

Hybrid repair of a large pseudoaneurysm of the proximal right subclavian artery in a Marfan patient

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ABSTRACT

A pseudoaneurysm of the proximal right subclavian artery is rare and most commonly caused by penetrating or blunt trauma. We report a case of a Marfan patient with a large iatrogenic pseudoaneurysm of the right subclavian artery, induced by a puncture lesion during central venous catheter placement for an elective endovascular thoracic aortic procedure. The patient was successfully treated with a hybrid approach, which consisted of endovascular coiling and balloon occlusion of the adjacent vessels, followed by open surgical exploration and uneventful closure of the puncture hole with the use of bovine pericardium-reinforced sutures. (*J Vasc Surg Cases and Innovative Techniques* 2017;3:215-7.)

Placement of a central venous catheter (CVC) in the internal jugular vein is a common procedure during anesthesia. Unfortunately, an accidental puncture in the adjacent common carotid artery or even the subclavian artery (particularly in altered vascular anatomy) may occur, risking pseudoaneurysm formation if it is not adequately managed.¹ Because of the deep cervical or even intrathoracic location, open surgical repair may be complex and hazardous. Conversely, important adjacent side branches may preclude endovascular repair by a covered stent or local thrombin injection.²⁻⁴ We report a hybrid approach for treatment of a large pseudoaneurysm of the proximal right subclavian artery (RSA) caused by a puncture lesion during CVC placement for elective thoracic endovascular aortic repair. The patient consented to publication.

CASE REPORT

A 60-year-old Marfan patient with a history of extensive thoracic aortic surgery (ascending to proximal descending aorta and distal descending to aortic bifurcation replacement) presented with aneurysmal dilation of the descending thoracic aorta in the segment between both Dacron prostheses. This was treated successfully with a stent graft bridging these prostheses performed under general anesthesia (including CVC), allowing motor evoked potential monitoring. Recovery was uneventful, apart from marginal swelling on the lower right

side of the neck, considered a hematoma and left untreated. Two weeks later, the patient was readmitted with a progressive, large pulsating mass on the right side of the neck (*Fig. A*). Ultrasound examination revealed a pseudoaneurysm, without clear origin. Computed tomography angiography clearly showed the mass originating from the RSA, displacing the trachea and adjacent neck structures (*Fig. B*). Intra-arterial angiography showed an active blush site close to the ostium of the right vertebral artery (RVA; *Fig. C*), suggesting that the pseudoaneurysm was most likely caused by an unnoticed, inadvertent arterial puncture during CVC. Because of its location (deep in the neck), origin (proximal RSA, near the RVA), and intrinsic vasculopathy (Marfan syndrome), both open surgery and endovascular repair were deemed unfeasible. Alternatively, a hybrid approach was proposed, first securing the origin by endovascular means, followed by open surgical exploration and primary closure.

Arterial access for multiple catheters and wires was obtained by introducing one 16F sheath (DrySeal; W. L. Gore & Associates, Flagstaff, Ariz) in the distal RSA after surgical exposure through an infraclavicular incision. After angiography, the costocervical trunk and the right internal mammary and ascending cervical arteries were coiled (Complex Helical and Interlock coils [Boston Scientific, Marlborough, Mass]; Tornado [Cook Medical, Bloomington, Ind]). A 4F Fogarty over-the-wire occlusion balloon (Edwards Lifesciences, Irvine, Calif) was placed in the RVA, without alterations on the intraoperative electroencephalogram. The RSA segment proximal to the lesion was occluded with a Reliant balloon (Medtronic, Plymouth, Minn), and the segment distal to the lesion was occluded with a 5F over-the-wire Fogarty balloon (Edwards Lifesciences; *Fig. D*). Unfortunately, a Mo.Ma device (Medtronic) was not feasible because of the large RSA and no usable femoral access (due to surgically altered aortic arch anatomy) for obtaining proximal and distal control.

