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CASE REPORT

Nature's Wastebasket: The Role of the External Carotid Artery in Acute Stroke

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ABSTRACT

We describe a novel technical approach to acute stroke illustrated by the case of a 41 year old male who presented with tandem right common carotid artery (CCA) and M1 occlusions. His NIHSS was 17 and Alberta stroke programe early CT score (ASPECTs) was 8. Thrombectomy initially proved challenging due to large volume CCA thrombus that repeatedly occluded the aspiration catheters. However, by inflating a balloon distally and pulling clot into the adjacent ECA, we were able to quickly restore distal contrast flow to the intracranial circulation and achieve Thrombolysis In Cerebral Infarction/Arterial Occlusive Lesion (TICI2C/AOL3) revascularization.

BACKGROUND

Rapid and compete restoration of cerebral perfusion is the primary goal of endovascular intervention for acute stroke.[1] Recent advances in biomedical device engineering, such as stent retrievers and large bore aspiration catheters, have assisted neurointerventionalists in achieving this goal.[2 3] However, clinical presentations such as large-volume clot still pose a challenge to rapid recanalization[4] and may require a different therapeutic approach.

CASE PRESENTATION

The patient is a middle-aged person without known relevant medical history who was brought to the emergency room by ambulance after a witnessed collapse. The neurological exam was significant for left hemiparesis, with a National Institutes of Health Stroke Scale of 17 (table 1).

INVESTIGATIONS

CT of the brain demonstrated minimal hypodensity within the right middle cerebral artery (MCA) territory with an ASPECTS score of 8. CT angiography (CTA) of the brain showed absence of contrast within the petrous right internal carotid artery (ICA) with distal reconstitution in the cavernous segment and diminutive opacification of the right MCA. Cerebral blood flow and blood volume suggested a modest core infarct of the right MCA but with large penumbra of potentially salvageable brain tissue (figure 1). A CTA of the neck was not performed as part of the initial work-up by stroke neurology; in the interest of time, the patient was taken to the angiography suite for further evaluation rather than repeat CTA.

DIFFERENTIAL DIAGNOSIS

Differential considerations include spontaneous right ICA dissection, large thromboembolism (eg, cardiac source) or ruptured plaque of the carotid bifurcation.

TREATMENT

Given the acute presentation of cerebral ischemia, the patient was initially administered intravenous

Table 1 Patient's Preoperative NIH Stroke Score

1a	Level of consciousness (LOC)	0	Keenly responsive
1b	LOC questions	0	Performs both tasks correctly
1c	LOC commands	0	Performs both tasks correctly
2	Best gaze	1	Partial gaze palsy
3	Visual	2	Complete hemianopia
4	Facial palsy	2	Partial paralysis (total or near total paralysis of the lower face)
5a	Motor left arm	4	No movement
5b	Motor left leg	4	No movement
6a	Motor right arm	0	No drift, limb holds 90° (or 45°) for full 10 s
6b	Motor right leg	1	Drift
7	Limb ataxia	0	Absent
8	Sensory	2	Severe to total sensory loss; patient is not aware of being touched in face, arm, leg
9	Best language	0	No aphasia, normal
10	Dysarthria	1	Mild to moderate, patient slurs at least some words, and at worst can be understood with some difficulty
11	Extinction and inattention	2	Profound hemi-inattention or hemi-inattention to more than one modality; does not recognize own hand or orients only to one side of space
Total		17	

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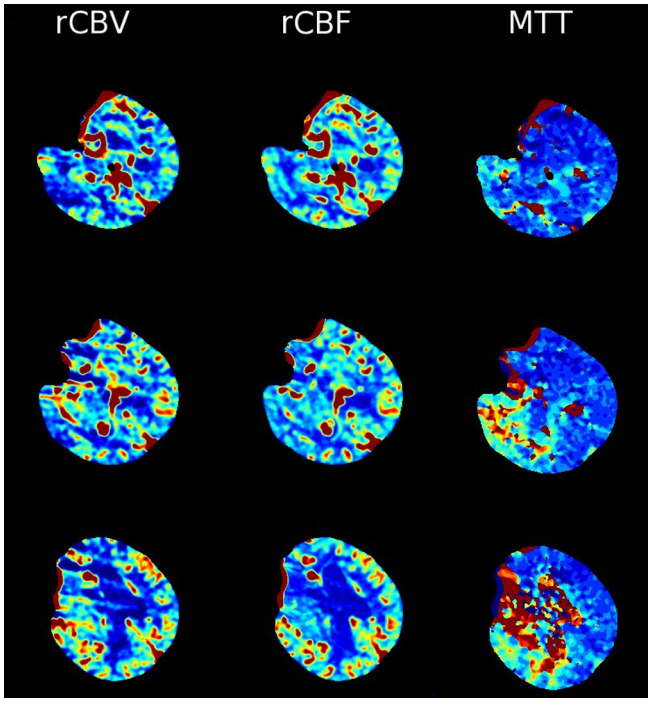

