

## Percutaneous axillary artery access for fenestrated and branched thoracoabdominal endovascular repair

An upper extremity access (UEA) is necessary for complex endovascular aortic repairs, especially for branched and fenestrated endografts to successfully catheterize target vessels with a caudal orientation.

The subclavian artery and axillary artery (AxA) have largely been described as UEA sites for different endovascular aortic and cardiac interventions with large sheaths, despite requiring surgical cutdown. At present, percutaneous vessel closure devices (VCDs) are employed during complex aortic repair to close the femoral access site, but no specific device has been designed to perform percutaneous closure of UEAs, thus allowing a totally percutaneous procedure.

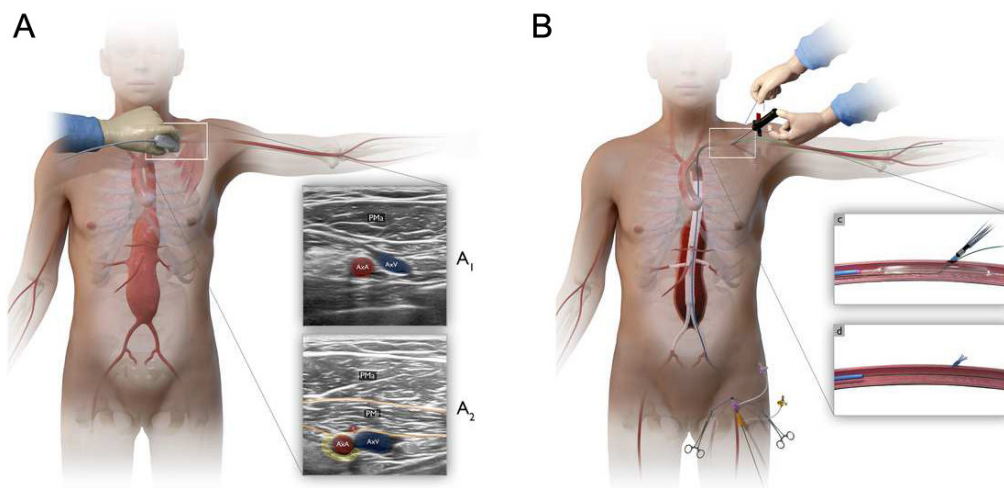


Fig. 1 A. The anterior wall of the axillary artery (AxA, highlighted in red) first segment (A1) is punctured through the pectoralis major muscle (PMa) under ultrasound guidance, avoiding passage through the axillary vein (AxV, highlighted in blue). The AxA is divided into three segments in relation to the pectoralis minor muscle (PMi) insertion. The first segment is between the lateral edge of the first rib and the medial border of the PMi. The second segment (A2) is behind the PMi with many collaterals (C) arising from the artery and surrounded by the lateral, posterior, and medial cord (LC, PC, and MC, highlighted in yellow). The third segment (A3) is between the lateral border of the PMi and the inferior border of the teres major muscle surrounded by the brachial plexus. The site of skin puncture for the A1 segment is below and lateral to the clavicle to limit the risk of pneumothorax but also to allow transverse ultrasound visualization and furthermore to achieve manual compression of the artery if needed. A small (1-cm) oblique incision is made on the skin at the puncture site to facilitate placement of vessel closure devices (VCDs) deployed at 1:30- and 10:30-o'clock positions.

B. From the femoral access, a properly sized (diameter equal to or 1 mm smaller than that of the axillary artery [AxA]) noncompliant balloon is inflated at the axillary puncture site to achieve hemostasis while the sheath is being removed. After removal of the sheath, the suture lines of the two ProGlide vessel closure devices (VCDs) are tied down while keeping the balloon inflated and leaving the axillary access guidewire in place (c). Proper hemostasis is checked clinically and by means of angiographic assessment, after endoclamping release, with and without the presence of the axillary access guidewire (d). In patients with inadequate hemostasis, an additional ProGlide can be used as long as the AxA wire is still in place. After removal of the wire, minor vessel complications (no flow-limiting lesions or minor bleeding) can be treated conservatively by manual compression or reinflation of the balloon, then re-examined after 15 minutes and after protamine infusion. In patients in whom closure is not deemed successful by the percutaneous technique, two bailout options might be planned: deployment of a covered self-expanding stent from the femoral access or reinflation of the balloon to achieve hemostasis and then surgical repair of the AxA.

In our practice, a minimum size of 6 mm was deemed appropriate for a percutaneous AxA closure and to allow nonocclusive passage of large sheaths. Ultrasound guidance allows the user to safely puncture the artery identifying the correct spot to avoid accessing of the AxA through the vein, nerves, or pectoralis minor muscle. Furthermore, it helps identify postoperative complications, such as flow limiting lesions, as well as pseudoaneurysms or active bleeding.

The AxA first segment is punctured, and two VCDs are deployed according to the device's instructions for use. A femoral access is maintained during the procedure as a safety net to endoclamp the artery during the closure to avoid any bleeding and to perform any bail-out technique if needed. After the axillary closure step, an angiographic check is performed and if no other procedures have to be performed, the femoral access is completely closed.

Primary technical success of pAxA closure was 100%; in one case, an adjunctive Perclose ProGlide device was used to achieve complete closure, but no secondary procedures were required. Completion angiography performed at the end of the closure did not reveal any flow-limiting dissection or stenosis, and the brachial and radial pulses were palpable. No upper limb ischemia was noticed at the end of the procedure. The completion and postoperative day 1 ultrasound assessment did not reveal any complications. In one case, we observed that the puncture site had been made through the pectoralis minor muscle; and in two cases, a hematoma <15 mm in thickness was noticed surrounding the AxA, without clinically relevant consequences. All patients were discharged without neurologic deficits related to the AxA puncture site. No late complications were observed at the site of UEA percutaneous repair.

Interestingly, we analyzed the AxA anatomy and we found out that the median diameters of the AxA in the first and third segments were statistically different ( $P < .001$ ) with a median difference of 1.5 mm (1.0-2.0 mm). Moreover, the distance between the end of the first segment of the AxA and its origin from the arch was statistically different with a median difference of 36 mm (17-50 mm). Positive linear correlation was found between the height of the patients and the diameter of the AxA.

This transaxillary percutaneous approach offers different advantages. The increased working length achieved with this access allows the operator to work from the right side of the patient, which has been proved to decrease the operator's radiation dose exposure. Performing a total percutaneous procedure, we are able to use only local anesthesia. This allows us to perform an early neuromonitoring of the patient at the end of the procedure, it shortens the operative time and reduces the need for postoperative transfusions.

In our experience, the AxA is a suitable site for large-sheath catheterization in terms of both diameter and wall quality and that a percutaneous closure with off-label use of currently available VCDs is safe and feasible if performed by experienced percutaneous operators.

***Luca Bertoglio, Alessandro Grandi, Roberto Chiesa***

*Division of Vascular Surgery, "Vita – Salute" University, Scientific Institute H. San Raffaele, Milan, Italy*

## **Publication**

[Percutaneous axillary artery access for fenestrated and branched thoracoabdominal endovascular repair.](#)

Bertoglio L, Mascia D, Cambiagli T, Kahlberg A, Melissano G, Chiesa R

*J Vasc Surg. 2018 Jul*