A hybrid endovascular and open approach to rare thyrocervical trunk and subclavian pseudoaneurysms complicated by embolic brachial artery occlusion

Katerina Jou, BS,[a,b] Lily S. F. Adler, BA,[a,c] Krystina N. Choinski, MD,[a] Bryan P. Myers, MD,[a] William P. Zickler, MD,[a] *and* Rami O. Tadros, MD, FACS, FSVS, RPVI,[a] *New York, NY; and New Brunswick, NJ*

ABSTRACT

Subclavian and thyrocervical trunk pseudoaneurysms are rare pathologies and even more so when they occur simultaneously. Treatment of these vascular injuries can be done endovascularly or with open surgery. We present a novel two-stage, hybrid open and endovascular approach to the management of a healthy 41-year-old man with no personal or family history of connective tissue disorders, who presented with subclavian branch and thyrocervical trunk pseudoaneurysms complicated by brachial artery occlusion. The pseudoaneurysms were treated with microvascular plug deployment, followed by subclavian artery covered stenting, with treatment of the brachial occlusion via open thrombectomy with patch angioplasty. The patient recovered without any complications. (J Vasc Surg Cases Innov Tech 2024;10:101523.)

Keywords: Microvascular plug; Patch angioplasty; Pseudoaneurysm; Subclavian artery pseudoaneurysm; Thyrocervical trunk pseudoaneurysm

Subclavian and thyrocervical trunk pseudoaneurysms are rare, typically resulting from trauma, and have a high risk of thrombosis, distal embolization, and mortality, if ruptured.[1-5] We present a case of concurrent subclavian artery branch and thyrocervical trunk pseudoaneurysms complicated by brachial artery thrombosis. These pseudoaneurysms were treated via a two-stage, hybrid endovascular and open approach with microvascular plug (MVP) embolization of the thyrocervical trunk pseudoaneurysm, covered stenting of the subclavian artery, and brachial thrombectomy with patch angioplasty. The patient provided written informed consent for the report of his case details and imaging studies.

CASE REPORT

One year after experiencing a self-resolving, sharp pain above his left clavicle while serving a tennis ball, a healthy 41-year-old man presented to orthopedic surgery with a 1-month history of progressive left upper extremity pain, weakness, and an enlarging pulsatile mass in his upper chest. A left clavicle radiograph was unremarkable. Computed tomography angiography displayed a 4.6 × 2.8 × 2.9-cm vascular structure off the left subclavian artery but normal carotid and vertebral arteries. Magnetic resonance imaging of the left shoulder suggested subclavian artery and thyrocervical trunk pseudoaneurysms (Fig 1). Given these findings, the patient was referred urgently to vascular surgery where the physical examination revealed a left arm mean arterial pressure 30 points lower than the right, and arterial duplex ultrasound showed a pseudoaneurysm off the left supraclavicular subclavian artery with brachial artery thrombosis.

A left upper extremity angiogram with pseudoaneurysm embolization and brachial thrombectomy were pursued via transradial access. The patient was Barbeau type B with left radial and ulnar signals and intact motor function and sensation; thus, radial access was deemed safe. An angiogram showed a left thyrocervical trunk pseudoaneurysm (Fig 2). This was treated with selective catheterization and MVP embolization: three MVP-5Q plugs (Medtronic) for outflow branches and one for the inflow (Fig 3), using 20% oversizing to minimize the embolic risk.

The angiogram also displayed a pseudoaneurysm of an avulsed left subclavian artery branch, likely the costocervical trunk (Fig 4). We successfully accessed the pseudoaneurysm, embolizing an outflow branch using an MVP-5Q plug, again with 20% oversizing. The subclavian pseudoaneurysm neck was 1 cm long by 7 mm wide. The left vertebral artery was 3 cm proximal to the subclavian pseudoaneurysm neck; thus, it was deemed safe from embolization risk or coverage. We attempted to seat an MVP-9Q plug in the branch ostium, coupled with ultrasound-guided thrombin injection to prevent plug migration; however, this was unsuccessful, and the plug immediately migrated into the aneurysm. Persistent flow into the subclavian artery pseudoaneurysm was noted (Fig 5).

