PERCUTANEOUS AXILLARY ARTERY ACCESS – VIABLE OPTION, OR IS IT THE PITS?

M. Nassar, KT. Tan, A. Jaberi, S. Kalra, S. Mafeld
University Health Network, Toronto, Canada

PURPOSE:

Percutaneous axillary artery access (PercAx) is an alternative arterial access site for endovascular procedures. However, it is associated with higher complication rates compared with femoral access.

Herein we aim to:

- ✓ Describe the planning principles we utilize for PercAx
- ✓ Explain our patient selection for PercAx
- ✓ Describe our approach to hemostasis for PercAx
- ✓ Review our approach to potential complications of PercAx

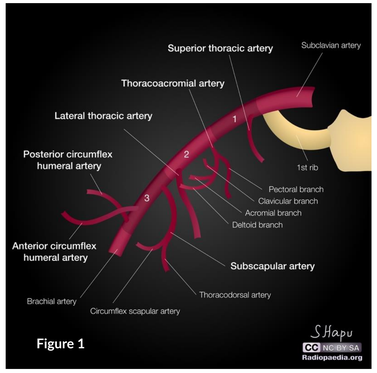

Figure 1

The axillary artery has three parts (Figure 1)[1] and originates at the lateral margin of the first rib as a continuation of the subclavian artery and extends to the inferior border of the Teres major tendon. The axillary artery is divided into three parts: the first part is medial to the pectoralis minor muscle, the second is posterior to the pectoralis muscle and the third part is lateral to the pectoralis minor muscle[2]. Each location has potential advantages and disadvantages; however the first segment has been shown to be larger in diameter comparted with the third segment which may be important for circumstances where larger Fr sheath sizes are needed[3]. A pre-procedure CT angiogram is helpful for axillary access planning for evaluation of atherosclerosis that could pre-dispose to closure device failure. Practically speaking, on table ultrasound is helpful for selecting an optimal site for access. Typically the authors start with ultrasound evaluation of the axillary artery in the delto-pectoral groove (Figure 2), as this is often the site where the artery is most superficial and can be accessed with the arm in the abducted or tucked in the side. Furthermore, although not traditionally thought to be compressible, some degree of compression of the axillary artery can be placed in this location and may be a useful adjunct to a closure device in some circumstances (Figure 2).

WARNING | The techniques described herein are off label

METHODS:

A retrospective assessment of our institution's recent experience with PercAx was conducted. Techniques for puncture, and approaches to hemostasis were studied and select cases were reviewed to delineate our successes and highlight our approach to management of complications.

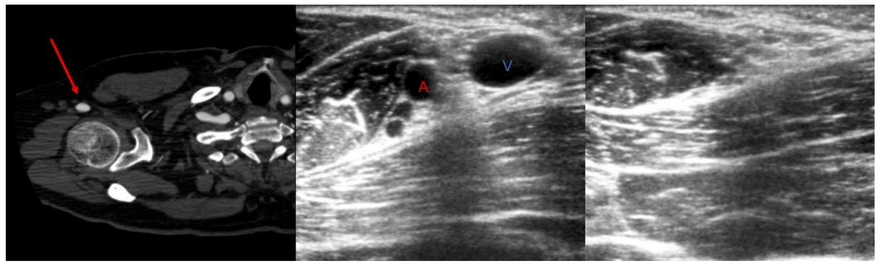

Figure 2: CTA of axillary artery in the delto-pectoral groove. US images of the axillary artery in the delto-pectoral groove without compression and with compression

CONTRAINDICATION CONSIDERATIONS TO PERCAX:

- ➢ Axillary artery < 5mm
- ➢ Previous surgery or pacemaker
- ➢ Severe atherosclerotic disease
- ➢ Increased BMI

Main advantages of PercAx are favourable angles for endovascular visceral interventions, and accommodation of large bore devices in the setting of severe or occlusive iliofemoral atherosclerotic disease. At our institution, we primarily utilize PercAx for large bore cardiac devices, fenestrated or branched endovascular aneurysm repair (EVAR), and visceral interventions.

