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Rise and restore: the role of cerebral angiogram with mechanical thrombectomy in the case of cerebral vascular accident and a wake-up stroke: a case report

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Abstract

Background Intravenous thrombolytic therapy with tissue plasminogen activators (that is, tenecteplase, alteplase) and mechanical thrombectomy are both considered standard treatments for acute ischemic stroke, with mechanical thrombectomy being the gold standard for large vessel occlusions. Mechanical thrombectomy is a minimally invasive procedure that is increasingly considered a gold standard for treating ischemic strokes caused by large vessel occlusions, offering a less invasive alternative to traditional surgical options while minimizing vascular and epidermal risks.

Case presentation A 45-year-old American male presented with aphasia and right-sided weakness for an unknown time, secondary to a wake-up stroke, was subsequently diagnosed with a cerebral vascular accident and underwent a mechanical thrombectomy. Considering that a large vessel ischemic stroke has a greater risk of poor prognosis, the level of recovery seen in our patient highlights what has been shown in recent trials, namely that expansion of mechanical thrombectomy indications in large-core patients can have a meaningful impact, as up to a third of patients can be functionally independent at 90 days. In our patient's case, he only needed about 96 hours before he was able to go home to his wife and two children. Also, given the large stroke and bearing in mind the risks versus benefits, the decision was made not to be overly aggressive and stent the dissection, as it was not re-occluding and flow-limiting, as this would require dual anti-platelet medications which would have increased the risk of bleeding.

Conclusion This case highlights that effective management requires not only understanding available therapeutic options but also knowing when their application is most appropriate, regardless of the level of invasiveness. This principle is central to optimizing patient outcomes and exemplifies the thoughtful application of clinical judgment—in the words of a colleague: "the art of practicing medicine."

Keywords Wake-up stroke, Thrombolytic therapy, Mechanical thrombectomy, Cerebral angiogram

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Background

In the United States, the incidence of thrombotic cerebrovascular events is approximately 1 to 3 cases per 1,000 individuals. Of these cases, not all require surgical intervention and can be managed via anticoagulant or thrombolytic therapy [1]. Thrombectomy is a common procedure; however, its success rate is dependent on the location and extent of the blood clot. It is primarily used

to treat deep vein thrombosis (DVT), acute mesenteric ischemia, renal artery occlusion, myocardial infarction (MI), or stroke. Thrombectomies are classified as two types: surgical (open) or percutaneous (mechanical). In the case of our patient, the latter was utilized, and thus will serve as the premise of this discussion [2].

Surgical thrombectomy, is a surgical procedure wherein a blood clot is removed from the inside of an artery and/or vein. During a surgical thrombectomy, an incision is made into a blood vessel, the clot is removed, and the respective blood vessel is repaired; in some cases, using a balloon or stent is required to adequately restore the blood flow and keep the vessel open. In our patient, the minimally invasive percutaneous catheter-directed mechanical thrombectomy (MT) without thrombolysis was performed, using a device inserted via catheters, either through aspiration, stent relievers, or a combination, to remove occlusions from the blood vessels. The procedure can be done under conscious sedation or general anesthesia (driven by best practice protocol of the treating institution. In our case, general anesthesia was used). Arterial access is then typically obtained via the femoral artery; however, more devices are emerging to allow these procedures to be done from the radial artery. Once arterial access is obtained, the guide catheter is placed in the internal carotid artery and the thrombectomy devices are then deployed in an attempt to remove the clot [3].

Case presentation

A 45-year-old Caucasian American male presented as a wake-up stroke, with his last known well time at 22:00 when he went to bed. He was noted to wake up with neuro-deficits at 07:00 by his spouse who immediately called the emergency services. He presented to the emergency department at 07:50 with left gaze, right-sided weakness, right facial droop, and aphasia, and was documented on arrival to have a National Institutes of Health Stroke Scale (NIHSS) of 17, a Modified Rankin Scale (mRS) of 5, and an Alberta Stroke Program Early CT (ASPECT) score of 6.