The brachial artery was occluded at the brachial bifurcation, with collateralization and outflow reconstitution to the radial and ulnar arteries distal to the occlusion. The occlusion was

From the Division of Vascular Surgery, Department of Surgery, Icahn School of Medicine at Mount Sinai,[a] the City University of New York School of Medicine,[b] New York; and the Rutgers Robert Wood Johnson Medical School, New Brunswick.[c]

Correspondence: Rami O. Tadros, MD, FACS, FSVS, RPVI, Division of Vascular Surgery, Department of Surgery, Icahn School of Medicine at Mount Sinai, The Mount Sinai Medical Center, 1425 Madison Ave, 4th FL, New York, NY 10029 (e-mail: rami.tadros@mountsinai.org).

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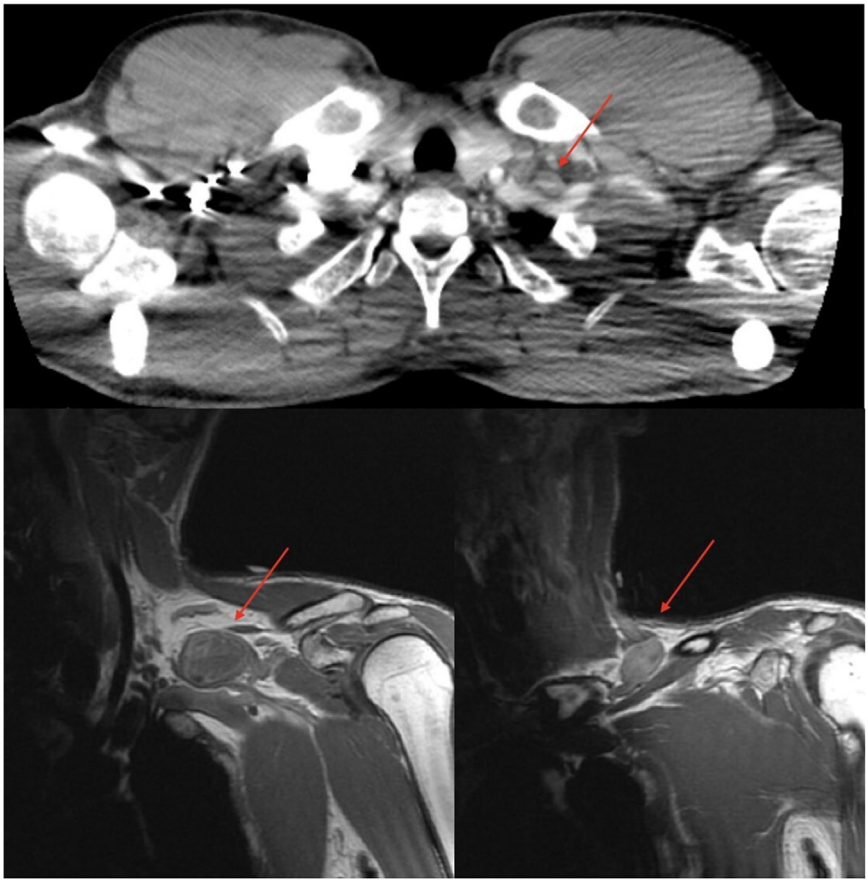

Fig 1. Computed tomography angiography of the chest, axial image, showing a 4.6 × 2.8 × 2.9-cm, ovoid vascular structure off the left subclavian artery, concerning for pseudoaneurysm vs aneurysm. Magnetic resonance angiography of the shoulder, coronal image, displaying a pseudoaneurysm of the left subclavian artery and a focal aneurysmal-like dilatation of the thyrocervical trunk.

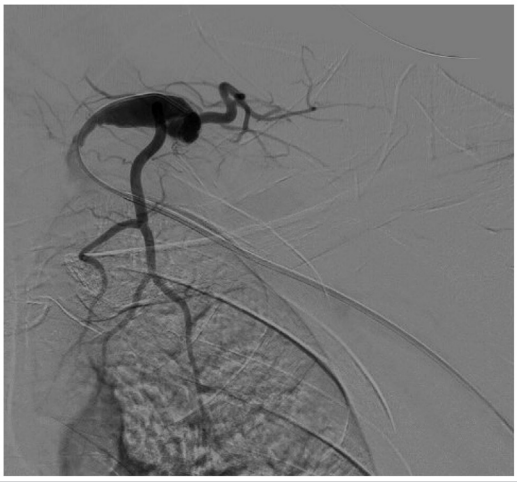

Fig 2. Upper extremity angiogram displaying selective cannulation of a thyrocervical trunk pseudoaneurysm.

