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Type I Endoleak Following Covered Stent Graft Placement for Traumatic Subclavian Artery Pseudoaneurysm

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Abstract

Subclavian artery pseudoaneurysm is an uncommon entity caused by trauma or iatrogenic arterial injury. Endovascular management is the preferred treatment strategy but can be complicated by endoleaks. We report a case of type I endoleak occurring after endovascular covered stent placement to treat a traumatic pseudoaneurysm of proximal left subclavian artery.

Keywords

- subclavian artery
- pseudoaneurysm
- endoleak
- covered stent-graft
- endovascular

Introduction

Subclavian artery (SCA) pseudoaneurysm is an uncommon pathology caused by a penetrating or blunt trauma, or it may be iatrogenic, caused by inadvertent arterial puncture during central venous catheterization. Surgical resection and reconstruction are technically difficult and require sternotomy or a clavicular resection, especially when the lesion is present in the proximal third of the SCA. Endovascular management options include stent-assisted coiling, covered stent graft placement, or percutaneous thrombin injection.[1–5] Placement of covered stent graft is considered the most preferred technique; however, it requires lack of tortuosity of the vessel and sufficient landing zone to protect the ipsilateral vertebral artery (VA). Endoleak after endovascular stenting remains an Achilles' heel of endovascular repair, mostly reported with aortic aneurysms.[6] We report a case of type I endoleak occurring after endovascular covered stent placement to treat a traumatic pseudoaneurysm of the proximal left SCA.

Case Report

A 20-year-old man presented with pulsatile swelling in the left supraclavicular region for the last 2 weeks, following a stab wound in the left supraclavicular region 15 days ago. The patient was diagnosed with pseudoaneurysm from the left SCA by a color Doppler done from an outside center and was referred to the interventional radiology unit for endovascular management. Computed tomography (CT) angiography showed a large ($2.2 \times 1.8 \times 3.6$ cm) partially thrombosed saccular pseudoaneurysm in the left supraclavicular fossa arising from the anterior aspect of the proximal left SCA located between the origins of the thyrocervical (TC) trunk and the costocervical (CC) trunk. The neck of the aneurysm measured 8.8 mm. Proximally, the distance of the site from

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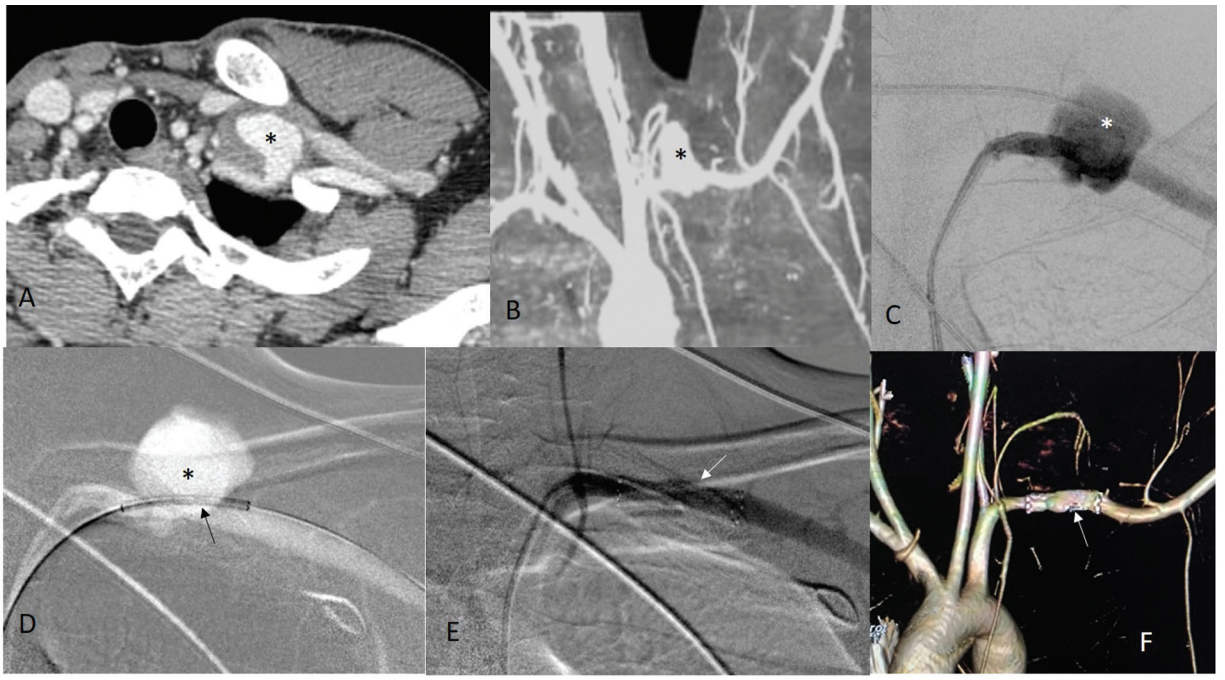

