JSCAI
The official journal of the Society for Cardiovascular Angiography & Interventions

JSCAI Case Report

Angio-Seal Closure for Traumatic Left Subclavian Artery Pseudoaneurysm: A Case Report

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ABSTRACT

Subclavian artery pseudoaneurysms are rare and associated with high morbidity and mortality. Alternative approaches to open surgical repair can include endovascular repair or ultrasound-guided thrombin injection. Here, we describe a safe and novel technique of closure of a subclavian artery pseudoaneurysm with Angio-Seal that was unresponsive to thrombin injection and in a difficult location for open repair.

Introduction

Delayed presentation of subclavian artery (SCA) pseudoaneurysm following blunt trauma is rare and is associated with high morbidity and mortality.[1,2] Noninvasive approaches with endovascular repair[2,3] and ultrasound (US)-guided thrombin injection[4] are now favored over operative surgical repair because of significant risk.[3] Angio-Seal (Terumo Interventional Systems) is a vascular closure device comprising a bioabsorbable anchor and collagen plug, used for closure of common femoral artery (CFA) access after percutaneous procedures. To date, its use has not been reported in the closure of traumatic SCA pseudoaneurysms.

History of presentation

A 66-year-old man presented with progressive left neck and shoulder pain associated with paresthesia and acute transient blurry vision after a recent motor vehicle accident that occurred 1.5 weeks prior to his presentation. His medical history included hypertension, total knee replacement, anxiety, and hepatic steatosis. He was a former 30-pack-year smoker and an opioid and alcohol user.

Immediately after the motor vehicle accident, he initially presented to an outside hospital where he suffered multiple injuries including a sternal fracture, left first and second rib fractures, left pulmonary contusion, and bilateral pelvic fractures. All were treated non-operatively. He suffered a neck and clavicular hematoma. Computed tomography scan and ultrasound did not demonstrate any acute vascular injury. Subsequent MRI brain demonstrated subacute infarcts in the right temporal, occipital lobes, and bilateral frontal and cerebellar lobes. He was discharged to rehabilitation after 3 weeks of hospitalization. The day following discharge, he presented to our hospital with an enlarging neck mass and pain.

Investigations

A computed tomography angiography demonstrated a new left multilobulated SCA pseudoaneurysm, measuring up to 4.3 cm, between the origins of the left vertebral and left internal mammary arteries (LIMA) behind the clavicle. The hematoma measured 6 × 10 × 10 cm (Figure 1). MRI brain showed early subacute left cerebellar hemisphere infarct and chronic bilateral small cerebellar infarcts, no filling defects or dissection flap with the ongoing left SCA, LIMA, or vertebral arteries; however, an enlarging hematoma was noted.

Management

On hospital day 3, he underwent US-guided thrombin injection. An arterial duplex scan demonstrated a fully thrombosed left SCA pseudoaneurysm with normal arterial flow throughout the left arm. He was subsequently discharged on postoperative day 3. He presented to the

Keywords: Angioseal; peripheral intervention; pseudoaneurysm; vascular closure device.
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https://doi.org/10.1016/j.jscai.2024.102021
Received 21 January 2024; Received in revised form 31 March 2024; Accepted 2 April 2024
Available online 23 April 2024

