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Technical Notes & Surgical Techniques

Iatrogenic carotid-cavernous fistula secondary to endovascular rescue of a left M1 occlusion in the presence of a cavernous carotid aneurysm utilizing a stentriever

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ABSTRACT

Background and importance: Iatrogenic Direct carotid-cavernous fistulas (CCFs) are uncommon complications of intracranial endovascular rescue. We describe the first reported case of an intraprocedural direct carotid cavernous fistula that developed immediately after flow restoration during treatment of an acute left M1 occlusion utilizing a stentriever.

Clinical presentation: This was an 86 year old right handed Caucasian woman who presented with acute onset of aphasia, right sided weakness, and right facial droop. The time of onset was unknown. NIHSS scale on arrival to the ED was 16. Stroke protocol CT Perfusion imaging demonstrated a large region of ischemic penumbra within the left MCA distribution. Occlusion of the left M1 segment with collaterals to a limited number of opercular, insular, and cortical branches was noted on CT Angiography. Successful TICI 3 endovascular rescue of the left M1 occlusion was obtained. Later attempts at embolizing the iatrogenic left CC Fistula were abandoned for patient safety.

Conclusion: While CCFs are not life threatening, the morbidity from ocular complications can be high. Each Carotid Cavernous Fistula should be reviewed as a unique case and the optimal treatment should be selected to decrease risk to the patient. Careful Endovascular navigation and device deployment of the retriever under full inspection of the roadmap may prevent or reduce the incidence of direct CCFs; however, sometimes it may become necessary to choose the potential complication to save a patient's life as was the case described in this report.

1. Background and importance

Carotid-cavernous fistulas (CCFs) are the result of an abnormal communication between the internal and/or external carotid arteries and the cavernous sinus [1]. The most common cause of a direct CCF is head trauma from a basal skull fracture resulting in a traumatic tear in the wall of the cavernous internal carotid artery, or the rupture of a cavernous segment aneurysm. Internal carotid artery (ICA) damage is an infrequent but potentially serious surgical complication of endovascular rescue [1–3]. The most common symptoms of CCFs consist of red eye, diplopia, proptosis, migraine and vision loss. Patients may also complain of ocular bruits that they perceive as a swooshing or buzzing sound. Less frequently, subjects may also report pain in the first division of the trigeminal nerve [3]. Reduced arterial blood flow to the orbit and venous engorgement are responsible for ocular signs of CCFs. Clinical signs include arterialization of conjunctival vessels, proptosis, conjunctival chemosis, ophthalmoplegia, eyelid swelling and ocular bruits [4].

Ophthalmoscopic abnormalities include dilation of retinal veins, intraretinal hemorrhages, mild optic disc swelling and non hematogenous retinal detachments and choroidal detachments [4,5].

Abbreviations: CCFs, Iatrogenic Direct carotid-cavernous fistulas; M1 occlusion, M1-middle cerebral artery occlusions; NIHSS scale, The National Institutes of Health Stroke Scale; CCF, Carotid-cavernous fistula