TECHNICAL STEPS:

The following are our steps for PercAx:

1. Arm positioned in approximately 90 degrees of abduction. Ultrasound evaluation to ensure axillary artery is patent, and > 5mm
2. Under ultrasound visualization, access axillary artery where it is most superficial, often in the delto-pectoral groove, using 21-gauge micropuncture set
3. In the event of smaller access sheath size <8Fr, a Pre-close technique is not typically used and hemostasis achieved with Angio-Seal™ (Terumo, Tokyo, Japan). For larger >8Fr sheath sizes a Pre-Close technique is most often used:
   a. Dissect the subcutaneous tissues using a 6-8F dilator to create a clear path for pre-close technique using two Perclose Proglide™ (Abbott Vascular, Redwood City, California) VCDs (Figure 3)
   b. Place a 7-10F sheath and exchange for a larger and longer sheath as required

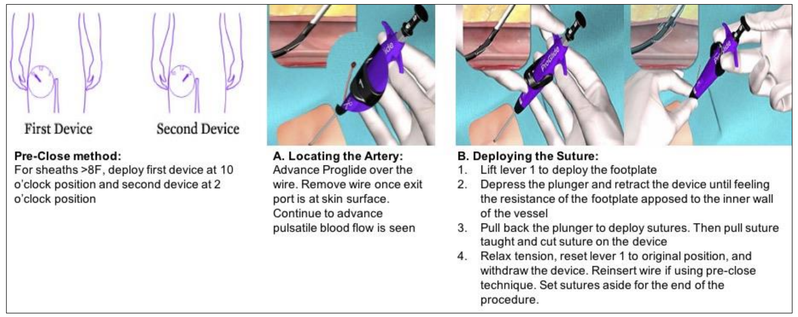

Figure 3 (Courtesy of Abbott Vascular)

Suture-based (Perclose Proglide™) or collagen-plug mediated closure (Angio-Seal™) of the axillary arteriotomy site is crucial as manual compression is often insufficient for hemostasis. Rates of successful hemostasis with vascular closure devices (VCD) is reported as 82.5-100%[4,5]. Schäfer et al[6] reported 11% of their patients undergoing PercAx for Transcatheter aortic valve implantation (TAVI) required stent grafts and Branzan et al[4] reported adjunctive endovascular techniques for hemostasis in 17.5%.

The following are our steps for closure of PercAx > 8F (For access < 8F we preferentially deploy an Angio-Seal™ VCD):

1. An 8-French 90 cm-long sheath is advanced from common femoral artery access into the subclavian artery. This is accomplished by catheterization of the subclavian artery, or over a through-and-through wire after snaring the wire in the descending aorta, usually a stiff 0.018" wire. This wire serves as a safety wire.
2. An 8-10 mm balloon catheter is then advanced into the proximal subclavian artery or brachial artery over a second wire from the transfemoral sheath. As described in the Hamburg Sankt George approach[7], this allows for a "dry" field during VCD deployment and immediate endovascular hemostasis in the event of VCD failure to allow for surgical cutdown or endovascular stent deployment (Figure 4).
3. Transaxillary sheath is then removed and the Perclose sutures are tightened
   - **TIP:** In the event of non-pulsatile leakage with the wire in-situ after initial tightening of the sutures, we will test for hemostasis with inner dilator of 8F sheath. If there is decreased flow, we will deploy an adjunctive 8F Angio-Seal™
4. An angiogram is performed via the transfemoral sheath to assess hemostasis

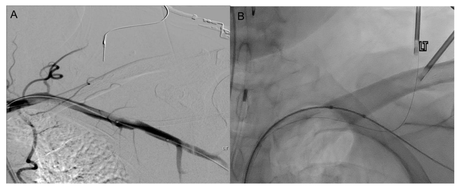

Figure 4: A) 9F PercAx sheath with balloon positioned near PercAx site in preparation for hemostasis. **B)** Balloon-assisted tightening of Perclose sutures

Complications of PercAx include persistent bleeding resulting in hematoma or pseudoaneurysm, local nerve injury, stenosis or occlusion, and dissection.

TOP TIP | In the event of VCD failure with ongoing active bleeding, we most commonly deploy a self-expanding covered stent (VIABAHN, Gore & Associates, Flagstaff, Arizona, USA) via the transfemoral sheath (Figure 4). VIABAHNs up to 8mm in diameter can be accommodated through a 7Fr sheath on 0.018" platform while VIABAHNs 9-13mm on the 0.035" platform require larger caliber sheaths (9-12Fr). In our experience an 8mm VIABAHN is often a sufficient size for hemostasis in the event of continued extravasation.