The patient had a medical history of Irritable bowel syndrome (IBS) and celiac disease, his workup was negative for previous trauma or chiropractic adjustments of his neck. He presented with relevant cardiac and neurological risk factors of dyslipidemia and male gender; however, he presented with no significant family history, and denied any usage of tobacco, vapes, alcohol, or illicit drugs. He was identified as low risk for food insecurity, transportation needs, and housing stability. He was diagnosed with acute cerebrovascular accident (CVA) owing to the occlusion of the left middle cerebral artery, with an active internal carotid artery dissection contributing to the wake-up stroke. He was taken for a computed tomography (CT) head/neck angiogram at 08:24, which showed a complete occlusion of the left cervical internal carotid artery to the middle cerebral artery M1 segment. The CT perfusion study showed a cerebral blood flow difference of 105 mL between the right (159 mL) and left (54 mL). He was taken to Neuro-Interventional (NIR) Radiology with successful revascularization of the left internal carotid artery (LICA), with evidence of a long segment of underlying dissection from its origin to the petrous segment with the clot throughout, using aspiration by 08:35 (approximately 11 minutes). Two additional passes were made in the supraclinoid LICA and M1 segments with a Penumbra Red 72 aspiration catheter to complete revascularization (TICI 2B/3) by 08:42 (Fig. 1). There was an approximate 50–75 cc of blood loss for the total procedure, and he did not present with any evident complications. The door-to-first-pass goal was successfully met in this patient (53 minutes).

Upon discharge, at approximately 96 hours, he had a documented NIHSS of 1 and a mRS of 0. Post-surgical procedures, his spouse admitted to the patient lifting heavy weights before bed almost every night—this is presumed to be the contributing mechanism to the underlying dissection. He was started on heparin infusion post-operatively and later transitioned to 5 mg apixaban (Eliquis) twice daily, with plans to transition to aspirin in 3–6 months, as per guidelines. Upon follow-up, the patient denied loss of balance, muscle weakness, numbness of extremities, or vision problems; however, he indicated a residual speech deficit in "sh" and "ch" sounds.

The patient presented with sudden neurological deficits upon waking, classified as a wake-up stroke [4]. The patient was deemed appropriate for MT owing to exclusion criteria for tenecteplase (TNK) therapy, as well as surgical thrombectomy [5]. Per novel research, MT posed the less invasive procedure, with reduced risk factors, while carrying a higher efficacy rate with improved

Fig. 1 Gross image of the 2 cm clot removed during the thrombectomy

prognosis post-operatively. He was therefore scheduled for a cerebral angiogram with possible mechanical thrombectomy under general anesthesia; hence this patient presentation is unique, owing to the presence of a long dissection from the internal carotid artery (ICA) to the petrous segment with accompanying thrombus throughout the dissection. This arterial dissection poses an elevated risk of acute hemorrhage, and surgical thrombectomy poses an inherent risk of causing dissection due to mechanical trauma on the lumen walls. The procedure involved careful maneuvering of the vasculature to prevent introduction of the guide catheter into the false lumen of the dissection [6]. The previous blood flow to the ischemic areas was deemed to be 0 on the thrombolysis in cerebral infarction (TICI) scale, indicating no blood flow.

After the initial pass, the TICI was measured at 2, indicating a 50% return of blood flow. Two more attempts were made to retrieve smaller clots in the distal middle cerebral artery (MCA), and retrieve two smaller occlusions in the M1 segment (Fig. 2). After these additional two attempts, the TICI was deemed to be 2C: a near-complete reperfusion of small and distal branches of vessels having flow restored. Post-surgical completion, the TICI was deemed to be 3, indicating complete reperfusion of the thrombolytic area with complete blood flow returned, and hemostasis of puncture site achieved by 09:30. The procedure was completed with no stent applied to the dissected area.