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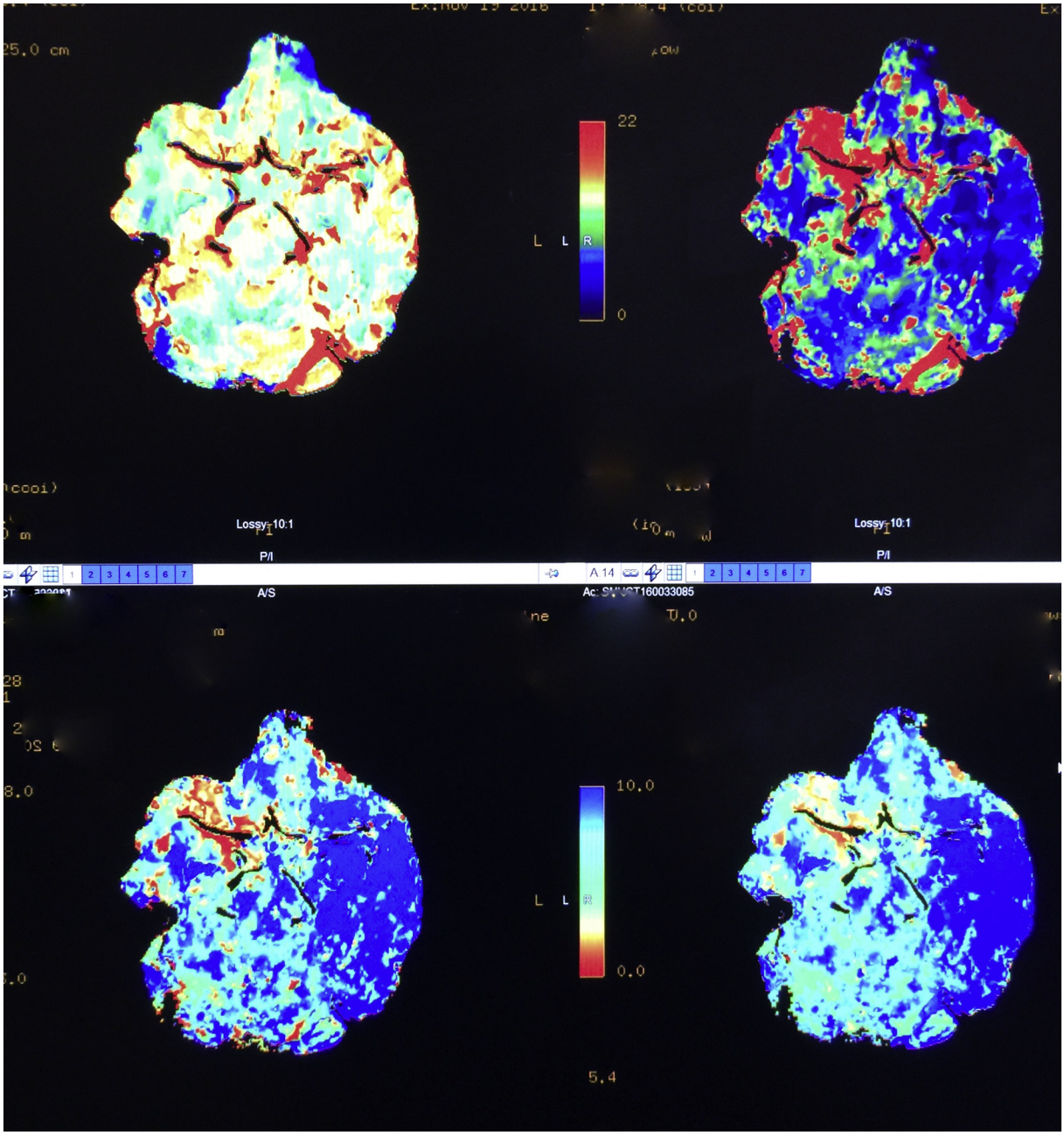

Fig. 1. CT Perfusion demonstrating left MCA territory salvageable ischemic penumbra

1.1. Bioethics

An informed consent form was signed by the patient agreeing with the publication of the case report.

2. Clinical presentation

This was an 86 year old right handed Caucasian woman who presented with acute onset of aphasia, right sided weakness, and right facial droop. The time of onset was unknown as she was found on the ground on a street of her neighborhood, confused. Neurologic examination was consistent with a left hemisphere syndrome, and her NIHSS scale on arrival to the ED was 16. She was found to have a previous medical history of Paroxysmal Atrial Fibrillation. Multimodal imaging with CT, CT angiography, and CT perfusion was performed as per our Acute Stroke protocol which demonstrated a large region of ischemic penumbra within the left MCA distribution (Fig. 1). Occlusion of the left M1 segment with collaterals to a limited number of opercular, insular, and cortical branches was noted. Mechanical embolectomy was performed to revascularize the left MCA and after the procedure she was AAO x 4, able to move all extremities, and her facial droop had resolved. NIHSS improved to 0. She was now able to communicate that she previously took the direct oral anticoagulant dabigatran (Pradaxa) for her atrial fibrillation but it was discontinued a year prior because she had developed a spontaneous retinal hemorrhage.

