

# Endovascular Management and Treatment of Acute Ischemic Stroke



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## KEYWORDS

- Acute ischemic stroke • Endovascular intervention • Intra-arterial therapy • Large vessel occlusion
- Stentriever • Thrombectomy

## KEY POINTS

- Endovascular therapy should be reserved for acute strokes with large vessel occlusion confirmed by noninvasive imaging (computed tomographic [CT] angiography or magnetic resonance angiography) or catheter angiography.
- Advanced perfusion imaging helps identify patients with a favorable penumbra/ischemic core mismatch irrespective of the time of onset of stroke symptom.
- Stentriever leads to higher recanalization rates and improved long-term clinical outcomes in patients with stroke, compared with early mechanical thrombectomy approaches.
- Enrollment of eligible patients into clinical endovascular stroke trials is critical for better understanding of the role of endovascular interventions in the treatment of acute stroke.



Videos of Solitaire Deployment and Solitaire Withdrawal accompany this article at <http://www.neurosurgery.theclinics.com/>

## INTRODUCTION

Each year approximately 795,000 Americans experience a new or recurrent stroke.<sup>1</sup> Ischemic stroke is by far the dominant stroke type, affecting 87% of all patients (the remaining 13% of strokes

are caused by intracerebral and subarachnoid hemorrhages). At present, only 3% to 4% of patients with acute ischemic stroke are treated with systemic intravenous (IV) thrombolysis with recombinant tissue plasminogen activator (rt-PA).<sup>2,3</sup> Barriers to receiving IV thrombolysis

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Abbreviations and acronyms	
ASPECTS	Alberta Stroke Program Early CT Score
CT	Computed tomography
IA	Intra-arterial
ICA	Internal carotid artery
IMS	Interventional Management of Stroke
IV	Intravenous
MCA	Middle cerebral artery
MR RESCUE	Mechanical Retrieval and Recanalization of Stroke Clots Using Embolectomy
NIHSS	National Institutes of Health Stroke Scale
Rt-PA	Recombinant tissue plasminogen activator
SWIFT	Solitaire with the Intention for Thrombectomy
SWIFT PRIME	Solitaire FR with the Intention for Thrombectomy as Primary Endovascular Treatment for Acute Ischemic Stroke
SYNTHESIS Expansion	Synthesis Expansion: A Randomized Controlled Trial on Intra-Arterial versus Intravenous Thrombolysis in Acute Ischemic Stroke
THERAPY	Assess the Penumbra System in the Treatment of Acute Stroke
TICI	Thrombolysis in cerebral infarction
TREVO 2	Thrombectomy Revascularization of Large Vessel Occlusions in Acute Ischemic Stroke

include the public's lack of knowledge of stroke symptoms; delay in recognizing stroke symptoms, seeking medical attention, and hospital arrival; as well as multiple contraindications to systemic administration of rt-PA.<sup>2,4,5</sup>

Endovascular intra-arterial (IA) therapy is reserved for strokes from large vessel occlusion. Data from academic medical centers in the United States and Canada show that large vessel occlusion is responsible for 29% to 46% of ischemic strokes and is associated with a higher National Institutes of Health Stroke Scale (NIHSS) score, 4-fold increase in mortality, and worse neurologic outcome than other types of ischemic strokes.<sup>6-9</sup>

According to previously published population- and epidemiology-based stroke studies, an estimated 4% to 14% of acute stroke cases (corresponding to 25,000-95,000 patients with stroke) may be eligible for endovascular stroke

therapy.<sup>8</sup> At present, approximately 14,000 patients undergo IA stroke interventions in the United States.<sup>8</sup> The rapid evolution of endovascular stroke therapies has led to the ability to achieve successful recanalization with newer devices. The introduction of stent retriever (stentriever) technology to the arsenal of stroke neurointerventionists has led to improved clinical outcomes, making stentriever the dominating modern thrombectomy device.<sup>10,11</sup>

Nevertheless, the efficacy of endovascular therapy against systemic thrombolysis or standard medical therapy has yet to be proved. In recent randomized trials of IA stroke interventions that included mostly early-generation thrombectomy devices, clinical outcomes were similar between endovascular and traditional approaches to stroke treatment.<sup>12-14</sup>

This article provides an overview of the current status of endovascular stroke interventions. The role of clot properties and advanced perfusion imaging in determining eligibility for endovascular treatment is discussed. Currently available revascularization devices and their technical characteristics are discussed. Finally, an update on ongoing and future trials of endovascular stroke therapies is provided.

## SELECTION OF PATIENTS FOR ENDOVASCULAR THERAPY

### *Defining the Optimal Time Window for Intervention*

At present, there are 4 thrombectomy devices approved by the Food and Drug Administration under 510(k) clearance for recanalization of cerebral vessels in patients with acute ischemic stroke – the Merci Retrieval System (Concentric Medical, Mountain View, CA, USA), the Penumbra system (Penumbra Inc, Alameda, CA, USA), the Solitaire FR stentriever (ev3/Covidien Vascular Therapies, Irvine, CA, USA), and the Trevo ProVue stentriever (Stryker, Kalamazoo, MI, USA). All these devices were tested in corresponding trials that enrolled patients presenting within 8 hours of symptom onset.

Widespread use of advanced physiologic perfusion imaging technology now challenges this strict time-based selection approach. A multicenter retrospective study of 247 patients treated with endovascular therapy based on CT perfusion imaging findings, regardless of the time from stroke symptom onset, showed that IA revascularization can be safe and effective beyond the 8-h time limit in a carefully selected population.<sup>15</sup> The rates of functional outcome and symptomatic intracerebral hemorrhage were similar in strokes within and

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