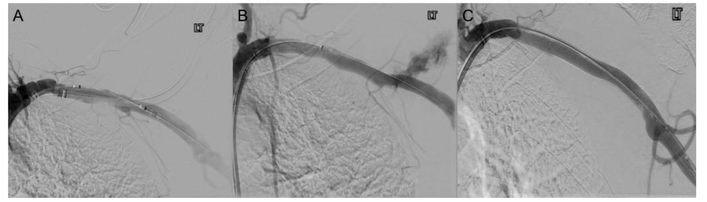

Figure 5: A) Positioning of a transfemoral 8F sheath and balloon catheter in preparation for removal of transaxillary sheath. **B)** Active bleeding from axillary arteriotomy site following removal of 12F sheath and deployment of two Perclose and Angio-Seal™ **C)** Successful endovascular hemostasis with overlapping 8 mm VIABAHN stents

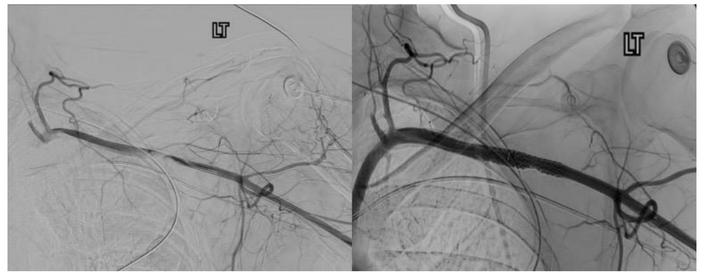

Figure 6: Severe stenosis of left axillary artery felt to be related to Perclose VCD following decannulation of an Impella device. Treated with 8 mm balloon-expandable stent via a brachial approach

Figure 7: Active extravasation felt to related to double wall puncture and occlusion related to VCD following PercAx for visceral artery stenting. Treated with a 7 mm VIABAHN stent via a transfemoral approach

TOP TIP | For cases in which transfemoral access is not pre-established, radial or brachial approach can be used for further endovascular management of complications (Figure 6). If the brachial can accommodate a 7Fr sheath, deployment of a VIABAHN may be an option. In the event of iliac occlusive disease and unsuitable brachial access, radial access can be obtained allowing for deployment of an occlusion balloon to allow for attempted tamponade or as an interim measure before transfer for surgical repair.

RESULTS:

Since 2018, we have successfully achieved hemostasis for PercAx with sheaths ranging from 5-18F in 24 of 30 patients. Of the 6 patients requiring further intervention for hemostasis, 3 were successfully managed endovascularly and 3 required surgical cut-down. For access >8F, hemostasis was best achieved using dual hemostatic techniques. Complications included, pseudoaneurysm formation, extravasation and acute vessel occlusion.

CONCLUSION:

PercAx is a viable option for both small and large bore access when femoral access is not suitable either due to iliac occlusive disease or results in an unfavourable angle to the target vessel. Both suture mediated with or without adjunctive collagen plug or dual collagen plug techniques can be safe and efficacious for hemostasis.

REFERENCES

- 1. Hapugoda, S. Axillary artery (illustrations) | Radiology Case | Radiopaedia.org. Radiopaedia https://images.radiopaedia.org/cases/axillary-artery-illustrations?lang=us.
- 2. Vl. The Arteries. 4b. The Axilla. Gray, Henry. 1918. Anatomy of the Human Body. https://www.bartleby.com/107/149.html.
- 3. Tayal, R. et al. CT Angiography Analysis of Axillary Artery Diameter versus Common Femoral Artery Diameter: Implications for Axillary Approach for Transcatheter Aortic Valve Replacement in Patients with Hostile Aortoiliac Segment and Advanced Lung Disease. Int J Vasc Med 2016, 3610705 (2016).
- 4. Branzan, D., Steiner, S., Haensig, M., Scheinert, D. & Schmidt, A. Percutaneous Axillary Artery Access for Endovascular Treatment of Complex Thoraco-abdominal Aortic Aneurysms. European Journal of Vascular and Endovascular Surgery 58, 344–349 (2019).
- 5. Bertoglio, L. et al. Percutaneous axillary artery access for fenestrated and branched thoracoabdominal endovascular repair. Journal of Vascular Surgery 68, 12–23 (2018).
- 6. Schäfer, U. et al. Safety and efficacy of the percutaneous transaxillary access for transcatheter aortic valve implantation using various transcatheter heart valves in 100 consecutive patients. International Journal of Cardiology 232, 247–254 (2017).
- 7. Schäfer, U. et al. Direct Percutaneous Access Technique for Transaxillary Transcatheter Aortic Valve Implantation: "The Hamburg Sankt Georg Approach". JACC: Cardiovascular Interventions 5, 477–486 (2012).

UNIVERSITY OF TORONTO

TORONTO JDMI
University of Toronto
Sinai Health System
University Health Network
Women's College Hospital

UHN Toronto General Toronto Western Princess Margaret Toronto Rehab Michener Institute