surgery, hemostatic disorders, or history of hemorrhagic stroke). Since it was shown to be beneficial 20 years ago, no other medication or technique has been shown to significantly reduce the neurological handicap. Although tolerance was similar to IV t-PA in the IMS 3, MR RESCUE and SYNTHESIS trials [6–8], the benefit of intra-arterial mechanical thrombectomy was not confirmed before the arrival of “stent retrievers”. “Stent retrievers” represent major therapeutic progress because they are significantly more effective than earlier devices (for example MERCI retriever device) making it possible to significantly improve the neurological prognosis at 3 months [9,10].

The goal of this review was to present the results of mechanical thrombectomy (MT) by “stent retriever”, to describe the main clinical and radiological parameters influencing prognosis and to imagine the main situations for the use of this technique (contraindication to IV thrombolysis, basilar artery occlusion...).

Pivotal therapeutic trials on stent retrievers

The clinical benefit of MT by “stent retriever” was first reported in December 2014 in the randomized clinical trial the Multicenter Randomized Clinical Trial of Endovascular Treatment for Acute Ischemic Stroke in the Netherlands (MR CLEAN), which compared the best medical treatment (IV thrombolysis within 4 h 30 after the onset of symptoms in case of no contraindications) to MT in association with IV thrombolysis in patients presenting with confirmed ischemic stroke of the distal internal carotid and/or the proximal middle cerebral artery (Table 1) [11]. Femoral puncture had to be performed within 6 hours after the first symptoms. Diagnosis of stroke was based on non-enhanced head CT and CT angiography. Most patients had undergone IV thrombolysis (89%) before the procedure. The trial was stopped after 500 patients had been included (267 patients in the thrombolysis group and 233 patients in the MT group). IV thrombolysis was begun after 85 min in the MT group and 87 min in the thrombolysis group, and femoral puncture lasted 260 min in the MT group (or 2 hours and 55 min

after thrombolysis) (Table 2). This study showed that MT (by “stent retriever” in 97% of the cases) resulted in an absolute benefit of 13.5% compared to IV thrombolysis alone (Rankin score [mRS] ≤ 2 at 3 months 32.6% compared to 19.1%; OR = 1.67, 95% CI = 1.21–2.3) (Fig. 1). The median NIHSS (NIH stroke scale) score at 24 hours and at 7 days was significantly lower in the MT group (13 vs. 16 at 24 hours, 8 vs. 14 at 7 days). The number of complications in the MT group was similar because the risk of symptomatic hemorrhagic stroke (with the same definition as that in the ECASS 3 study [3]) was 7.7% following MT (compared to 6.4% in the IV thrombolysis group alone). Three-month mortality was not different in the two study arms (18.9% vs. 18.4% at 30 days). However, stroke in a new territory was reported in 5.6% of the patients after MT due to fragmentation of the clot during removal (vs. 0.4% after IV t-PA alone).

In 2015, four randomized controlled trials, Endovascular Treatment for Small Core and Anterior Circulation Proximal Occlusion With Emphasis on Minimizing CT to Recanalization Times (ESCAPE), Extending the Time for Thrombolysis in Emergency Neurological Deficits-Intra-Arterial (EXTEND-IA), Solitaire With the Intention for Thrombectomy as Primary Endovascular Treatment Trial (SWIFT PRIME), Randomized Trial of Revascularization With the Solitaire FR Device Versus Best Medical Therapy in the Treatment of Acute Stroke Due to Anterior Circulation Large Vessel Occlusion Presenting Within Eight Hours of Symptom Onset (REVASCAT) also confirmed the functional benefit of MT associated with IV thrombolysis in proximal artery occlusion [12–15]. ESCAPE was stopped early after inclusion of 315 patients due to a positive intermediate analysis [12]. Although the time window was 12 hours, rapid management was essential because the delay between radiological diagnosis and femoral puncture was 1 hour. A better clinical outcome (mRS ≤ 2 at 3 months) was observed in the MT group (53.0% vs. 29.3%; OR = 3.1, 95% CI = 2.0–4.7) as well as a significant decrease in mortality (19% vs. 10.4%). The benefit of MT persisted in the different subgroups (patients older than 80, initial NIHSS > 19, patients treated after 6 hours). One out of 3 patients undergoing thrombectomy had an improved mRS. One out of 4 patients undergoing thrombectomy was independent (mRS ≤ 2 at 3 months) EXTEND-IA was a phase 2 trial that analyzed the ischemic penumbra before treatment (CT perfusion) and evaluated early reperfusion and neurological improvement on day 3 [13]. This study was stopped early because of a positive intermediate analysis after randomization of the first 70 patients. A favorable outcome (mRS ≤ 2 at 3 months) was obtained in 71% of the patients in the MT arm compared to 40% in the control group ($P < 0.01$; number of patients to be treated = 3). SWIFT PRIME was stopped early after a positive intermediate analysis of the first 196 patients [14]. The patients were selected based on CT or magnetic resonance (MR) (CT or MR perfusion with the RAPID software for the first 71 patients) and unlike previous studies, tandem occlusions were exclusion criteria. A favorable clinical outcome was significantly more frequent in the MT group (60.2% vs. 35.5%, $P < 0.001$). REVASCAT was also discontinued early by the data and safety monitoring board [15]. The number of independent patients at 3 months significantly increased after MT (43.7% vs. 28.2%; OR = 2.1).

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