

Update on Neurointerventional Therapy for the Treatment of Acute Cerebral Ischemia

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Abstract

Mechanical thrombectomy (MT) is a minimally invasive, fluoroscopically guided procedure to remove clots from the arteries in the head and neck. The procedure can be performed very quickly and effectively, with low complication rates, as techniques and technology have advanced in recent years. MT is among the most efficacious procedures performed today, with a very low number needed to treat (NNT) to impact outcomes. Expanded indications for MT include patients with large core infarcts, extended time windows from stroke onset, more distal occlusions, and milder symptoms. Trials have shown a significant benefit of MT in terms of reduced disability in nearly every patient population studied.

Pre-Test

1. Which of the following patients might be a candidate for mechanical thrombectomy?
 - a. 78 year-old man who lives in a nursing home and needs some assistance, presenting as a wake-up stroke (last known normal > 12 hours ago) with NIH Stroke Scale (NIHSS)¹ 15 including right gaze deviation, slurred speech, and left sided weakness. Head CT shows a large right middle cerebral artery (MCA) territory infarct involving more than half the MCA territory, and computed tomography angiography (CTA) shows large vessel occlusion (LVO) in proximal right middle cerebral artery (MCA, M1 segment).
 - b. 71 year-old woman who lives independently, last known normal six hours ago, presenting with moderate to severe aphasia but normal strength in all extremities, and low NIHSS < 6. Head CT negative, CTA shows a distal left MCA (M3 segment) occlusion.
 - c. 91 year-old woman who lives independently, last known normal time unknown, presenting with NIHSS 20 including left gaze deviation, aphasia, and right sided weakness. Head CT shows small left MCA territory infarct and CTA shows left intracranial internal carotid artery occlusion (LVO).
 - d. None of the above.
 - e. All of the above.
2. What treatment options are available for this patient?

81 year-old woman, last known normal 16 hours ago, presents to your hospital with right gaze deviation and left sided weakness, NIHSS 14. Head CT negative, CTA shows right MCA M1 occlusion (LVO).

Mechanical Thrombectomy

Mechanical thrombectomy (MT) is a minimally invasive procedure to remove clots from the arteries in the head and neck, performed through a small 2-3 mm incision (usually in the groin, wrist, or occasionally neck) that allows access to the arterial system. The procedure can be performed under local anesthesia, conscious sedation, or general anesthesia depending on the patient's clinical status and co-morbidities. A series of catheters are advanced into the brain using live x-ray (fluoroscopy) and subsequent devices specially designed to remove clots are used. The procedure has a technical success rate approaching 90%, with complication rates comparable to the administration of IV thrombolytics.² Limitations of the procedure include the need for highly trained physicians (neurointerventional surgeons), dedicated endovascular suites/equipment, and well-coordinated systems of care to minimize time from symptom onset to time of clot removal.

MT for acute ischemic stroke in the setting of large vessel occlusion is among the most efficacious surgery/intervention performed today. The number needed to treat (NNT) for one patient to have reduced disability is as low as 2, with NNT as low as 2.8 for functional independence at 90 days.³ When compared to other common procedures such as percutaneous coronary intervention for STEMI (NNT 23 to save a life),⁴ the very low NNT for MT indicates incredible procedural efficacy with a major impact on functional outcomes.

Stroke survivors represent the number one cause of long-term disability in the United States. Mechanical thrombectomy results in a significant cost benefit to the health care system by improving functional outcomes in the most severe strokes, thereby reducing the number of patients requiring long term care. Clinical outcome in ischemic stroke patients is measured using the modified Rankin Scale (ranging from mRS 0 = no disability to mRS 6 = dead). The benchmark outcome endpoint in stroke research and clinical trials has been functional independence at 90 days (mRS 0-2). Fifty percent of patients who undergo MT for large vessel occlusion stroke will have significant early neurological recovery at 24 hours, and nearly 50% will have functional independence at 90 days (mRS 0-2)² including the ability to perform all their activities of daily living (self-care/driving), and may be able to return to work.

A major paradigm shift in patient selection is an understanding that most patients that undergo MT have improvement in their functional status when compared to medical management alone without higher rates of complications. The indications for mechanical thrombectomy continue to expand and these trends include:

1. Patients presenting in a more delayed fashion from symptom onset, including wake-up strokes (no time restrictions for MT using advanced imaging techniques such as perfusion imaging; important to remember that rapid/earlier treatment is always favorable)^{5,6};
2. Patients presenting with larger infarcts on initial CT imaging (large core infarction)⁷;
3. Patients with pre-existing disability (mRS > 3) or life expectancy less than six months (cancer/hospice);
4. Patients with milder stroke with disabling symptoms (low presenting NIHSS; trials ongoing)⁶;

5. Patients with smaller or more distal clots (trials ongoing).⁶

Evolving techniques and technology are allowing shorter procedure times (often less than 30 minutes), more complete clot removal, and higher rates of single pass efficacy which result in safer, more cost-effective procedures with lower complication rates.

