

Vascular Access Management in Percutaneous Transcatheter Aortic Valve Replacement (TAVR) Procedure

PRIMARY LARGE BORE ACCESS:

Transfemoral Access (TF)

Pre procedure	<ul style="list-style-type: none">• Selection of suitable large sheath femoral access site should be based on detailed review of TAVR protocol CT. Compared to angiography, contrast CT assessment of iliofemoral system provides more predictive information for vascular complications post TAVR¹• If available, previous angiograms can be reviewed for Ilio-femoral anatomy including presence of atherosclerosis, position of inferior epigastric artery and CFA bifurcation into SFA and Profunda Femoris in relation to femoral head
Intra procedure	<ul style="list-style-type: none">• If anatomy is suitable, TF access is preferred over other access sites due to lower invasiveness, ease of patient recovery, can be performed without general anesthesia and requires shorter hospital stay²• Pre-procedure Pedal and femoral pulse in each limb should be checked and marked• Fluoroscopy in AP projection for identification of the superior and inferior border of the femoral head• Consider Ultrasound guided access in all cases since studies show significantly reduced risk of vascular complications compared to fluoroscopy alone while increasing first pass success rate and decreasing accidental venipunctures³, especially in obese patients or those with distorted anatomy. Fluoroscopy roadmap can be use in hostile groin access as well.• Micro puncture (21g) needle access technique should be used in all cases as it is associated with reduced vascular complications compared with 18g needle⁴• Initial placement of 4 Fr sheath in the common femoral artery followed by femoral angiography in 30-degree ipsilateral oblique for accurate evaluation of the bifurcation. If arteriotomy position is too high ie. above inferior epigastric or too low ie. below the bifurcation,

	<p>sheath may be removed, and artery re-accessed after appropriate manual pressure for hemostasis</p> <ul style="list-style-type: none"> • Using two Perclose ProGlide devices for ‘preclose technique’ offers a simple, highly effective and safe method for hemostasis in TF-TAVR^{5,6} (see addendum for details of sheath removal technique) • Single Perclose ProGlide may have equivalent, acceptable rates of technical success and procedural complications compared with double Perclose technique⁷, with higher rates of bailout deployment of second vascular closure device for successful hemostasis (see addendum for description of technique) • Large sheath should be advanced over a stiff 0.035-inch guidewire, under fluoroscopy and sutured in place to skin once in position. The distal tip of the sheath should be placed proximal to the abdominal aortic bifurcation to prevent potential interaction of the valve with iliac artery calcification as it exits the sheath tip • Protamine can be administered for reversal of anticoagulation prior to large bore sheath removal • Consider Balloon Occlusion Technique (BOT) in selected cases with unfavorable anatomy (calcified, small vessel, etc) to decreased major vascular and bleeding complications⁸ This can be done from radial or contra femoral access. (see addendum for description of technique) • Manta vascular closure device is feasible with an acceptable rate of access-site-related complications and no major vascular complications based on observational studies⁹ • If secondary access is contralateral CFA, vascular closure device of choice or manual pressure can be held for hemostasis depending on degree of atherosclerosis/calcification and location of arteriotomy. Consider adopting radial access or distal radial access as first option for secondary arterial access.
<p>Post procedure</p>	<ul style="list-style-type: none"> • Consider admission to step down unit post TAVR • Assessment of peripheral vascular status (pulses, capillary refill, edema) • Nursing staff to monitor sheath sites (arterial and/or venous) by assessing for ecchymosis, bleeding, or hematoma formation post procedural; every 15minutes x 4; then every 30 minutes x 2; then hourly x 2 until stable; then every 4 hours x 24 hours • Consider 2 to 6-hour bed rest (Individualize duration based on factors such as hemostasis technique, success of hemostasis etc) • Notification of provider immediately of changes such as: <ul style="list-style-type: none"> ○ External bleeding at the site ○ Neurovascular complications (sensory or motor changes in the affected extremity)



	<ul style="list-style-type: none"> ○ Internal bleeding (e.g., localized hematoma or retroperitoneal bleed)
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Transcaval Access(TC)