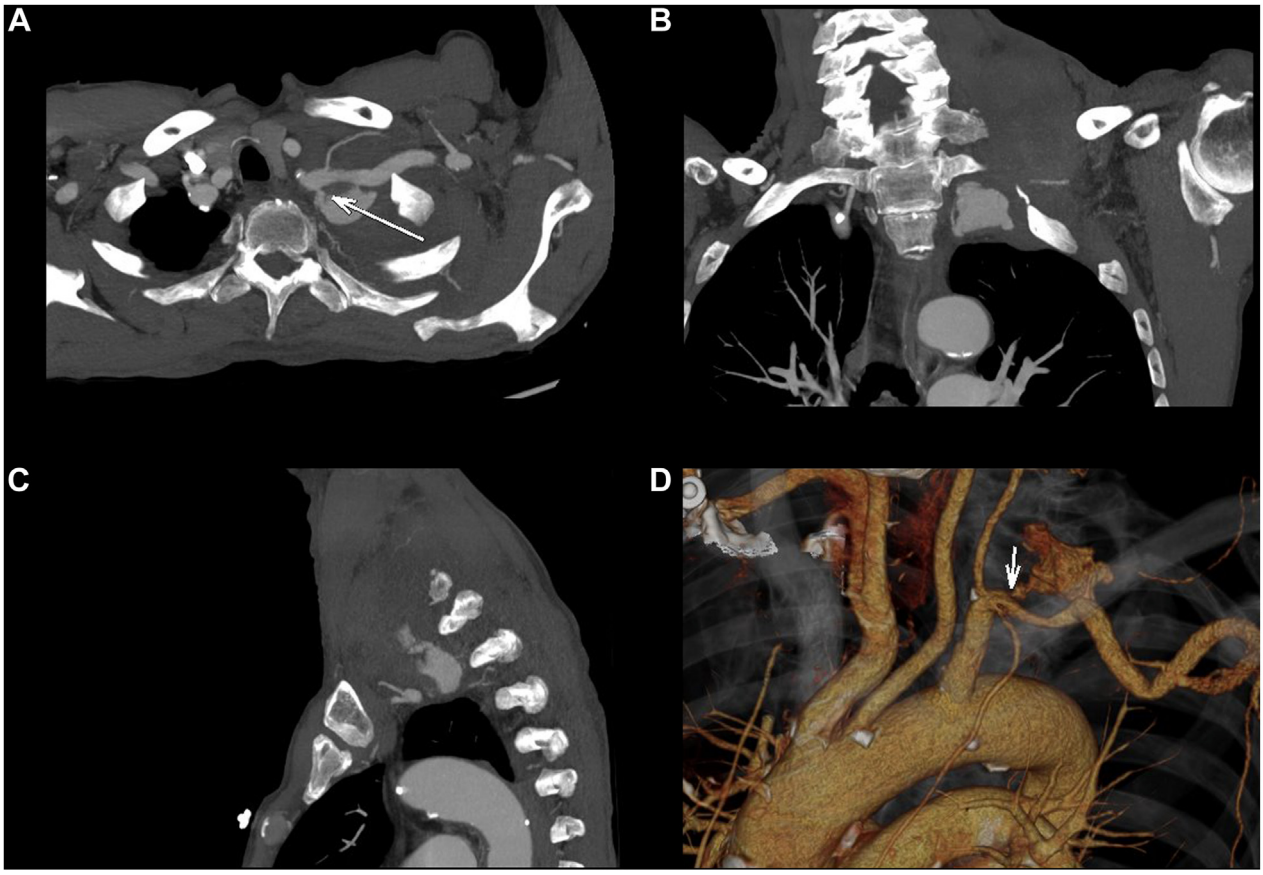

Figure 1.
CT angiography (A) transaxial with corresponding (B) coronal and (C) sagittal views showing the left subclavian artery pseudoaneurysm and large supraclavicular hematoma with (D) 3D reconstruction. The white arrow points to the pseudoaneurysm neck.

hospital 48 hours after discharge with enlarging left neck swelling. Computed tomography angiography thoracic and head/neck demonstrated persistent multilobulated left SCA pseudoaneurysm and unchanged large left supraclavicular hematoma. He underwent repeat thrombin injection; however, post-procedure arterial duplex demonstrated persistent flow through the pseudoaneurysm. Given the unresponsiveness to multiple thrombin injections, SCA pseudoaneurysm closure with off-label use of Angio-Seal was arranged.