3. Neurovascular technique

The patient was placed on the angiographic table in the supine position and after sterile prep and drape per protocol, access was obtained to the right femoral artery with a 6 French sheath. Intraarterial infusion of non-thrombolytic nitroglycerin was initiated to ameliorate

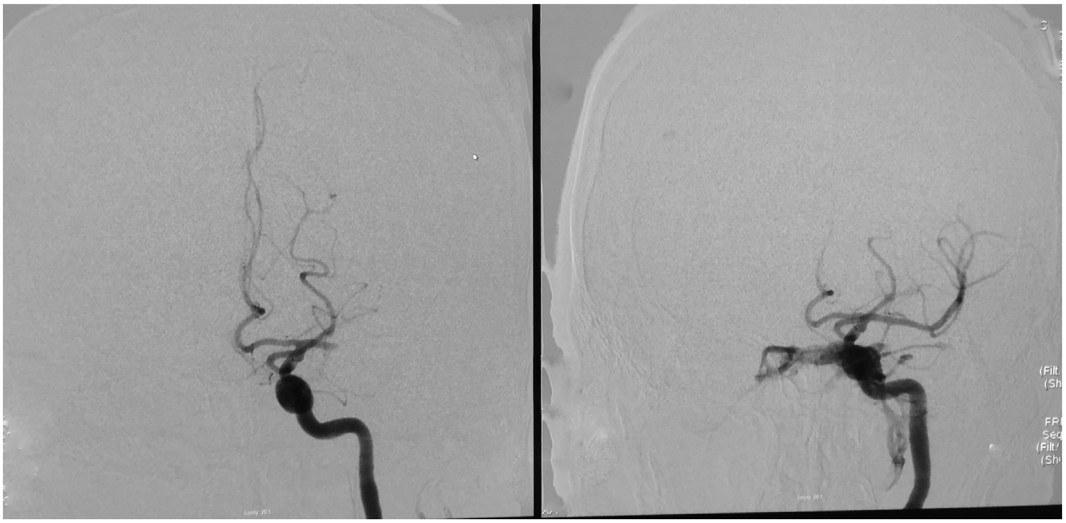

Fig. 2. AP DSA demonstrating prethrombectomy left M1 occlusion and post thrombectomy M1 revascularization now with the iatrogenic CC Fistula

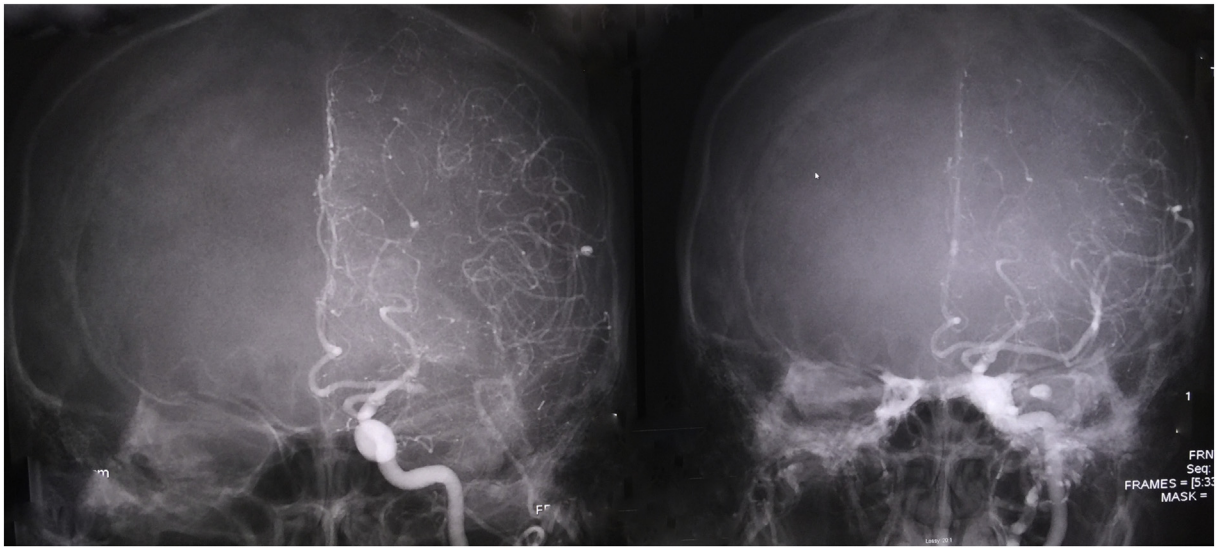

Fig. 3. Unsubtracted AP image demonstrating prethrombectomy left M1 occlusion and post thrombectomy M1 revascularization now with the iatrogenic CC Fistula