After exclusion of the segment containing the pseudoaneurysm neck from inflow and outflow, a longitudinal incision of the cervical skin was made across the swelling. Anterior to the sternocleidomastoid muscle, between the right common carotid artery and the internal jugular vein, the now nonpressurized aneurysm sac was exposed and opened. After removal of blood and clots, a 2-mm defect in the anterior wall of the

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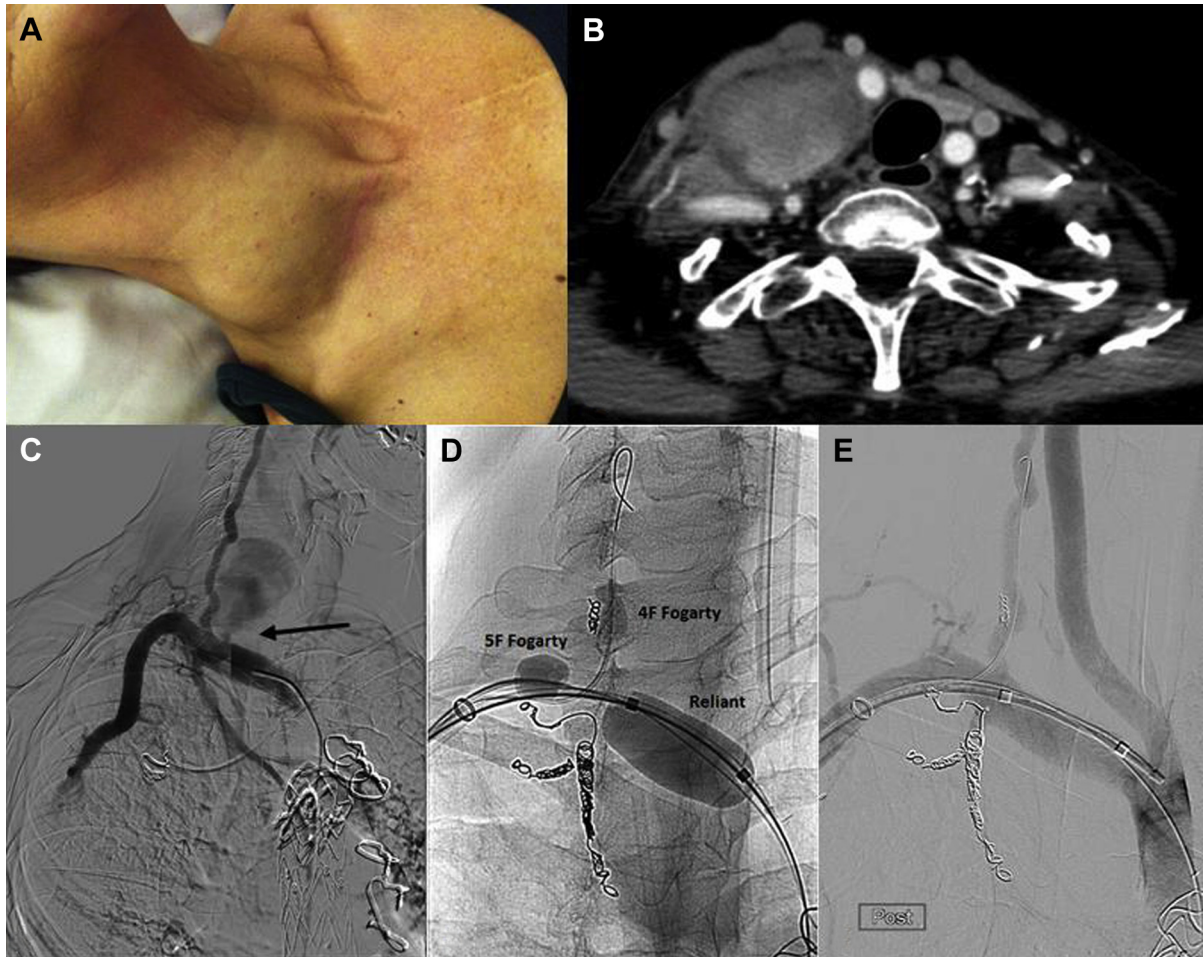