Figure 1 CT perfusion performed as part of the initial diagnostic evaluation shows a large area of delayed mean transit time (MTT) in the right temporoparietal region. Cerebral blood volume (CBV) and flow (CBF) are largely preserved and symmetric compared with the left, suggesting a large penumbra.

tissue plasminogen activator following initial head CT. However, laboratory results demonstrated thrombocytopenia (platelet count of 95) and the infusion was discontinued. The patient received only 9 mg of the 81 mg calculated dose.

Following CTA and perfusion, he was brought directly to the interventional suite for diagnostic angiography and potential thrombectomy. Given our suspicion of a tandem occlusion and

Figure 2 Right CCA angiogram, lateral projection: large volume thrombus at the common carotid artery.

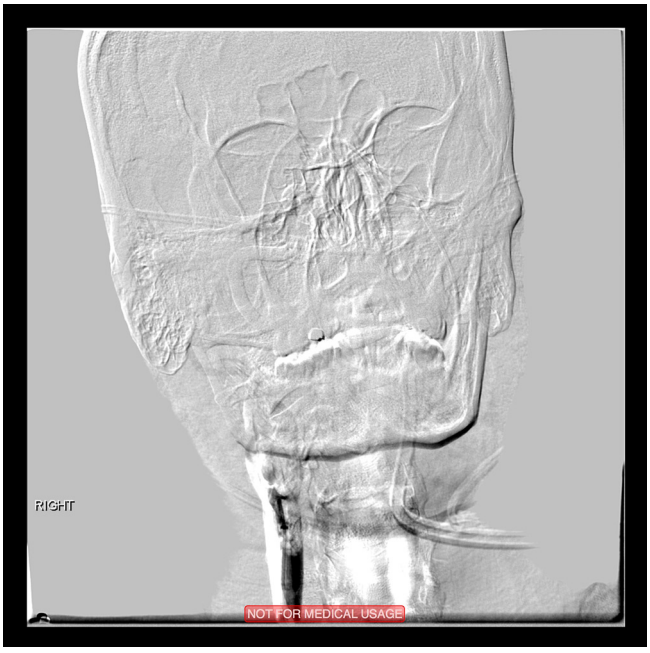

Figure 3 Right CCA (Common Carotid Artery) angiogram, Anteroposterior (AP) projection: large volume thrombus at the common carotid artery.

lack of CT angiographic images of the neck, we chose to begin with a complete diagnostic angiogram to evaluate the collateral circulation and potentially locate the site of occlusion though retrograde opacification.

A 5 Fr/10 cm sheath was placed into the right common femoral artery and entered with a 5 Fr angled glide catheter and 0.35' glidewire. Initial DSA images from left CCA and vertebral artery injections revealed both a hypoplastic anterior communicating artery (AComA) and right PComA, respectively; the circle of Willis was incompetent. The right CCA angiogram demonstrated

Figure 4 After repeated aspiration from a large-bore sheath in the CCA, angiography demonstrates the proximal extent of the thrombus now at the ICA origin.

