

Emergency Department Treatment of Acute Ischemic Strokes: The Future of the Brain Cath Lab

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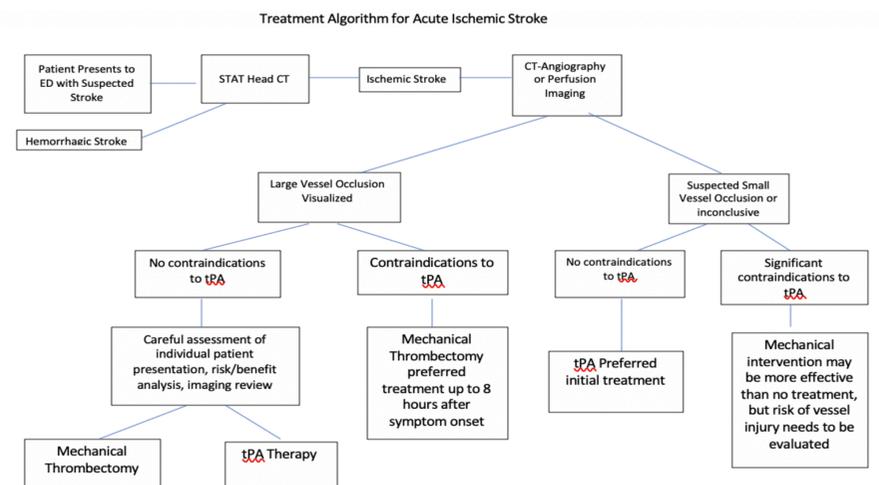
Abstract

Acute ischemic strokes are defined as a sudden cessation of blood flow to an area of the brain, resulting in hypoxic death of brain tissue and subsequent loss of neurologic function. They are a leading cause of serious disability worldwide and cost the US healthcare system roughly \$3.2 billion per year.¹ Historically, first-line treatment for acute ischemic strokes has been thrombolytic therapy with Tissue-Type Plasminogen Activation (tPA), which works by systemically altering the blood's clotting cascade. tPA is a very effective therapy, however, it carries with it a significant risk of life-threatening bleeding events. Because of the wide array of contraindications to tPA, many patients with prior history of bleeding, anticoagulation use, or prolonged presentation of symptoms are ineligible for this therapy. Mechanical thrombectomy (MT) is an alternative treatment which involves placing catheter-guided stents directly at the site of intravascular blockages in the brain. This method has primarily been reserved for patients in which systemic anticoagulation is contraindicated and was considered a second-line treatment for years. During the early 2010's, several studies supported the consideration of mechanical thrombectomy as an additional first-line treatment choice in certain patient populations, rather than strictly as an alternative to tPA. This research is essential in determining the safest, most effective treatment for stroke patients on an individual level. It may also lead to expedited triage protocols in the emergency department and faster time to treatment.

Background

Ischemic strokes make up 87% of all strokes that occur.² Risk factors for ischemic strokes include uncontrolled hypertension, smoking, type two diabetes, advanced age, and male gender. Patients with ischemic strokes can present differently, however the most typical presentation is a sudden onset of painless neurologic deficit. Symptomatology is further dependent on the specific vessel involved, but may include hemiparesis, aphasia, facial sensory loss, gait ataxia, or vertigo. The diagnosis of ischemic stroke begins with determining the etiology as quickly as possible. A non-contrast head CT should be obtained within thirty minutes of arrival to the ED.¹ The FDA has approved the use of tPA in patients with no medical contraindications, whose onset of symptoms is within 3.5 hours of administration. Historical studies showed tPA to be effective in improving neurologic function at 3 months post-stroke when compared to supportive treatment alone.³ Because of the significant bleeding risk associated with tPA, patients need to be screened appropriately for any predisposing risk factors for bleeding. After 4.5 hours from symptom onset, the risk of severe hemorrhage outweighs the benefits of fibrinolytic therapy.⁴ Mechanical thrombectomy (MT) involves introducing a intra-arterial stent via the internal or common carotid artery. The stent is delivered directly to the blocked vessel in the brain, expanded momentarily to allow for increased perfusion, and then removed, bringing the clot with it.⁵ Between the years of 2012 and 2017, five clinical trials studying the effects of mechanical thrombectomy on stroke treatment outcomes were conducted in Europe and the United States.⁶⁻¹⁵ One of these trials was stopped almost immediately due to proven benefit of thrombectomy on patient outcomes.