Fig. A. The patient presented with a pulsating mass of around 10 cm on the right side of the neck. **B.** The computed tomography angiography scan showed a large pseudoaneurysm, with an apparent connection with the right subclavian artery (RSA). **C.** Diagnostic angiography was performed from the groin to determine the origin of the pseudoaneurysm. A clear blush is visible next to the arrow. **D.** Angiogram made during the procedure, showing the coils in the right internal mammary artery and other side branches as well as the balloons inflated in the right vertebral artery (RVA; 4F Fogarty) and in the proximal (Reliant) and distal part (5F Fogarty) of the RSA. **E.** An angiogram showing the result after surgical repair of the puncture hole. The coil that projects over the RVA is in fact in the ascending cervical artery.

proximal RSA became clearly visible (near the costocervical trunk origin). The lesion was closed with a bovine pericardium-reinforced Prolene 5-0 suture. Next, the distal balloon was deflated, followed by the RVA balloon, flushing any potential air or debris toward the arm rather than toward the posterior intracranial circulation. Finally, the proximal subclavian balloon was deflated. No active bleeding was noted, and completion angiography showed complete exclusion of the pseudoaneurysm (Fig. E). The wounds were closed in layers, leaving a Redon drain in the neck to prevent pseudocyst formation. The patient was discharged home after 6 days. Computed tomography angiography after 3 months showed no complications.

DISCUSSION

With an incidence of around 1% to 2%, false aneurysms of the subclavian artery are slightly more common than its true aneurysms (0.13%).^{2,5,6} These pseudoaneurysms

are mainly caused by penetrating injuries or are iatrogenic in origin, mostly due to incorrect CVC insertion. Treatment is required to prevent rupture, embolization, or progressive tracheal compression.

Several techniques have been described to treat this pathologic process, including open surgical repair by either sternotomy or thoracotomy³ and ligation of the proximal part of the RSA with removal of the aneurysm and placement of an inlay prosthesis.⁷ However, exposure may be difficult, with increased risk of nerve damage and a potentially large amount of blood loss.⁸ Alternatively, endovascular repair has been described, with or without concomitant surgical bypass grafting.^{3,9,10} These covered stent grafts require precision placement to prevent occlusion of the RVA or right common carotid artery, risking cerebral malperfusion. A preplanned supra-aortic bypass graft may lower this risk but still risks local nerve damage

and stroke during temporary clamping of the carotids. Direct injection of thrombin is also described for the treatment of RSA pseudoaneurysms. Percutaneous thrombin injections have been shown to be an effective treatment option for femoral artery pseudoaneurysms.¹¹ Ultrasound guidance is necessary to safely use this technique for the subclavian artery. Leakage of thrombin into the systemic circulation could potentially cause thromboembolic events. Positioning the needle tip away from the native artery or simultaneous use of a balloon across the neck of the pseudoaneurysm may prevent this.⁴ In our patient, local thrombin injections would have resulted in a large thrombosed aneurysm, not relieving the mechanical burden. Full endovascular treatment was ruled out as an option because of the inevitability of covering adjacent vessels, risking a stroke or endoleak, and also because of the Marfan syndrome. Owing to the proximal location, it would not have been possible to safely obtain adequate surgical control of the bleeding site. Therefore, the bleeding site was controlled by use of coils and endovascular balloons in the RSA and the RVA. The test balloon occlusion did not alter the intraoperative electroencephalogram; otherwise, the blood pressure would have been temporarily increased. Although the coils resulted in definitive occlusion of some minor side branches, acute ischemia in the perfusion areas was not anticipated, and most probably collaterals will be formed in time, making the right internal mammary still available for coronary artery bypass grafting, albeit as a free or Y graft. No long-term data are available on the use of coils in patients with connective tissue disease; however, no complications are expected because of their low radial force.

This hybrid approach proved to be a safe alternative treatment option for iatrogenic pseudoaneurysm of the proximal subclavian artery.

CONCLUSIONS

We report a hybrid approach for safe and successful treatment of an iatrogenic proximal RSA pseudoaneurysm in

a Marfan patient. Treatment consisted of endovascular coiling and temporary balloon occlusion of adjacent vessels followed by open surgical repair.

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