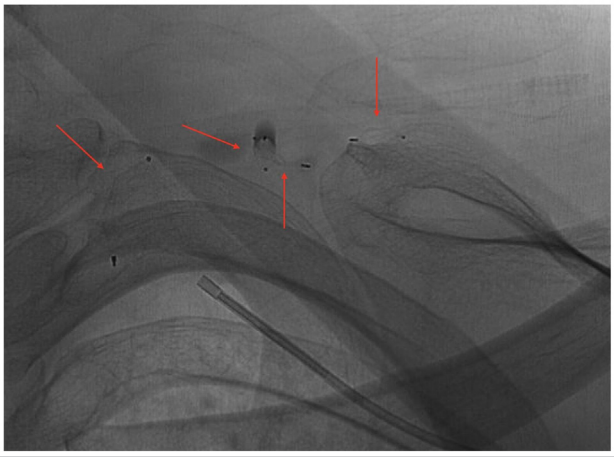

Fig 3. Microvascular plug (MVP) embolization of the left thyrocervical trunk pseudoaneurysm with treatment of three outflow branches and one inflow branch.

likely embolic and chronic given the prominent collateralization (Fig 6). Mechanical percutaneous JETi thrombectomy (Abbott Cardiovascular) was attempted; however, complete resolution was not possible given the chronicity. Due to the near stasis of flow into the pseudoaneurysm, there was low concern for rapid expansion or rupture after the initial intervention.

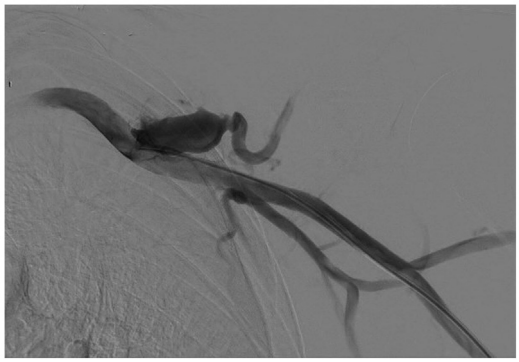

Fig 4. Angiogram of a left subclavian pseudoaneurysm, likely an avulsed branch off the subclavian artery.

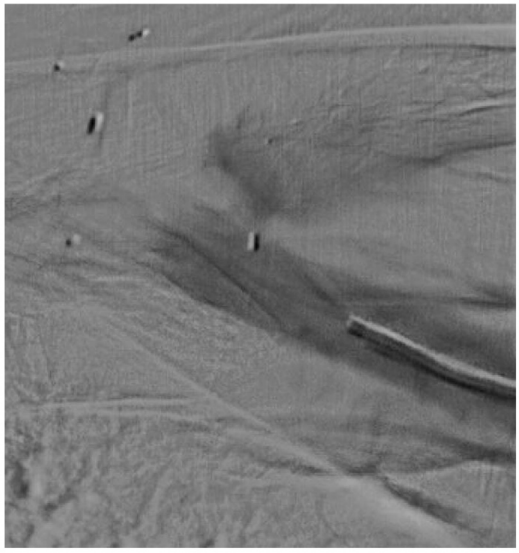

Fig 5. Blood flow persisting into left subclavian artery pseudoaneurysm after microvascular plug (MVP) deployment and 1 mL of direct thrombin injection under ultrasound guidance.

To give a break between contrast loads, the patient returned 2 days later for open brachial thromboendarterectomy with subclavian artery stenting. A lazy S incision was extended over the antecubital fossa to the proximal forearm to isolate the brachial artery. A longitudinal arteriotomy was made from the brachial artery to the proximal radial artery. Thromboendarterectomy was performed with proximal and distal Fogarty catheter passage. However, there was a lack of brisk back bleeding from the radial artery. Angiography showed a small filling defect at the radial artery access site, and intravascular ultrasound confirmed a distal thrombus. Fogarty embolectomy of the distal radial artery was performed, with brisk back bleeding on completion. The ulnar artery remained patent distal to the brachial artery thrombus tail seated at its ostium due to collateralization.