The carotid dissection was not emergently stented as it was deemed not flow-limiting. Given the large core stroke and the greater risk of bleeding (that is, petechial hemorrhaging and hemorrhagic conversion), the patient would have required commitment to dual anti-platelet therapy with aspirin and Plavix, which would increase the risk of bleeding. Though potential loading or intravenous medication drips can augment this, the key component was to reduce bleeding risk. Hence, in this patient, upon opening the vessels, blood flow was restored successfully with minimal complications (Fig. 3). Granted the extent of the dissection was not known prior to performing the MT, it was still considered a possibility, as whenever a tandem occlusion (ICA and MCA M1–2) is seen, computed tomography angiography (CTA) is needed to ensure accurate placement in the true lumen vessel. For our patient, management consisted of blood pressure control, antiplatelet therapy, and anticoagulation. The patient was advised to avoid trauma to the neck, avoiding activities such as contact sports or heavy lifting. Further treatment would include yearly diagnostic imaging to monitor the dissection (Fig. 4).

The foundational trial of endovascular thrombectomy, which is foundational for the treatment plan for this patient with a large vessel stroke, uses a criteria of: an ASPECT score of 5 or less and an ischemic core volume of > 50 mL, as per the reported mismatch flow value [7]. This is a noticeable improvement to the 40% of patients who experience moderate-to-severe impairments that require special care, while 25% recover with minor impairments [8]. Our patient is in line with the "large core" group, with an ASPECT score of 5 and showing an NIHSS score improvement within 72–96 hours; as opposed to the classical criteria of being functionally independent at 90 days.

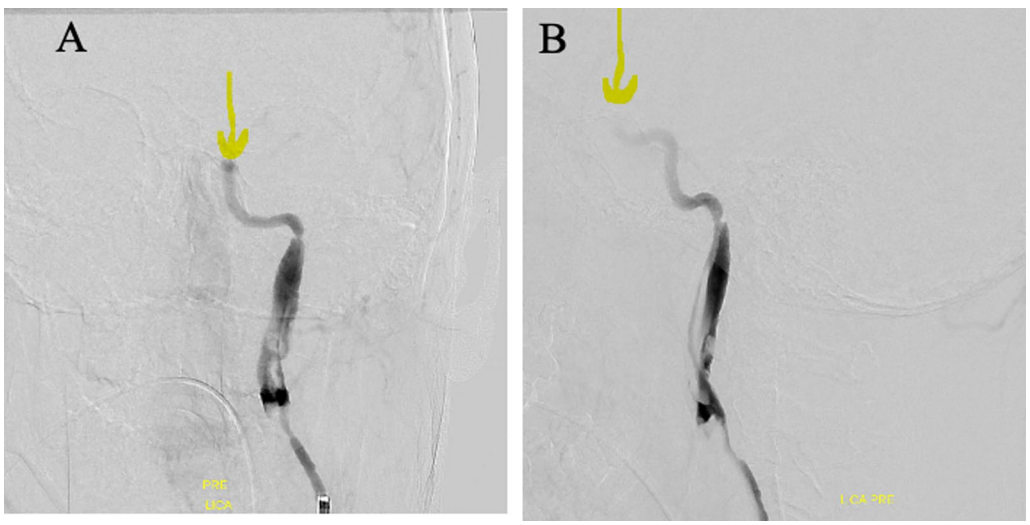

Fig. 2 Angiogram of the left middle cerebral artery M1/left internal carotid artery terminus occlusion before the removal of clot (**A**). Lateral view of the occlusion (**B**)