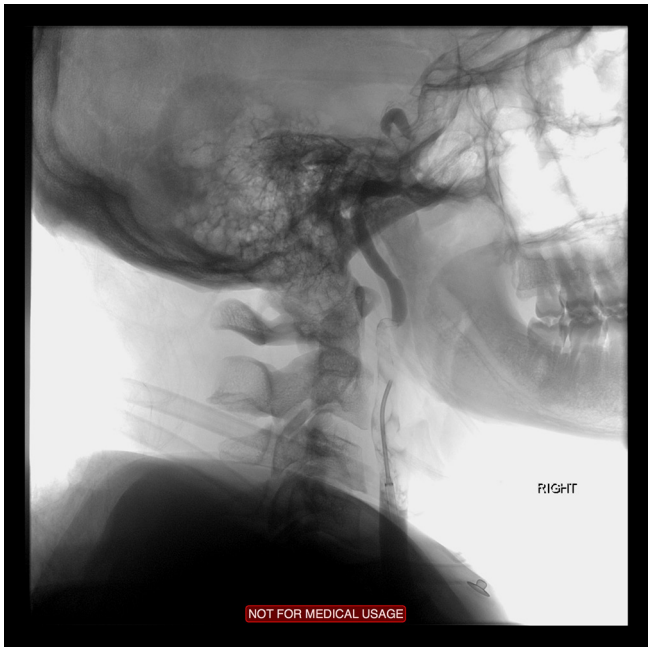

Figure 5 The carotid thrombus is drilled and navigated through with a catheter and wire. Angiogram confirms position distal to the clot and defines its superior extent prior to balloon inflation.

a large clot extending from the distal CCA into the cervical ICA (figures 2 and 3). There were no significant external carotid artery (ECA) to ICA collaterals.

Based on these findings, we then chose to proceed with a thrombectomy. The diagnostic system was exchanged for a 6 Fr/90 cm Neuron MAX sheath, which was then advanced to the proximal aspect of the clot over a 5 Fr Vert catheter and 0.38' glidewire; during a total of six aspirations, three separate Neuron MAX catheters were required due to repeated catheter obstruction by clot. An 8 Fr Flexor sheath was eventually placed into the proximal right CCA to maintain access while removing

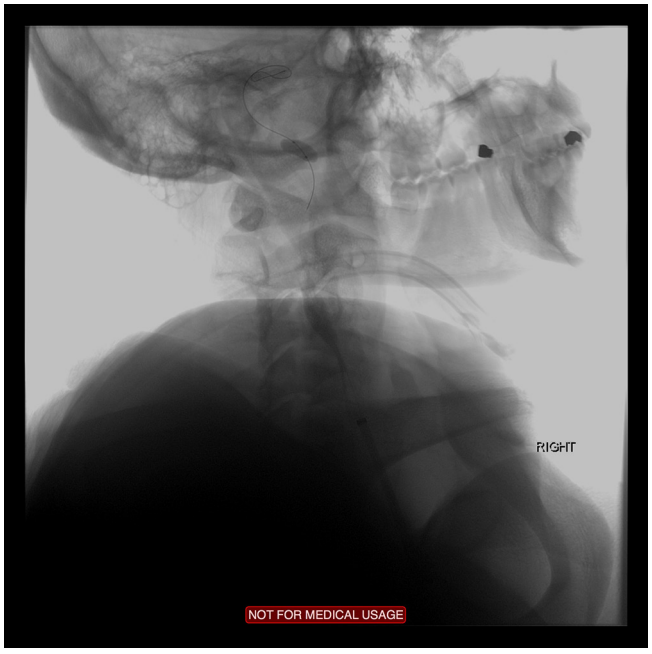

Figure 6 Single-shot radiograph of 7×7 mm balloon distal to the ICA clot and inflated just enough to appose the vessel wall.

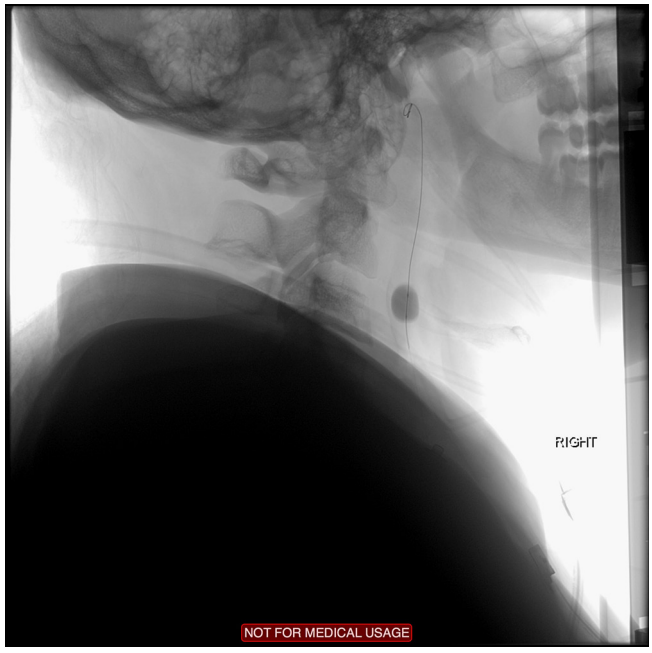

Figure 7 Single-shot radiograph of 7×7 mm balloon after having been pulled down to the carotid bifurcation. At this point, the balloon is slightly hyperinflated beyond the vessel diameter to propel clot into the ECA.

