A technique for prevention of posterior stroke during urgent revascularization of an acutely ischemic left upper extremity

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ABSTRACT

Upper extremity acute limb ischemia (ALI) owing to obstruction proximal to the vertebral artery poses the risk of posterior stroke during intervention. We describe a case of upper extremity ALI secondary to thrombosis of the proximal left subclavian artery with thromboembolic occlusion at the brachial bifurcation. The patient underwent a hybrid procedure of open thromboembolectomy with endovascular vertebral artery embolic protection. The patient's distal pulses and upper extremity function returned to baseline, without evidence of posterior stroke. A literature review revealed limited reports of the use of cerebral embolic protection in the setting of emergent thromboembolectomy for upper extremity ALI. (J Vasc Surg Cases Innov Tech 2024;10:101559.)

Keywords: Upper limb ischemia; Ischemic stroke; Large vessel occlusion; Upper extremity arterial occlusion; Thromboembolectomy; Cerebral embolic protection

Acute limb ischemia (ALI) of the upper extremity is less common and generally less severe than ALI of the lower extremity owing to its collateral circulation.[1] However, cases of upper extremity ALI owing to thromboembolic obstruction proximal to the vertebral artery pose a devastating risk of posterior stroke during revascularization.[2,3] There is sparse literature discussing the prevention of this complication during emergencies. We present a case of a left arm ALI owing to presumed in situ thrombosis of the proximal left subclavian artery with thromboembolic occlusion of brachial bifurcation managed via a hybrid technique of open thromboembolectomy with endovascular vertebral artery embolic protection through a single antecubital incision. The patient agreed to publication of case details and images.

CASE REPORT

A 66-year-old man with metastatic pancreatic cancer presented to the emergency department with 3 days of worsening left arm pain extending from his shoulder to his hand, numbness, and purple discoloration of the fingertips. Physical examination revealed absent radial, ulnar, and brachial pulses. Continuous wave Doppler ultrasound examination revealed monophasic arterial signals throughout the left upper extremity. The left fingertips were cyanotic with absent sensation to light touch, but full motor function remained intact. The remainder of his extremities had palpable distal pulses. His abdomen was nontender.

A therapeutic heparin infusion was initiated, and computed tomography angiogram of the chest and left upper extremity revealed thrombus in the proximal subclavian artery and at the brachial artery bifurcation. At the subclavian artery, the thrombus created a high-grade stenosis beginning one centimeter distal to the origin of the artery and extending to 1 cm proximal to the vertebral artery origin. The thrombus was occlusive at the brachial artery bifurcation. There were no significant arch lesions.

Given the concern for embolic posterior stroke with pure open or endovascular techniques, we performed a hybrid thromboembolectomy. In the operating room, he was positioned supine with the left arm extended. Through a transverse infra-antecubital incision, the brachial bifurcation was controlled with vessel loops, and a transverse arteriotomy was made in the brachial artery. Distal thromboembolectomy of the radial and ulnar arteries was performed with a 3F Fogarty embolectomy catheters with return of fresh thrombus and restoration of retrograde bleeding. An 0.035-inch wire was passed retrograde to the distal subclavian artery. An 8F sheath was advanced and positioned with the sheath tip in the distal subclavian artery. Retrograde angiogram revealed the origin of and a widely patent left vertebral artery and confirmed thrombus in the proximal subclavian artery (Fig 1).

The wire was advanced into the left vertebral artery. The sheath dilator was reinserted, and the sheath tip was advanced as close to the vertebral artery origin as possible. The wire was exchanged through a glide catheter for an 0.014-inch wire. A 4 × 30-mm noncompliant balloon catheter was advanced over the wire and positioned with the proximal end of the balloon at the vertebral artery origin. The balloon was inflated to only 4 atm to achieve profile. This method was chosen over a filter wire to promote the flow of embolic debris away from the vertebral artery altogether. Repeat retrograde angiogram demonstrated the vertebral artery was occluded. A 5F Fogarty embolectomy catheter was passed through the artery in buddy

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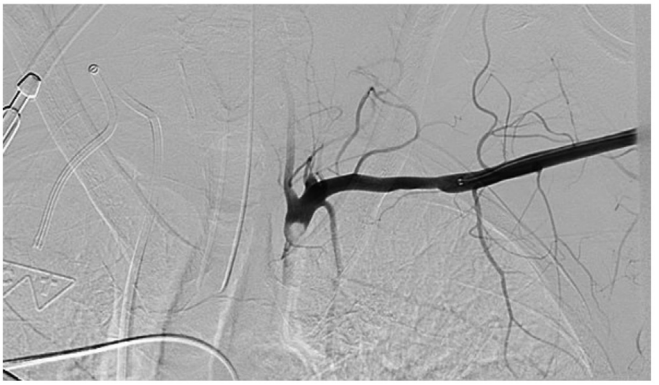

Fig 1. Retrograde angiogram of the subclavian artery demonstrating occlusive thrombus in the proximal subclavian artery with a widely patent the left vertebral artery.

