

# Thrombectomy for acute ischemic stroke: an evidence-based treatment

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Just 2 years ago, at the International Stroke Conference in Honolulu, Hawaii, USA, the Interventional Management of Stroke (IMS III),<sup>1</sup> Mechanical Retrieval and Recanalization of Stroke Clots Using Embolectomy (MR RESCUE),<sup>2</sup> and SYNTHESIS-Expansion<sup>3</sup> trials were presented and concurrently published in *The New England Journal of Medicine*. The overarching message to the medical community and lay press was that these studies provided unambiguous evidence that mechanical thrombectomy was ineffective in treating acute stroke secondary to emergent large vessel occlusion (ELVO). The investigators were careful to emphasize the adaptive designs of their trials, which allowed sites to use new thrombectomy devices as technology evolved, thus implying that the results would be directly applicable to modern clinical practice. When scrutinized by the interventional community, however, it was clear that these three trials had significant shortcomings.<sup>4–5</sup> Most notably, these trials were limited by the predominant use of antiquated thrombectomy technologies, poor revascularization rates, and the lack of vascular imaging required for patient enrollment. Collectively, these shortcomings made the studies' conclusions largely irrelevant to the contemporary application of thrombectomy for ELVO.

Unfortunately, this highly technical and nuanced argument was buried by the mantra: "thrombectomy shown to be ineffective in three clinical trials", an easily understood and succinct message.

Now just 2 years later, at the International Stroke Conference in Nashville, Tennessee, USA, the opposite has occurred. The Multicenter Randomized CLinical trial of Endovascular treatment for Acute ischemic stroke in the Netherlands (MR CLEAN),<sup>6</sup> The Endovascular treatment for Small Core and Anterior circulation Proximal occlusion with Emphasis on minimizing CT to recanalization times (ESCAPE),<sup>7</sup> the Extending the Time for Thrombolysis in Emergency Neurological Deficits—Intra-Arterial (EXTEND-IA)<sup>8</sup> and Solitaire FR With the Intention For Thrombectomy as Primary Endovascular Treatment for Acute Ischemic Stroke (SWIFT PRIME)<sup>9</sup> studies provide us with concordant, unambiguous, and overwhelming level 1a evidence that thrombectomy is profoundly beneficial in patients with ELVO. In each of the four trials, patients randomized to intra-arterial therapies had significantly improved outcomes compared with patients randomized to medical management alone (table 1). These results stand in stark contrast to those of the previous three trials. The reported numbers needed

to treat to achieve a good functional outcome were, remarkably, between 3 and 4. Thus, thrombectomy has now been established as the standard of care in patients presenting with ELVO.

These data have immediate and important implications for the neurointerventional community. We need to embark on a broad education platform that ranges from patients to emergency medical services professionals to other neurologically oriented physicians. There are several critical messages that must be conveyed. First, there is certainty that mechanical thrombectomy is beneficial in selected groups of patients with ELVO. These new studies employed contemporary neuroimaging and devices and in all patients, and therefore were directly reflective of current clinical practice. The new evidence is definitive, confirmed across multiple centers in different countries, without the significant limitations of the previous negative studies. As such, the data defines thrombectomy as the standard of care for many patients with ELVO. Second, now that we have defined the superiority of thrombectomy in these populations, it is imperative that health systems evolve to accommodate the need for timely and effective endovascular care for patients with stroke. It is now the responsibility of community physicians and emergency first-responders to identify patients with ELVO and transport them expediently to an institution capable of performing intra-arterial therapies. These studies all emphasized the importance of workflow and rapid, efficient team-based care. Placing contemporary thrombectomy devices in every hospital will not yield similar outstanding outcomes. Each trial's success was the result of a highly

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**Table 1** Results of the recently presented randomized controlled trials evaluating thrombectomy vs medical management for ELVO

Trial†	Treatment arm	Good outcome at 90 days (%)*	p Value or 95% CI
MR CLEAN <sup>6</sup>	IAT	33	5.9 to 21.2
	Medical	19	
ESCAPE <sup>7</sup>	IAT	53	<0.001
	Medical	29	
EXTEND-IA <sup>8</sup>	IAT	71	0.01
	Medical	40	
SWIFT-PRIME <sup>9</sup>	IAT	60	<0.001
	Medical	36	

\*Modified Rankin Score of 0–2.

†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; MR CLEAN, Multicenter Randomized CLinical trial of Endovascular treatment for Acute ischemic stroke in the Netherlands; SWIFT-PRIME, Solitaire FR With the Intention For Thrombectomy as Primary Endovascular Treatment for Acute Ischemic Stroke.

ELVO, emergent large vessel occlusion; IAT, intra-arterial therapy.

dedicated team. Centers of excellence will need to invest significant effort and resources to maximize care delivery pathways.

The entire infrastructure of stroke care delivery must now evolve. The current system is decentralized and designed to promote the efficient delivery of intravenous thrombolysis to patients at community hospitals. Now that thrombectomy has been shown to be beneficial for treatment of many patients with ELVO, the system must shift to a centralized network to allow for the rapid identification and delivery of patients with ELVO to a limited number of centers capable of performing thrombectomy and other advanced stroke care procedures. Formal regionalization of stroke systems will thus be necessary. Furthermore, innovative approaches to stroke care delivery, such as ambulance-based CT systems in mobile stroke units,<sup>10</sup> should be evaluated as a means by which to rapidly identify, treat, and provide an appropriate disposition of patients with ELVO.

Currently 24% of patients with stroke are discharged to inpatient rehabilitation and 31% to skilled nursing facilities. Of those returning home directly, 32% use home healthcare services.<sup>11</sup> Between 2012 and 2030, total direct medical stroke-related costs are projected to almost triple, from \$71.6 billion to \$184.1 billion,<sup>12</sup> with the inpatient hospital costs for an acute stroke event accounting for 70% of the first year post-stroke costs.<sup>13</sup> With improved early neurological improvement, patients undergoing thrombectomy can have decreased length of stay and reduced hospital cost. A significantly improved functional outcome at 3 months

should correlate with reduced long-term rehabilitation and further reduction in downstream cost of care for large vessel strokes. The potential impact of thrombectomy in reducing immediate and long-term cost should thus be accounted for as new systems of care for acute ischemic stroke are developed.

With the successful completion of these recent trials, the fundamental research question in acute stroke care has now changed from “Does thrombectomy work?” to “How can we make thrombectomy more effective?” Going forward, we must work to optimize patient selection, reduce time from stroke onset to revascularization, improve revascularization rates, and develop techniques to salvage ischemic penumbra. Advances in neuroimaging-based assessment and patient selection, device innovation, the standardization of interventional techniques and training, and the development of neuroprotective strategies should be the focus of future research. It is our responsibility as a community to ensure that all patients with ELVO have access to validated and highly effective intra-arterial therapies. To do so, we must strive to improve the systems, techniques, and technologies through which stroke care is delivered.

**Competing interests** None.

**Provenance and peer review** Commissioned; internally peer reviewed.

**To cite** Fiorella DJ, Fargen KM, Mocco J, et al. *J NeuroIntervent Surg* Published Online First: [please include Day Month Year] doi:10.1136/neurintsurg-2015-011707

Accepted 18 February 2015

*J NeuroIntervent Surg* 2015;0:1–2.  
doi:10.1136/neurintsurg-2015-011707

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