vasospasm and maintained for the duration of the intervention. An ACE64 Penumbra aspiration catheter was connected to continuous heparinized saline flush and advanced into the distal ICA over a Marksman microcatheter connected to continuous heparinized saline flush which was then advanced through the left MCA occlusion over a Synchro-14 microwire. After an angiographic run to demonstrate appropriate positioning, a 6 mm × 25 mm stentriever (Trevo Stent retriever, Stryker Neurovascular, 2017) was deployed and after allowing for several minutes of reperfusion, the device was extracted under Penumbra aspiration removing a solid occlusive mass. Prior to deployment and subsequent to removal of the Stentriever, angiograms were performed through the existing catheter to verify appropriate placement and efficacy. A final angiographic run was performed through the guide catheter confirming TICI 3 flow (Fig. 2) and after evaluation with a femoral runoff; the arteriotomy was closed with an AngioSeal device. The patient remained hemodynamically stable throughout the procedure and demonstrated neurologic improvement. The final angiographic run had revealed the development of a new CC Fistula secondary to rupture of a cavernous segment aneurysm after extraction of the stentriever (Fig. 3), as there was no early venous filling seen during or subsequent to deployment of the device.

Despite the direct carotid cavernous fistula, the patient remained asymptomatic during her hospitalization. She was seen in clinic after 90 days and remained at her neurologic baseline with no new neurological symptoms, an NIHSS stroke scale of 0, and a Modified Rankin Score of 0. MRI of the brain reported a stable mild enlargement of the left superior ophthalmic vein as a result of the previously identified left-sided carotid cavernous fistula and a stable minimal prominence of the left-side of the pituitary gland which may be the result of the cavernous sinus prominence as well.

4. Discussion

Direct fistulas are abnormal communications between the venous cavernous sinus and the carotid artery. They may occur spontaneously, but often are the result of head trauma. Different treatment modalities can be implemented for the closure of a direct carotid cavernous fistula (CCF) such as transarterial or transvenous embolization with coils and/or liquid embolics, balloon embolization, stent placement, or flow diversion. Potential complications of treatment include loss of vision, oculomotor nerve palsy, ischemic stroke, vessel rupture with cerebral hemorrhage, and death, however, the success rate of endovascular repair ranges from 55 to 99% [1,6]. The endovascular treatment of spontaneous direct CCF has even been reported with direct access

through the superior ophthalmic vein being described [2,7]. To our knowledge, the iatrogenic development of a direct CCF secondary to endovascular rescue with a stentriever has not been previously described. Likewise, the timing and indications for treatment for these fistulae have not been elucidated and the mechanism of spontaneous healing is uncertain. In our case, venous access to the cavernous sinus could not be safely obtained without subjecting her to direct access through the superior ophthalmic vein which the patient was disinclined to undergo given the paucity of her symptoms. Limitations are, as this is a single case report and not a controlled study, we do not claim that it represents a true, valid comparison with non-biased or statistical criteria. However, we feel that some useful conclusions can be extracted despite this limitation, especially in the context of a lack of any other publications for Iatrogenic Direct carotid-cavernous fistula due to Neurovascular rescue for ischemic stroke.

5. Conclusion

Iatrogenic direct CCFs secondary to vessel injury during endovascular rescue may be able to be observed rather than treated emergently unless they are associated with cortical venous reflux or hemodynamic compromise. Careful visualization of the underlying cavernous carotid artery and cautious navigation and device deployment under a high quality fluoroscopic roadmap may prevent or reduce the incidence of direct CCFs secondary to devices like stentrievers, however, ultimately the risk of proceeding must be weighed against the potential benefit, or in the case of an acute stroke secondary to a large vessel occlusion, the consequence of lack of success of revascularization.

Declaration of Competing Interest

Authors did not report any conflict of interest related to the case report.

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