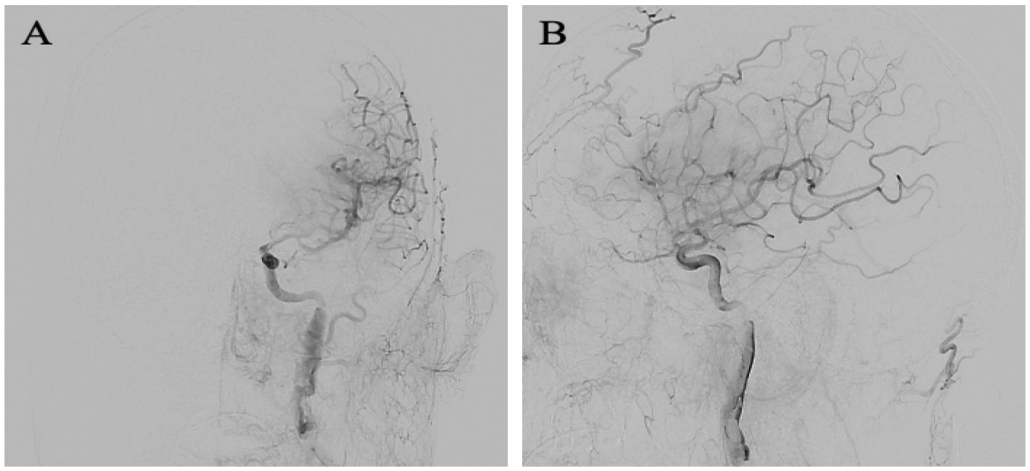

Fig. 3 Angiogram of the left middle cerebral artery M1/left internal carotid artery terminus occlusion before (**A**) and after (**B**) removal of the clot

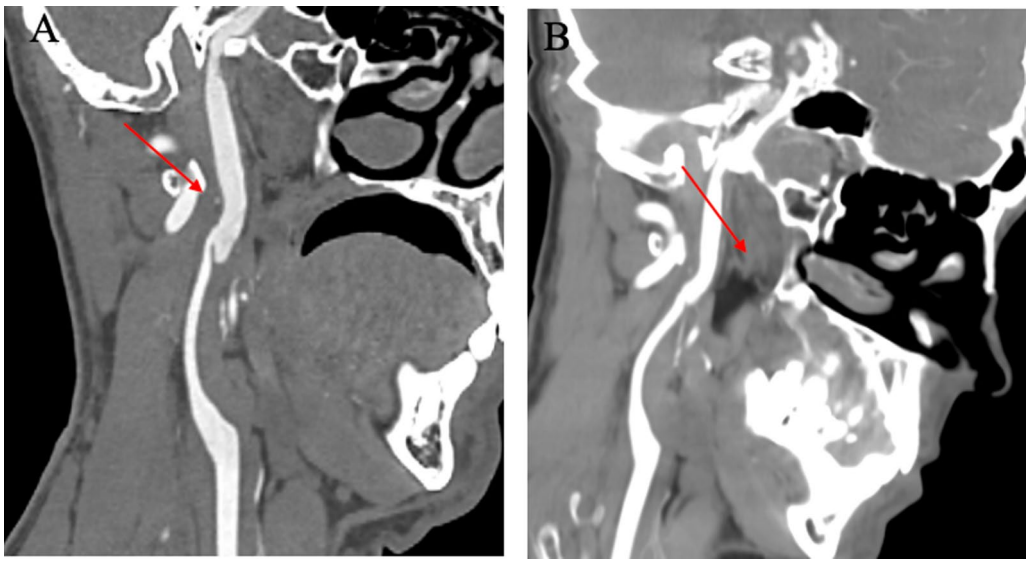

Fig. 4 Sagittal computed tomography angiography indicating a small, healing, non-flow-limiting dissection flap in the carotid artery (red arrow) (**A**). Sagittal computed tomography angiography in different position with persistent non-occlusive dissection (red arrow), indicating partial healing without significant luminal compromise (**B**)

Discussion and conclusion

For patients undergoing an acute ischemic stroke, intravenous thrombolytic therapy with alteplase or tenecteplase (TNK) is considered the first-line therapy. TNK is indicated for use in the restoration of blood flow up to 4.5 hours from the last known time of ischemic stroke [5, 9]. Mechanical thrombectomy (MT) is a surgical intervention by which a blood clot is removed under image guidance, with the aim to rescue ischemic penumbra [3]. MT is indicated for patients with acute ischemic strokes due to a large artery occlusion in the anterior circulation, which can be treated within 24 hours of the time last known to be well (that is, the neurologic baseline). The American Stroke Association recommends that mechanical thrombectomy therapy be utilized when the following criteria is met: mRS < 2, NIH stroke score > 6, ASPECT score > 6, and within 6 hours of symptom onset. The team reassessed the patient as an ASPECT score of 5, and in reference to recent studies [5], trialed a mechanical thrombectomy for a large vessel occlusion.