Fig. 1 (**A**) Axial computed tomography (CT) angiography, (**B**) coronal maximum intensity projection, (**C**) and digital subtraction angiography images showing the pseudoaneurysm (*) arising from the proximal subclavian artery. (**D**) Placement of stent (*black arrow*) across the pseudoaneurysm (*). (**E**) Post-stenting DSA run and (**F**) CT angiography 3 days after deployment of stent (*white arrows*) shows obliteration of pseudoaneurysm.

the origin of the VA, TC trunk, and internal mammary arteries was approximately 2.2, 1.6, and 1.6 cm, respectively. Distally, the distance from the CC trunk was 1.8 cm. The diameter of the VA distal to origin of the left VA was 6 mm. Considering the neck size (8 mm), and proximity with VA, we decided to treat the patient with a 30 × 8 mm covered stent graft.

A 5-Fr H1 catheter was positioned at the origin of the left SCA using a 6-Fr sheath via the transfemoral approach. Digital subtraction angiography (DSA) showed the wide neck aneurysm, and precise relation of aneurysm in the neck and the VA, following which a guidewire was passed across to the left axillary artery, and was exchanged with ultra-stiff guidewire (0.035 inches) through a multipurpose catheter. A 6-Fr vascular access sheath was exchanged with a 9-Fr sheath and a 8 mm × 30 mm covered stent (Department of Radiodiagnosis and Imaging Covera Plus, Vascular Covered Stent, Angiomed GmbH & Co., Bard, Karlsruhe, Germany) was placed and deployed across the aneurysm neck with the proximal landing zone nearly 1 cm from the VA. Immediate DSA run and a CTA performed 3 days later showed complete obliteration of the pseudoaneurysm. The patient was started on 325 mg aspirin with intention to change to 75 mg after 1 week. The patient was discharged with proper counseling and follow-up after 1 week was advised (►**Fig. 1**).

Against the advice to avoid exaggerated movement of the procedural site, the patient engaged in strenuous occupational activity. Two weeks after the procedure, the patient had a repeated trauma in the form of fall from motor cycle, following which the swelling increased in size, became pulsatile, became progressively painful, with decreased muscle power of the left upper limb. A Doppler sonography performed revealed a leak at the proximal and distal ends of the stent and the left radial artery showed low-resistance monophasic waveform (►**Fig 2**). CTA confirmed the presence

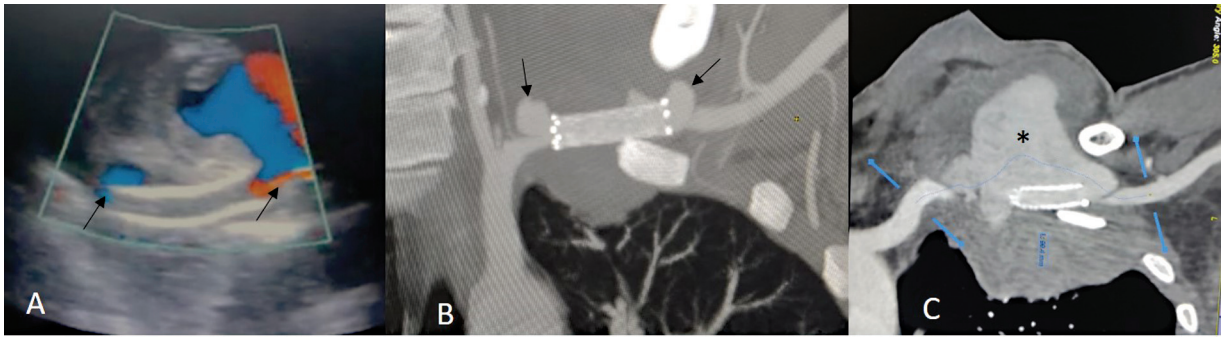

Fig. 2 (**A**) Color Doppler and (**B**) computed tomography (CT) angiography coronal images, 15 days after the procedure showing active color Doppler flow and contrast filled extravasation at the proximal and distal ends of stent (*black arrows*). (**C**) CT angiography done 45 days after the initial procedure shows frankly ruptured partially thrombosed recurrent pseudoaneurysm (*).

