Technical Notes

Emergent carotid endarterectomy and mechanical thrombectomy in tandem occlusion

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INTRODUCTION

Management of acute tandem occlusions, or occlusions of the extracranial portion of the internal carotid artery (ICA) with concurrent thromboembolism of the intracranial ICA or middle cerebral artery (MCA), poses a major clinical challenge. Approximately 10–15% of large vessel occlusions resulting in acute ischemic stroke (AIS) are related to tandem occlusions; however, despite their prevalence, an optimal management strategy has not been reached. This subset of patients has worse neurologic outcomes compared to those with single occlusions and generally respond poorly to thrombolysis alone, likely due to decreased delivery of the thrombolytic to the intracranial obstruction due to the extracranial obstruction. [3,7,9]
Current endovascular therapeutic strategies include recanalization of the intracranial occlusion through mechanical thrombectomy (MT) followed by stenting of the extracranial ICA (head-first), and the reverse, extracranial stenting followed by intracranial MT (neck-first). Cirillo et al. found that endovascular ICA stenting used in management of tandem occlusions led to improved revascularization and had improved long-term morbidity and mortality when compared to non-stenting techniques. This methodology of endovascular intervention, in addition to MT, has been widely accepted as more successful compared to thrombolysis alone. The thrombectomy in tandem lesions collaboration compiled several cases of tandem occlusions involving the anterior circulation to compare the speed and rates of reperfusion in head-first versus neck-first endovascular approaches. The study found similar rates of successful reperfusion in the two approaches, although the head-first approach led to faster reperfusion times. Lockau et al. found intracranial thrombectomy before proximal stenting was associated with shorter reperfusion times resulting in overall improved clinical outcomes.

At our institution, a comprehensive stroke center, we have adopted the head-first paradigm, as described previously. However, in this peculiar case, we were unable to cross the cervical occlusion despite various wires, microwires, and microcatheters used, so we proceeded with an emergent carotid endarterectomy (CEA) before we were able to perform the intracranial thrombectomy.

**CASE PRESENTATION**

The patient is a 78-year-old who awakened with aphasia and right hemiparesis. When symptoms persisted, he presented to an outside hospital and was not a candidate for tPA given unknown onset of symptoms. Of note is the patient had suffered sudden loss of vision in the left eye 2 weeks before presentation, was started on aspirin, evaluated by ophthalmology as an outpatient, and was thought to be an ischemic etiology, so a carotid ultrasound was ordered but had not been completed by the time of his presentation. Computed tomography (CT) angiography/CT perfusion was completed (Time 00:00) revealing cervical carotid occlusion and tandem left MCA-M2 occlusion with no core infarct and 50 ml of ischemic penumbra [Figure 1]. After review of the imaging, we recommended loading the patient with 300 mg of clopidogrel and 325 mg of aspirin in preparation for possible carotid angioplasty and stenting. Patient was transferred to our facility by ambulance directly to the angio suite (Time 02:46). Patient was placed under general anesthesia with a targeted systolic blood pressure of 140–180 per our routine for AIS. We proceeded with a right femoral access (Time 02:51) as we have not adopted radial access for anterior circulation stroke given our significantly better times with femoral access. An 8-Fr short sheath was utilized, and 6-Fr Neuron MAX sheath (Penumbra Inc., California, USA) was navigated to the left common carotid artery, over an angled tip 6-Fr Berenstein catheter (Penumbra Inc., California, USA), over on 0.035" glidewire (Terumo, New Jersey, USA). We are routinely able to cross the carotid occlusion with this construct and perform the intracranial thrombectomy before attending to the cervical carotid occlusion on the way out. However, multiple wires, microwires, and microcatheters were attempted but unsuccessful in crossing the cervical occlusion [Figure 2]. Hence, at this point, we decided to transfer the patient to the operating room (Time 04:09) for an emergent CEA. Femoral sheath was kept in place while all catheters were removed. A standard left CEA incision was performed (04:48). After completion of the endarterectomy and closure of the arteriotomy (Time 05:33) [Figure 3], we proceeded with intraoperative thrombectomy.

![Figure 1: Postprocessed computed tomography perfusion images revealing no core infarct and 50 cc salvageable brain tissue (Penumbra).](image-url)
before cervical incision closure. We reaccessed (Time 05:56) the same femoral sheath, and utilizing the C-Arm, we navigated the Neuron MAX to the vertical petrous carotid over an angled tip 6-Fr diagnostic catheter over a glidewire. We then achieved revascularization (Time 06:14) with a Red 68 reperfusion catheter (Penumbra Inc., California, USA) in combination with a solitaire retrievable stent (Medtronic, California, USA) [Figure 4]. The patient recovered well postoperatively, with persistence of light perception only in the left eye, and otherwise was discharged with NIHSS of 2 due to minor facial palsy and minor dysarthria. Magnetic resonance imaging demonstrated left subcortical infarct with no complication [Figure 5]. At 30-day follow-up, the patient’s visual deficit persisted, but with resolution of the prior neurologic deficits and an mRS of 1.