The subclavian branch pseudoaneurysm had thrombosed outflow but patent inflow on angiography. An 11 × 50-mm covered Viabahn stent (W.L. Gore & Associates) was deployed and postdilated with 9-mm balloon angioplasty. Angiography confirmed pseudoaneurysm exclusion (Fig 7). The arteriotomy was closed with an 8.0 × 0.8-cm bovine pericardium patch (Fig 8). Completion angiography demonstrated an excluded subclavian pseudoaneurysm with patent brachial, radial, and ulnar arteries and an intact palmar arch.

The patient was discharged home on postoperative day 1. To prevent thrombosis of the new stent, he started 60 days of rivaroxaban 10 mg and 7 days of dual antiplatelet therapy (aspirin 81 mg and clopidogrel 75 mg), after which clopidogrel was continued for 90 days total.

At his 3-month follow-up, he remained asymptomatic with palpable radial and ulnar pulses, normal Allen's test findings, and a triphasic palmar arch signal. Arterial duplex ultrasound displayed triphasic waveforms throughout the brachial artery and subclavian artery stent. No perfusion was noted in either pseudoaneurysm.

DISCUSSION

Subclavian artery pseudoaneurysms have an incidence of 1% to 2%.[4] Etiologies include trauma, atherosclerosis, thoracic outlet syndrome (TOS), and connective tissue disorders.[1,6] Thyrocervical trunk aneurysms are even less common, typically resulting from iatrogenic central venous cannulations.[3,7] This patient's serving injury likely avulsed the subclavian artery, resulting in a pseudoaneurysm, and continued use of the arm likely compressed the artery, leading to thrombosis and embolization to the distal brachial artery. Similar injuries have been reported in baseball pitchers and elite overhead throwing athletes.[8,9]

This case is distinct from another documented subclavian aneurysm complicated by TOS in a tennis player.[10] Although there are established associations between rigorous, repetitive shoulder motion, muscle hypertrophy, and TOS, our patient exhibited no signs or symptoms of TOS and did not have a congenital first rib. Provocative maneuvers during angiography further ruled out arterial compression. Having multiple pseudoaneurysms without any personal or family history of connective tissue disorders warranted a genetic workup, which was ultimately negative; however, he is following up with vascular medicine to screen for aortic aneurysms.

Conventional angiography remains the diagnostic standard for subclavian and thyrocervical trunk aneurysms; alternatives include duplex ultrasound, computed tomography angiography, and magnetic resonance angiography.[2,11] Although we discussed an open approach, the location of the subclavian pseudoaneurysm would have likely required a claviculectomy, and the patient was reluctant to undergo such an invasive procedure. The use of MVPs successfully treated the thyrocervical pseudoaneurysm. They are effective, with results comparable to those with coil embolization.[2] The MVP advantages include the ability to reposition once deployed,

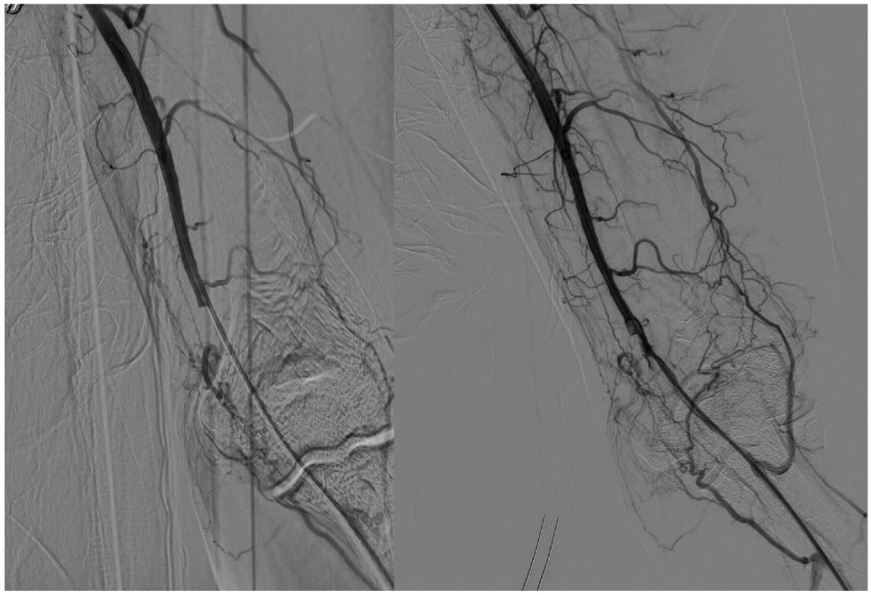

Fig 6. Left brachial artery occlusion noted on an upper extremity angiogram, likely secondary to emboli.