of endoleaks at the proximal and distal ends of the stent and the proximal end was in close proximity to the VA. The patient denied any repeat procedure at that time predominantly due to financial reasons and poor affordability. The patient again presented to us 1 month later, with increased swelling, excruciating pain, and left upper limb paraparesis. CTA showed a large recurrent pseudoaneurysm (4×6 cm), with an 8-cm surrounding hematoma that was compressing the left VA (►**Fig 2**). After consultation with the vascular surgeon, the decision was made to treat this pseudoaneurysm with a longer covered stent with protective VA embolization using coils. Right VA angiogram revealed opacification of both posterior cerebral arteries (PCA). Anterior spinal artery (ASA) was not arising from the right VA. DSA run through the left SCA showed that the left VA was not related to the site of the endoleak. This prompted us to preserve the left VA and a vascular 8 mm $\times$ 100 mm covered stent (Covera Plus, Angiomed GmbH & Co. Bard) was deployed with proximal landing zone just distal to the VA origin (►**Fig 3**). To relieve the mass effect and brachial plexopathy, 25 mL of blood was aspirated from the supraclavicular hematoma. Postprocedure angiography and CT angiography done 3 days later showed complete occlusion of pseudoaneurysm. This time, the patient was started on 75 mg of clopidogrel once daily during the first week and subsequently replaced by 75 mg of aspirin twice daily. After consultation with the cardiothoracic surgery department and apprehension about infection, no additional local percutaneous intervention was tried and the patient was put on routine follow-up to monitor the decrease in size of associated hematoma and improvement of the left upper limb muscle power. at 2 months of follow-up, the swelling significantly reduced, and there was relief in pain and improvement in motion. Color Doppler did not reveal any subsequent evidence of recurrence and there was significant reduction in the size of hematoma.

Discussion

Recurrence of the pseudoaneurysm after covered stent placement is rare and has been reported mostly due to filling by the branches from the ipsilateral common carotid artery, VA, and TC or CC trunk, categorized as type II endoleak. Very few cases (around 10) have been reported discussing the management of recurrent endoleaks following initial stenting of an SCA traumatic pseudoaneurysm. They are usually treated by re-stenting or with additional local percutaneous intervention or followed up for spontaneous resolution.[6] We report this case of type I endoleak following endovascular management of SCA, manifesting as a leak from both proximal and distal ends of the stent graft. Type I endoleaks are caused by inadequate seal at the proximal and distal ends of a stent graft and have a high risk of rupture.[7] We presumed that the strenuous activity