US-guided retrograde puncture of the right CFA was performed and a 5F sheath was placed. A 5F Berenstein catheter and guide wire combination were used to access the left SCA and the 5F sheath was exchanged for a 7F destination sheath. The catheter and wire combination were used to access the pseudoaneurysm arising from the left proximal SCA with contrast injection confirming position (Figure 2, Supplementary Video 1). Subsequently, US-guided Angiocath puncture of the persistent patent pseudoaneurysm was performed via the left supraclavicular with contrast injection confirming position within the pseudoaneurysm sac (Figure 3, Supplementary Video 2). A 0.035" exchange length guide wire was then introduced via the Angiocath (BD) and a snare was introduced via the Berenstein (Merit Medical) catheter from the right CFA. The guide wire from the left subclavian access was snared and pulled through the sheath, resulting in through-and-through access. Dilatation was performed over the wire in the neck of the pseudoaneurysm and a 6F Angio-Seal sheath was advanced over the guide wire under fluoroscopic guidance (Figure 4, Supplementary Video 3). Back bleeding was achieved at the left SCA and the Angio-Seal was then successfully deployed. Repeat angiography demonstrated occlusion of flow within the pseudoaneurysm with preserved antegrade flow in the left subclavian, axillary, vertebral arteries, and

Figure 2.
Digital subtraction angiography of the left subclavian artery (SCA) pseudoaneurysm. A 5F Berenstein catheter and guide wire combination were advanced via the right femoral artery to access the left SCA pseudoaneurysm. Contrast injection in the anterior-posterior view confirmed the position of the catheter at the left SCA pseudoaneurysm.

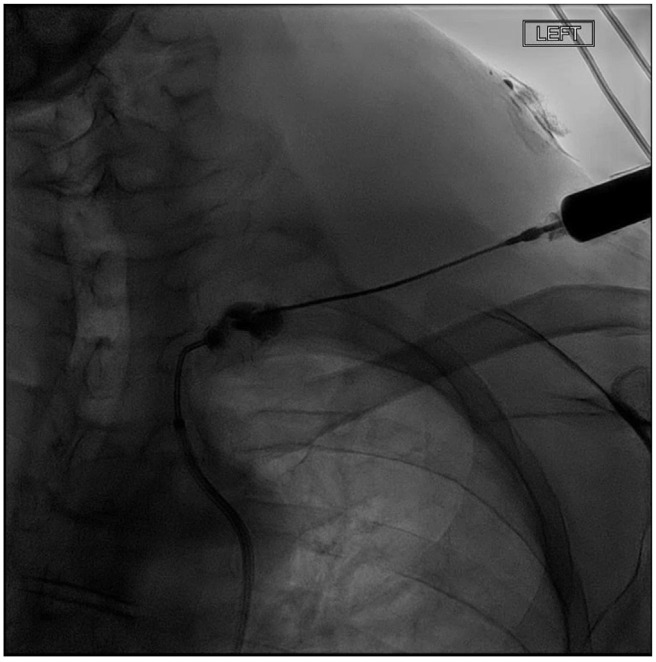

Figure 3.
Fluoroscopy in anterior-posterior view of ultrasound-guided puncture of the left subclavian pseudoaneurysm puncture from the left supraclavicular. Using ultrasound guidance, Angiocath puncture of the patent pseudoaneurysm via the left supraclavicular position with contrast injection confirming position within the pseudoaneurysm.

LIMA (Figure 5). Duplex ultrasonography the next day demonstrated normal flow in the left SCA with flow no longer visible in the pseudoaneurysm. A follow-up study 1 month later confirmed successful closure of and reduction in the size of the pseudoaneurysm and overlying hematoma with patent flow in the distal arteries.

Discussion

This is the first report of percutaneous repair of a traumatic thrombin-resistant SCA pseudoaneurysm using an Angio-Seal vascular closure device.

Figure 5.
Digital subtraction angiography of the left subclavian artery following the deployment of the Angio-Seal. Angiography demonstrated occlusion of flow within the pseudoaneurysm with preserved antegrade flow in the left subclavian, axillary, vertebral arteries, and left internal mammary arteries.