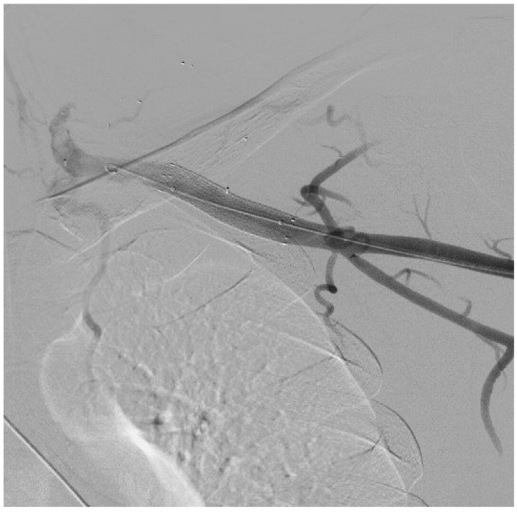

Fig 7. Deployment of an 11 × 50-mm Viabahn stent to successfully exclude the left subclavian artery pseudoaneurysm.

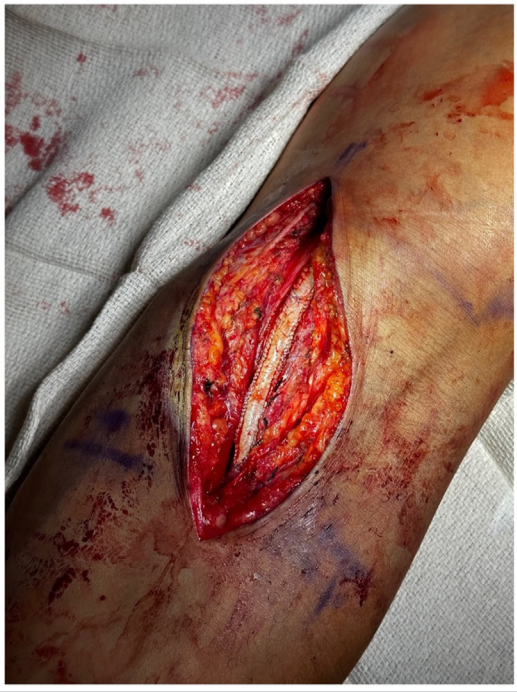

Fig 8. Bovine patch angioplasty of the brachial artery after thromboendarterectomy for chronic occlusion.

reduced hemostasis time, that a single plug can replace multiple coils, and less computed tomography artifact compared with platinum coils.[12-14] Of note, MVPs are more effective in straight arteries, including the subclavian artery and thyrocervical trunk.[7] Despite these benefits, the risks include rupture, nontarget embolization, and aneurysm recurrence.[15] Thrombin injection of the subclavian pseudoaneurysm was pursued after MVP deployment because it has proven success in managing iatrogenic pseudoaneurysms.[12]

The patient's brachial thrombus likely resulted from chronic emboli from the pseudoaneurysm, necessitating open thrombectomy and repair. Prior studies report chronic emboli from aneurysms; however, these cases attributed the extremity symptoms to nerve compression.[16,17] In contrast, our patient's pain and paresthesia were likely due to ischemia rather than compression, because sensory and motor functions were largely unaffected across the brachial plexus distributions.

Compressive symptoms, including dysphagia, dyspnea, and Horner syndrome, were not noted.[7]

CONCLUSIONS

This case highlights the successful two-stage management of concurrent subclavian branch and thyrocervical trunk pseudoaneurysms, complicated by embolic brachial artery occlusion, using both endovascular and open surgical techniques. This hybrid approach demonstrates the need to adeptly use varied vascular surgery techniques when endovascular therapy alone is insufficient.

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DISCLOSURES

None.

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