**DISCUSSION**

In our case, proceeding with an emergent CEA was the reason MT was feasible. Although not classically performed in the setting of tandem occlusions, CEA served as a crucial step in the management of this patient. As stated previously, thrombolysis has poor efficacy in patients with tandem occlusions and the endovascular technique is superior. However, when endovascular techniques fail to recanalize the extracranial ICA, gaining access to the intracranial occlusion...
for revascularization is rarely possible. Utilizing the circle of Willis and accessing the occlusion from the contralateral carotid or posterior circulation is sometimes feasible, but in our patient was not an option. Reperfusing the ischemic penumbra allows a chance for neurologic recovery in patients with large vessel occlusions. As in this patient, there is actually potential for complete neurologic recovery.

To consider introducing emergent CEA as a management option, the treating facility has to be equipped for rapid conversion to operative intervention. For patients undergoing urgent CEAs, the rate of perioperative complication is higher than those who undergo elective CEA, and this is especially true regarding neurologic and cardiac complications. Most notably, these risks include potential for cerebrovascular accident, myocardial infarction, cranial nerve injury, and bleeding during the perioperative period. Karkos et al. analyzed the safety of CEA within 24 h of acute change in neurologic function in 114 patients who underwent CEA for evolving stroke. The risk of perioperative stroke was 16.9%, stroke/death was 20.0%, and stroke/death/major cardiac events was 20.8%. Although this does not entirely apply in the setting of tandem occlusion during management of AIS.

Despite the good neurologic outcome, the time to achieve reperfusion was suboptimal and leaves room for improvement. Had emergent CEA been a prior consideration, we would have saved significant time to achieve revascularization. Less time would have been spent on the failed attempts at coursing the occlusion, the OR would have been notified sooner, and a few minutes could have been saved in every step to achieve reperfusion had we have this approach planned for and protocoled previously. Similar to direct carotid puncture for difficult access, since it became a consideration, our preparedness and ability to safely utilize it became more timely and efficient.

CONCLUSION

This case highlights how the emergent CEA made reperfusion of the tandem occlusion possible and did not result in adverse events. We believe, this option is important to consider in the rare circumstance of being unable to cross a cervical occlusion in the setting of tandem occlusion during management of AIS.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Cirillo L, Romano DG, Vornetti G, Frauenfelder G, Tamburrano C, Tagliatela F, et al. Acute ischemic stroke with cervical internal carotid artery steno-occlusive lesion: Multicenter analysis of endovascular approaches. BMC Neurol 2021;21:362.
2. Elder TA, Verhey LH, Schultz H, Smith ES, Adel JG. Cervical carotid occlusion in acute ischemic stroke: Should we give tPA? Surg Neurol Int 2022;13:177.
3. Haussen DC, Turjman F, Piotin M, Labreuche J, Steglich-Arnholm H, Holtmannspottet M, et al. Head or neck first? Speed and rates of reperfusion in thrombectomy for tandem large vessel occlusion strokes. Interv Neur 2020;8:92-100.
4. Howell SJ. Carotid endarterectomy. Br J Anaesth 2007;99:119-31.
5. Kappelhof M, Marquering HA, Berkhemer OA, Majoie CB. Intra-arterial treatment of patients with acute ischemic stroke and internal carotid artery occlusion: A literature review. J Neurointerv Surg 2015;7:8-15.
6. Karkos CD, Hernandez-Lahoz I, Naylor AR. Urgent carotid surgery in patients with crescendo transient ischaemic attacks and stroke-in-evolution: A systematic review. Eur J Vasc Endovasc Surg 2009;37:279-88.
7. Kim YS, Garami Z, Mikulik R, Molina CA, Alexandrov AV, CLOTBUST Collaborators. Early recanalization rates and clinical outcomes in patients with tandem internal carotid artery/middle cerebral artery occlusion and isolated middle cerebral artery occlusion. Stroke 2005;36:869-71.
8. Lockau H, Liebig T, Henning T, Neuschmelting V, Stetefeld H, Kabbasch C, et al. Mechanical thrombectomy in tandem occlusion: Procedural considerations and clinical results. Neuroradiology 2015;57:589-98.
9. Rubiera M, Ribo M, Delgado-Mederos R, Santamarina E, Delgado P, Montaner J, et al. Tandem internal carotid artery/middle cerebral artery occlusion: An independent predictor of poor outcome after systemic thrombolysis. Stroke 2006;37:2301-5.
10. Zhu F, Hossu G, Soudant M, Richard S, Achit H, Beguinet M, et al. Effect of emergent carotid stenting during endovascular therapy for acute anterior circulation stroke patients with tandem occlusion: A multicenter, randomized, clinical trial (TITAN) protocol. Int J Stroke 2021;16:342-8.

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