Fig 2. Repeat angiogram revealing balloon occlusion of the vertebral artery, stenosis of the left subclavian artery without residual thrombus, and thrombus in the left axillary artery.

fashion around the sheath and advanced gently through the left subclavian artery into the aorta. With the sheath held in place to prevent dislodgement of the vertebral artery balloon, thromboembolectomy was performed several times only back to the axillary artery.

Repeat angiogram via the sheath revealed a stenosis of the proximal left subclavian artery and thrombus throughout the axillary artery (Fig 2). The Fogarty embolectomy catheter was removed and an 0.035-inch guidewire was advanced in buddy fashion around the sheath and into the aorta. A 9 × 39-mm Gore Viabahn VBX stent graft (W. L. Gore & Associates, Flagstaff, AZ) was advanced over this wire in bareback fashion and deployed across the subclavian artery stenosis. Repeat angiogram showed a widely patent left subclavian artery. The balloon catheter in the vertebral artery was deflated and a repeat angiogram showed a widely patent vertebral artery (Fig 3). All wires, catheters, and sheaths were removed. The residual thrombus in the axillary artery was removed via retrograde thromboembolectomy with a 5F Fogarty embolectomy catheter.

After restoration of arterial flow through the brachial artery, the radial and ulnar pulses were easily palpable with multiphasic arterial Doppler signals in the palmar arch and distal digital arteries. Postoperative assessment showed no evidence of focal neurological deficit or signs of posterior stroke. He was discharged home several days later with aspirin and therapeutic dosing of apixaban. At follow-up several weeks later, he reported no issues and had a normal examination.

Fig 3. Final angiogram revealing the patent left vertebral artery and left subclavian artery after stenting.

DISCUSSION

Acute thromboembolic occlusion of the great vessels creates a risk of stroke during revascularization. Although multiple modalities may be used to manage this form of ALI, most literature discussing stroke prevention during emergent revascularization focuses on the prevention of anterior stroke from innominate or carotid artery lesions[4,5] and rarely mentions the risk of posterior stroke during emergent thromboembolectomy of the proximal subclavian arteries.

In cases of combined subclavian and brachial occlusions, retrograde embolectomy via forearm incision poses the risk of occluding the proximal vertebral artery during pull back of thrombus across the vertebral artery origin or during stent deployment owing to extrusion of thrombus or atheroembolic plaque around the stent edges. Purely open management requires a separate supraclavicular incision, which requires the ability to abduct and adduct the arm to allow sufficient arm and neck exposure. Alternatively, brachial embolectomy via supraclavicular incision is possible, but typically requires an over-the-wire Fogarty embolectomy catheter, which creates an awkward technical demand for the surgeon.[1]

Pure endovascular techniques are possible, but still pose a risk of stroke if not planned thoughtfully. Engaging the thromboembolism antegrade creates a potential for embolization before the establishment of distal embolic protection. Reports from the management of chronic proximal subclavian artery obstructions suggest this risk can be mitigated by retrograde brachial access with vertebral artery embolic protection via a filter wire or balloon occlusion, followed by immediate attempt at antegrade percutaneous mechanical thrombectomy or stenting.[2,3,6] Unfortunately, these reports do not deal with acute thromboembolic obstructions. As such, there is no consideration of the potential for thromboembolization to the axillary or brachial artery during intervention, which would require further attempts at percutaneous mechanical thrombectomy or conversion to open treatment.

The report most like our case describes left arm ALI from a chronically occluded left proximal subclavian artery stent with acute thrombus formation distal to the stent and embolization to the brachial bifurcation.[7] This case was managed with open brachial thromboembolectomy followed by staged open thromboembolectomy of the proximal subclavian artery with direct loop control of the vertebral artery and carotid subclavian bypass. However, this case had the luxury of correcting the emergent ischemia via brachial embolectomy alone.

CONCLUSIONS

We believe that our single-incision hybrid technique is a simple and effective means of managing ALI of the left upper extremity owing to proximal subclavian artery thromboembolism while protecting the posterior circulation. In the future, we plan to alter our technique with a smaller diameter sheath to decrease the risk of brachial artery injury during passage of Fogarty thromboembolectomy and stent graft catheters in buddy fashion.

DISCLOSURES

None.

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