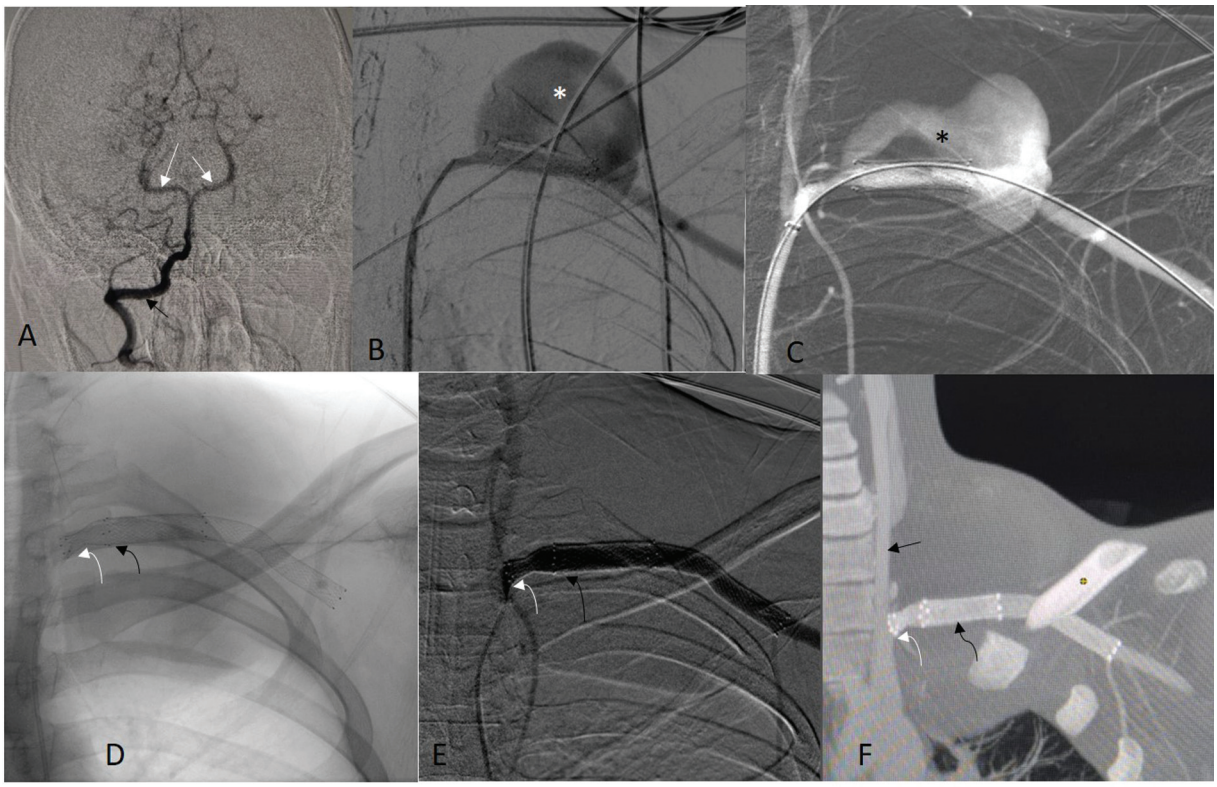

Fig. 3 (**A**) Right vertebral artery (*black arrow*) angiogram shows opacification of the bilateral posterior cerebral artery (*white arrows*) and nonvisualization of the right anterior spinal artery. (**B**,**C**) Digital subtraction angiography (DSA) run shows the large pseudoaneurysm (*) and placement of the longer covered stent, just distal to the left vertebral artery origin. (**D**) X-ray, (**E**) DSA run, and (**F**) computed tomography (CT) angiography images after placement of a longer stent (*white curved arrows*) through the initial stent (*black curved arrows*) show complete obliteration of the recurrent pseudoaneurysm and preservation of the left vertebral artery (*black arrow*).

immediately after the procedure leading to recurrent motion of SCA against the first rib and recurrent trauma might have led to leaks at the proximal and distal ends. The length of the covered stent (3 cm in the initial procedure), which enabled a little over 1 cm margins from the neck of the lesion, could have been deficient in providing adequate seal at the margins. This case highlights the requirement of rigorous counseling of the patients against strenuous activity after discharge, and for routine follow-up to monitor the procedure site.

Treatment of recanalized SCA pseudoaneurysm can be done via surgical resection, percutaneous glue/thrombin injection, or by placement of a longer covered stent.[5,8,9] Due to the proximity of the VA from the proximal leakage site, preserving the VA may compromise the stability of the proximal landing zone. Xu et al have reported the application of covered stent in a repeatedly regrowing iatrogenic SCA pseudoaneurysm near the origin of the VA, in which coiling of covered stent was placed across the VA as well as SCA pseudoaneurysm and the VA stump was coiled to prevent retrograde filling of the lesion through deep and ascending cervical collaterals and potential embolic source.[9] It should be noted that closure of the VA should be preceded by an angiogram of the contralateral VA to document sufficient collateral filling into the ipsilateral posterior circulation and identification of the origin of the ASA from the contralateral VA.[9] In our patient, we could not identify ASA from contralateral VA angiogram and thus we did not occlude the left VA, which otherwise would have led to spinal cord infarct.

Conclusion

In conclusion, we describe a rare occurrence of type I endoleak of SCA following the placement of covered stent graft. Placement of a longer stent graft was successful in the treatment of type I endoleaks.

Consent

Written informed consent was obtained from all the patients included in this study.

Data, Materials, and/or Code Availability

Data are available with the corresponding author and can be shared on reasonable request.

Authors' Contributions

A.V., P.K.S., and I.K. performed the procedure and collected the radiological data. M.S.A. was responsible for data collection and compilation. R.K. was responsible for clinical and surgical management and clinical data. All the authors read and approved the final manuscript

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Conflict of Interest

None declared.

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