Femoral and radial artery pseudoaneurysms do not infrequently occur following percutaneous interventions, whereas SCA pseudoaneurysms are rare, even more so following blunt trauma (3%).[1,2] Lack of prominent symptoms and physical examination findings with delayed presentation, as observed in our patient, has been reported in up to 25% of patients and may be explained by the extensive collateral circulation in the upper extremity.[5] Early recognition is essential; when left untreated, it is associated with significant morbidity and mortality due to compression of neurovascular structures, ischemia, embolism, and rupture.

There are currently no guidelines for treatment of SCA pseudoaneurysms; however, treatment is indicated if the patient is symptomatic or has a high risk for rupture or thromboembolism. Operative repair of SCA pseudoaneurysm has been the traditional approach but imposes a major surgical challenge with associated risk of injury to adjacent structures.[3] Noninvasive techniques have thus become a preferred treatment and include endovascular stenting or coiling, US-guided external compression, and US-guided thrombin injection. Open surgical repair would have been technically challenging to access as the

Figure 4.
Digital subtraction angiography showing Angio-Seal advanced into the pseudoaneurysm from the left supraclavicular puncture. A 0.035" exchange length guide wire from the left supraclavicular access was then snared and pulled through the sheath, resulting in through-and-through access (not shown). A 6F Angio-Seal sheath was advanced over the guide wire under fluoroscopic guidance and deployed.

injury was posterior to the clavicle. Importantly, given that our patient suffered from a concomitant ipsilateral (left) subacute cerebellar hemisphere infarct, he was felt to be at high operative risk. Based on the location of the SCA pseudoaneurysm, external compression was not attempted as it was likely to be unsuccessful due to the significant large hematoma, overlying clavicle, and depth of the artery. Similarly, placement of a covered stent was not pursued as the distance from the left vertebral artery to the pseudoaneurysm neck was insufficient and the extrinsic compression of the left SCA due to the large hematoma would increase the risk of restenosis.

US-guided thrombin injection has a reported success rate of >95% with a low complication rate of 1.3% and has primarily been used for the treatment of femoral artery (FA) pseudoaneurysms.[6,7] There have been a few case reports describing this technique for the treatment of SCA pseudoaneurysm with an estimated 82% success rate.[4] FA pseudoaneurysms unresponsive to US-guided thrombin injection were identified as having an underlying occult vascular injury or infection[8] and associated with obesity and aggressive antithrombotic therapy.[9] In an animal model, the effect of intraarterial thrombin was found to be directly related to dose and inversely related to baseline blood flow in the FA.[10] It may be possible that our patient's SCA pseudoaneurysm was refractory to thrombin injection due to high vessel flow.

Another novel noninvasive technique to repair CFA pseudoaneurysms is with off-label Angio-Seal use. Using US guidance and the micropuncture Seldinger technique, the pseudoaneurysm is accessed with the insertion of a sheath, exchanged for a guide wire and Angio-Seal deployed with the collagen plug external to the neck of the pseudoaneurysm.[7] Although all of these studies were single case reports with 100% success rate and low (2.5%) complication rates, it is important to avoid its use in calcified arteries and in large pseudoaneurysm orifice >5 mm due to the inability of the footplate to anchor on the vessel wall.

Conclusions

SCA pseudoaneurysms are rare and carry high morbidity and mortality if not diagnosed early. Angio-Seal can be considered as a safe noninvasive technique for closure of SCA pseudoaneurysm in cases that are thrombin resistant and in patients who have contraindications to endovascular stenting or surgical repair.

Declaration of competing interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding sources

This work was not supported by funding agencies in the public, commercial, or not-for-profit sectors.

Ethics statement and patient consent

Consent was obtained from the patient to share the details of his medical history and the intervention performed. The risks and benefits of the intervention were explained to the patient in full detail. The intervention itself adhered to all ethical guidelines.

Supplementary material

To access the supplementary material accompanying this article, visit the online version of the *Journal of the Society for Cardiovascular Angiography & Interventions* at 10.1016/j.jscai.2024.102021.

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