Proposed Stroke Treatment Algorithm



The Future of Stroke Treatment

Several follow-up studies have been conducted on the use of thrombectomy since these landmark trials were published. One study published in the New England Journal of Medicine (NEJM) showed that treatment of large vessel occlusions using mechanical thrombectomy was both effective and safe up to 8 hours after symptom onset.¹⁵ Another study published in the NEJM concluded that thrombectomy posed no additional harm over tPA and was more effective in the treatment of large vessel occlusions. It also suggested that this therapy was at least as effective as tPA in the treatment of small vessel occlusions.¹⁴ Evidence for efficacy of thrombectomy in the setting of small vessel occlusions needs further development, however current evidence suggests a statistical benefit and improved patient results, despite increased risk of hemorrhage and perforation.

Mechanical thrombectomy has demonstrated statistically significant improvements in both complete clot elimination as well as post-stroke disability scores and should be considered early in the stroke treatment algorithm. It also allows for effective management up to eight hours after symptom onset, which is more than double the timeframe for tPA. tPA still remains a good treatment choice in patients who do not meet qualifications for mechanical thrombectomy or who present early after symptom onset.

Although stroke treatment has dramatically improved within the last twenty years, new advancements in both imaging modalities and treatment options have created even more opportunities for growth. Further research is needed in order to determine the best way to deliver prompt, effective care to these patients. Despite potential administrative, infrastructural, financial, and personnel challenges, major hospital systems need to start re-thinking how strokes are handled in the emergency department. They need to consider all treatment options on an individualized level in a prompt and organized manner. After all, time is brain.

| Name of Study | Study Design | Statically Significant Findings | Adverse Events |
|---------------|---|---|---|
| MR CLEAN | 500 patients, all presented with CT-confirmed proximal large artery occlusions Two treatment groups: 1. Intra-arterial therapy 2. "usual care" treatment of tPA | Improvement in functional independence of patients at 90 days post-procedure. 75% showed no continued occlusions MT was statistically successful up to 6 hours after onset of symptoms | No significant difference in mortality rates or rates of intracerebral hemorrhage There was a small, but statistically significant increase in vessel dissection, perforation, new ischemic strokes in the MT group. |
| ESCAPE | 300 patients with CT-confirmed small cerebral infarcts Two treatment groups: 1. Mechanical thrombectomy using Solitaire Stent retriever 2. tPA only | Improvement in functional independence in MT group. 72% achieved total reperfusion after therapy. Statistically significant decrease in mortality rate in the MT group | No difference in rate of intracerebral hemorrhage between groups *this study was stopped early due to obvious benefits of mechanical thrombectomy. |
| SWIFT PRIME | 196 patients with CT-confirmed proximal MCA artery occlusions who presented within 6 hours of symptom onset Two treatment groups: 1. tPA followed by MT 2. tPA alone | 60% of patients who received MT demonstrated minimal disability at 90 days, while only 30% of patients in the tPA-only group achieved minimal disability score. | No statistically significant differences in 90-day mortality rates *this study was stopped early due to obvious benefits of mechanical thrombectomy. |
| REVASCAT | 160 patients between the ages of 18-85. Two treatment groups: 1. tPA + intra-arterial therapy 2. tPA alone | Statistically significant improvement in overall clinical patient outcomes in MT group. Treatment window for MT was statistically significant up to 8 hours after symptom onset. | *this study was stopped ¼ of the way through due to obvious benefits of mechanical thrombectomy. |

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