For our patient, their last known time of being well was at 22:00, and upon waking up, the patient displayed right sided weakness and aphasia. He was not a candidate for TNK, owing to assessments of a NIHSS of 16 and a

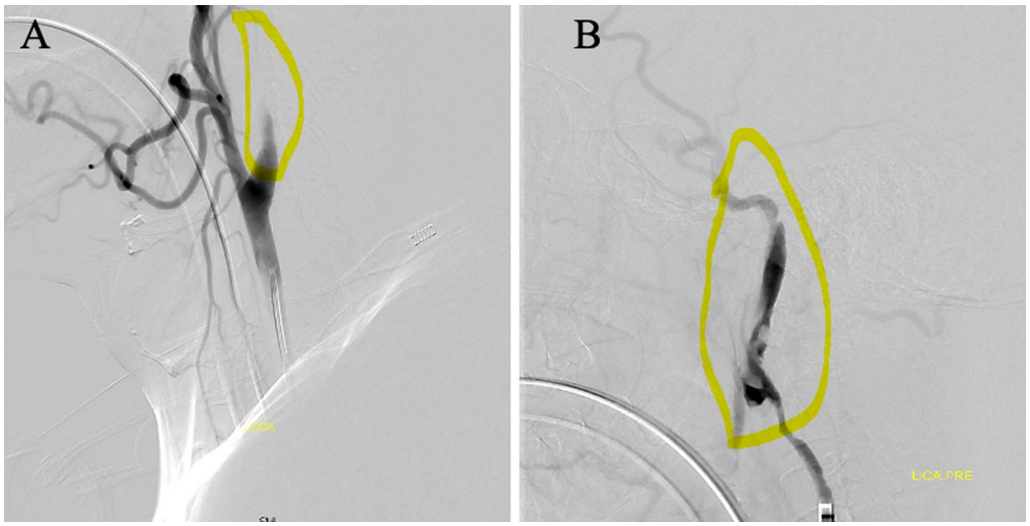

Fig. 5 Angiogram of the left internal carotid artery occlusion: pre-intervention angiogram demonstrating a significant occlusion of the left internal carotid artery (highlighted in yellow), showing a lack of distal flow (**A**). Post-initial opening angiogram showing partial recanalization of the previously occluded segment (highlighted in yellow), with improved but still restricted blood flow (**B**)

mRS of 5. The patient was not a good candidate owing to elevated mRS at baseline, a time course greater than 4.5 hours, and elevated glucose (168 mg/dL) (indicative of a poorer outcome with anticoagulant therapy as a sole treatment), as well as the thrombi being located in a larger vessel [10]. A potential complication could have been the dissection present in the left internal carotid artery. The patient was scheduled for cerebral angiogram, with a possible mechanical thrombectomy under general anesthesia. An immediate angiogram and thrombectomy was performed via the right femoral vein, whereby the left inferior carotid artery and left middle cerebral artery occlusions were addressed where the skin puncture was performed, and initial revascularization for the patient was achieved within 11 minutes (Fig. 5).

The patient had an uncomplicated recovery post-operatively. The post-operative scores were a NIHSS of 1 and a mRS of 0.

Abbreviations

DVT	Deep vein thrombosis
MI	Myocardial infarction
MT	Mechanical thrombectomy
NIHSS/NIH	National Institutes of Health Stroke Scale
ASPECT	Alberta Stroke Program Early CT Score
CVA	Acute cerebrovascular accident
NIR	Neuro-interventional
LICA	Left internal carotid artery
TNK	Tenecteplase
TICI	Thrombolysis in cerebral infarction
CTA	Computed tomography angiography
IBS	Irritable Bowel Syndrome

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Author contributions
SM was responsible for the data collection and writing the manuscript. MT was responsible for helping write the manuscript. FB was responsible for the patient's care, data collection, and review of the manuscript. HS was responsible for the patient's care and review of the manuscript.

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Availability of data and materials
Not applicable.

Declarations

Ethics approval informed consent to participate
The authors have complied with ethical standards for this case. The patient provided written informed consent to participate in the case report. A local institutional review board (IRB) was not required.

Consent for publication
Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests
The authors declare that they do not have any competing interests.

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