and flushing the Neuron MAX. Although a large volume of clot was aspirated over several minutes, the cervical internal carotid artery remained occluded (figure 4).

Next, a small amount of contrast was injected to delineate the proximal and distal margins of the clot (figures 5 and 6). Then a HyperForm 7×7 mm balloon was advanced beyond it over an X-Pedion 0.10' microwire and inflated. As the balloon was pulled down the ICA into the carotid bulb, it was gradually maximally inflated to maneuver clot

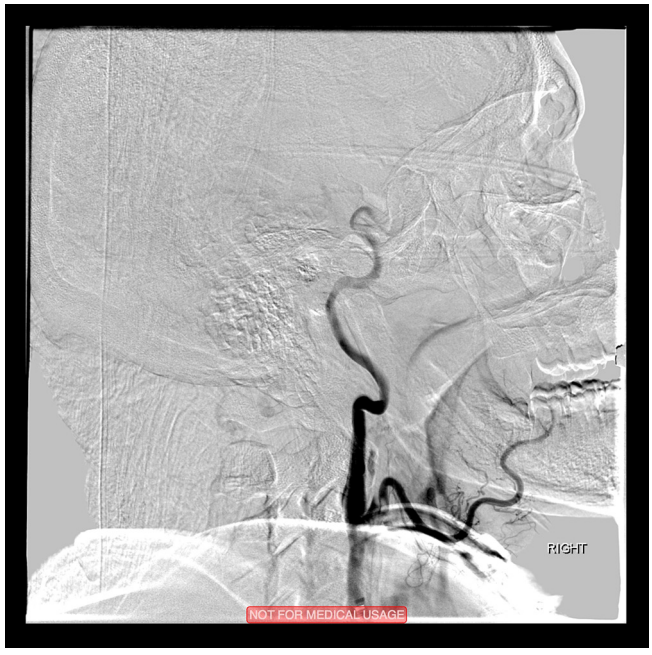

Figure 8 Postangioplasty right lateral Common Carotid Artery (CCA) angiogram demonstrates restored ICA patency and deposition of clot into the adjacent ECA, obstructing most of its branches.

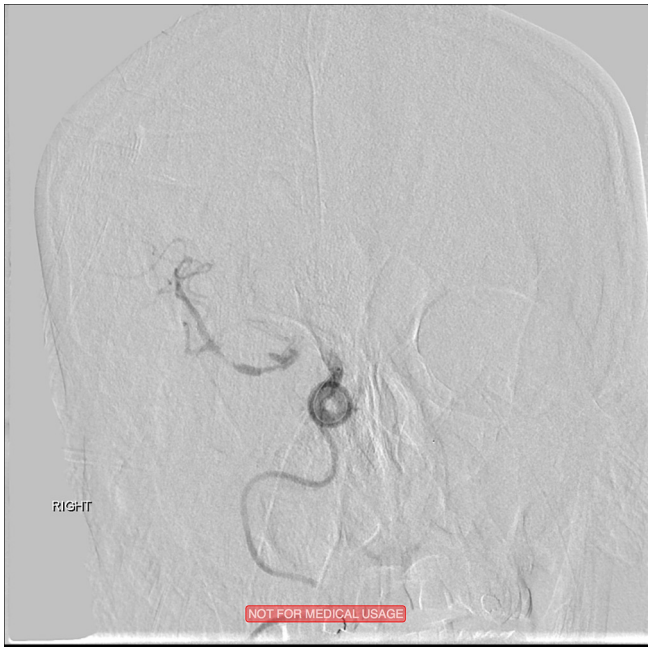

Figure 9 Right Internal Carotic Artery (ICA) angiogram in AP projection shows tandem thrombus at ICA terminus and proximal Middle Cerebral Artery (MCA).

into the adjacent ECA (figures 7 and 8). With the majority of clot thus evacuated, two further aspirations via another Neuron MAX led to complete AOL3 revascularization of the primary occlusive lesion (figure 9).