Patient outcomes from MT are optimized at hospitals certified as Thrombectomy Capable Stroke Centers or Comprehensive Stroke Centers (the highest level of stroke center certification) by The Joint Commission or other accrediting bodies. Facilities certified as Acute Stroke Ready Hospitals or Primary Stroke Centers are capable of acute evaluation, imaging, and treatment of ischemic stroke patients, including administering IV thrombolytics (and some Primary Stroke Centers may be capable of performing MT).

A major barrier to patients receiving MT is delayed presentation to the specialized centers capable of performing the procedure. Several critical factors may affect the pathway of the patient to the endovascular suite:

1. Delayed recognition that the patient is having a stroke by the patient/family/witness;
2. Delays in activation of emergency medical system (EMS) and transport to the closest stroke center;
3. Delays in transferring patients from a hospital without capabilities to perform MT to one that can (referred to as door-in/door-out time).

Patients and health care providers in Delaware are fortunate to have a state-wide Stroke System with formalized cooperation between the Delaware Department of Public Health, all hospitals throughout the state, EMS services, rehabilitation centers, and other agencies. The state's Stroke System works closely together to improve stroke care including access to MT for all patients throughout Delaware.

Post-Test

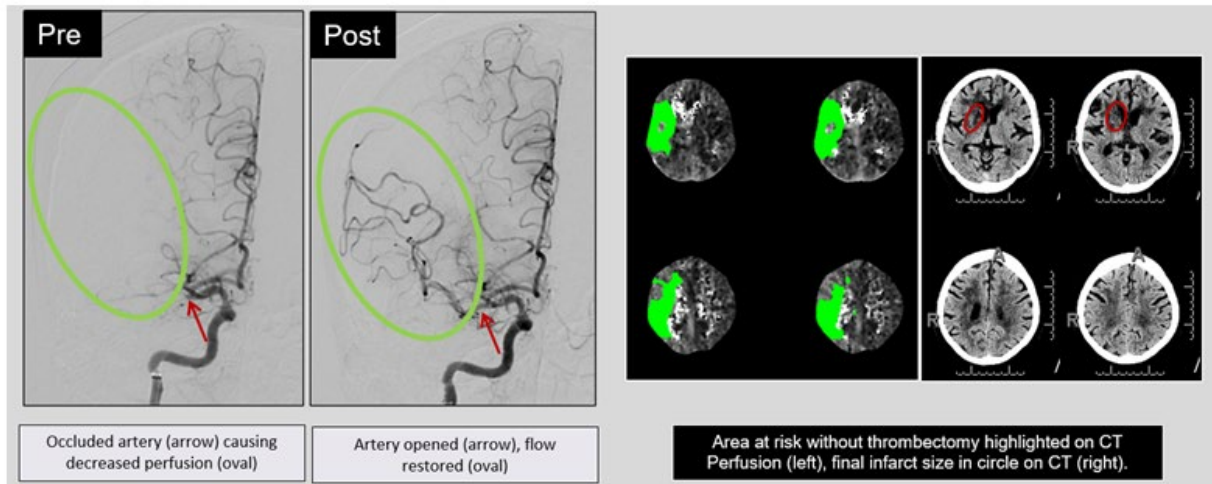
1. Which of the following patients might be a candidate for mechanical thrombectomy?
 - e. All of the above.

Expanding indications for MT allow access to the procedure for a broader group of patients with acute ischemic stroke, including those with large core infarcts or baseline functional deficits as with patient A, patients with milder but disabling deficits or more distal occlusions as with patient B, and in more extended time windows including unknown onset times as in patients A and C. We have no age or time cut-off for MT but rather use clinical and imaging information to make decisions regarding the procedure.

2. What treatment options are available for this patient?

This patient is outside the standard time window for IV thrombolytics. She is, however, a candidate for MT. She was transferred to our center and underwent successful MT (Figure 1). Her symptoms had nearly completely resolved upon discharge (NIHSS 1).

Figure 1. Before and After Images of a Successful Mechanical Thrombectomy



Key Points

- MT is a minimally invasive, fluoroscopically guided procedure to remove clots from the arteries in the head and neck, which can be performed very quickly and effectively with low complication rates as techniques and technology have advanced in recent years.
- MT is among the most efficacious procedures performed today, with a very low NNT of 2.6 for one patient to have reduced disability.
- Indications for MT are expanding, including those patients with large core infarcts, extended time windows, more distal occlusions, and milder symptoms. Trials have shown a significant benefit in terms of reduced disability in nearly every patient population studied, with ongoing trials expected to broaden the indications even further.

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