However, there was a tandem lesion obstructing the right ICA terminus and proximal MCA (figure 9). The Neuron MAX was advanced into the high cervical ICA and a Marksman 160 mm microcatheter/X-Pedion 14 microguidewire advanced into the M2 beyond the clot. Following two pulls with the Solitaire 4×20 mm stent retrieval device (figure 10) with concurrent aspiration on the Sofia Plus 6 Fr intermediate catheter (Solumbra technique), TICI 2C revascularization was achieved (figures 11 and 12).

Figure 11 Right ICA angiogram in AP projection following two pulls with 4×20 mm stent retriever with concurrent aspiration of intermediate catheter demonstrates TICI 2C revascularization.

OUTCOME AND FOLLOW-UP

The interval between symptom onset and groin puncture was 104 min; the procedure itself required 113 min to achieve TICI 2C recanalization. Following thrombectomy the patient experienced improved left-sided motor function, which became antigravity (3/5) in the left arm

Figure 10 Right ICA angiogram in lateral projection shows deployment of stent retriever in proximal M2 segment, distal to the MCA thrombus.

Figure 12 Right ICA angiogram in lateral projection following two pulls with 4×20 mm stent retriever with concurrent aspiration of intermediate catheter demonstrates TICI 2C revascularization.

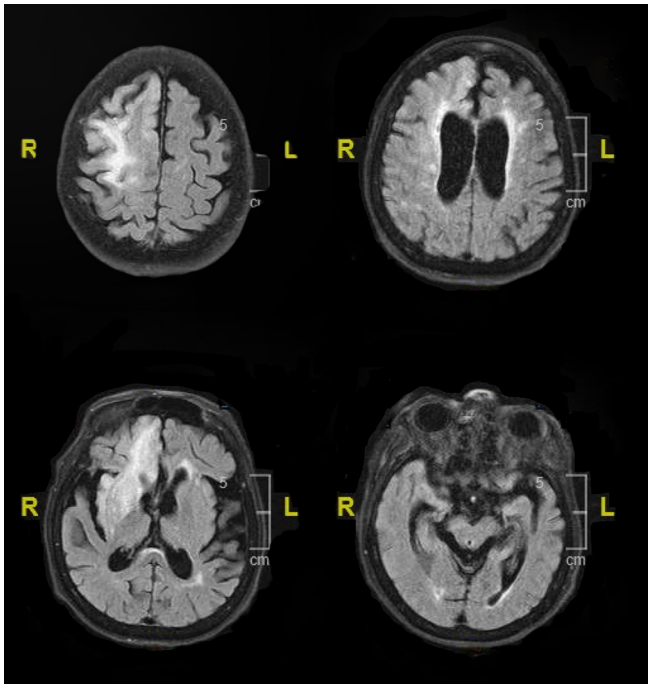

Figure 13 MRI performed on post-thrombectomy day 1. Axial FLAIR images demonstrate a small area of cytotoxic edema within the right frontal lobe, basal ganglia and insula consistent with recent infarction. However, much of the territory at risk identified on preoperative CTP appears normal.

and left leg. MRI showed small completed infarct primarily affecting the right frontal lobe (figure 13). On postoperative day 5, the patient was able to transfer into a wheelchair independently and operate the chair. His left sensory deficit and neglect were unchanged. Despite being accepted to an acute rehabilitation center, the patient left against medical advice on postoperative day 6 and has been lost to follow-up.

DISCUSSION

Despite the availability of wide-bore aspiration catheters for acute stroke, large volume clot burden, such as in the case described above, still presents a significant technical challenge to rapid and complete revascularization.[5 6] Once a catheter becomes obstructed by clot, the time lost in exchanging it or even losing access (if a larger coaxial system is not already in place) is not trivial. Few devices, if any, in the neurovascular armamentarium are designed to manage the volume of clot encountered in proximal, first-order arch vessels. In these situations, one must be prepared to quickly transition to an alternative revascularization strategy. The ECA represents a safe and effective depository for large volume carotid thrombus.

Contributors All authors contributed to this manuscript in an academically meaningful way.

Competing interests None declared.

Patient consent Patient lost to follow-up; left the hospital against medical advice.

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