Pre procedure	<ul style="list-style-type: none"> • Transcaval access is safe and feasible for TAVR in patients with unsuitable TF arterial access¹⁰ • Contrast enhanced CT is analyzed to identify a calcium-free target in the abdominal aorta near the IVC; without interposed structures such as bowel, safely away from renal artery, renal vein, and the aorto-iliac bifurcation in-case covered stent is required and sufficiently close to the femoral vein puncture site so that 35–40 cm introducer sheath will reach across into the aorta • CT measurements are obtained for sizing of aortic balloon for Tamponade and covered stent in case bailout for significant fistulous flow or bleeding is required
Intra procedure	<ul style="list-style-type: none"> • Use fluoroscopy guidance and consider ultrasound guidance for CFV access • Micro puncture system can be used for access • TC-TAVR is always performed via right CFV • Angiography via 4Fr sheath is performed before upsizing to 8Fr. Sheath • Consider double Perclose technique for CFV access site • Full heparin dose for ACT>300 before achieving transcaval access • Figure of eight and manual pressure are also acceptable for closure after sheath removal • CFA with best lumen profile for bailout equipment is chosen for secondary access which is obtained with standard technique as described above • Secondary arterial access can be closed with VCD of choice or manual pressure depending on anatomy • Reverse protamine before caval access is closed. • Have all the closure equipment including Ductal Occluder (eg. ADO1) and bailout balloon tamponade and cover stent in the room before closure is initiated
Post procedure	<ul style="list-style-type: none"> • Admit to ICU step down unit post TAVR • Assessment of peripheral vascular status (pulses, capillary refill, edema) • Nursing staff to monitor sheath sites (arterial and venous) by assessing for ecchymosis, bleeding, or hematoma formation post



	<p>procedural; every 15minutes x 4; then every 30 minutes x 2; then hourly x 2 until stable; then every 4 hours x 24 hours</p> <ul style="list-style-type: none"> • Consider 6-hour bed rest post procedure • Notification of provider immediately of changes such as: <ul style="list-style-type: none"> ○ External bleeding at the site ○ Neurovascular complications (sensory or motor changes in the affected extremity) ○ Internal bleeding (e.g., localized hematoma or retroperitoneal bleed). • Allow permissive anemia • If hemoglobin is >6-7 g/dl, transfuse hemodynamically significant bleeding only • Treat hypotension with volume and low dose vasopressors • Routine CTA abdomen should be obtained prior to discharge only if there is a concern for significant bleeding causing hemodynamic compromise or need for transfusion.
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Trans-Axillary Access (TAX)

Pre procedure	<ul style="list-style-type: none"> • Trans-Axillary access is safe alternate route when TF access is not feasible¹¹ • Contrast enhanced CT for evaluation of anatomy of right and left subclavian/axillary artery should be performed. Important considerations are anatomic variations, calcification, atherosclerosis, size, LIMA utilized as bypass conduit, morbid obesity, and tortuosity^{12,13} • Left Axillary is preferred, though right Axillary use has also been described • Procedure can be performed under General Anesthesia or Conscious sedation depending on operator experience and patient tolerance.
Intra procedure	<ul style="list-style-type: none"> • Advance 0.014- inch guide wire via secondary ipsilateral radial or femoral access into the descending aorta or ipsilateral brachial artery if advancing from femoral artery. Retain this wire to use as fluoroscopic guide for Axillary access and for bailout balloon or stent placement • Ultrasound and fluoroscopy guided arterial puncture with Ultrasound confirmation of needle tenting onto arterial wall and confirmation of needle tip in Axillary artery¹⁴. Consider use of Fluoroscopic roadmap.



	<ul style="list-style-type: none"> • Micro puncture system should be utilized for arterial access lateral to thoraco-acromial vessel and medial to subscapular and circumflex humeral artery. • Needle should be introduced at <45-degree angle from skin • Insert 0.035-inch guidewire and double Perclose the vessel. Perclose correlation with access should be done under fluoroscopy given differences of media of axillary artery (prone to dissection if excessive force is applied). • Access and closure should be done with dry technique to avoid blood extravasation during wire and sheath exchanges. Balloon should be at least 1:1 to vessel diameter inflated as low atmospheres. • Perform TAVR as per specific instructions for individual valves • For closure, advance appropriately sized peripheral balloon via femoral or radial access to Axillary artery and inflate to low pressure (1-4 atm) for dry closure • Have adequate covered stent in the room ideally self-expandable or surgical backup if not familiarized. • Protamine is administered and Perclose knots are tied down after balloon is pushed across the arteriotomy to confirm non capture of wire by sutures followed by wire removal once hemostasis is obtained • Completion angiogram is performed • In case of continued bleeding, manual pressure can be applied against 2nd rib for hemostasis, balloon tamponade can be performed, or peripheral stent can be placed via secondary radial or femoral access¹³
Post procedure	<ul style="list-style-type: none"> • Consider admission to step down unit post TAVR • Assessment of peripheral vascular status (pulses, capillary refill, edema) • Nursing staff to monitor sheath sites (arterial and/or venous) by assessing for ecchymosis, bleeding, or hematoma formation post procedural; every 15minutes x 4; then every 30 minutes x 2; then hourly x 2 until stable; then every 4 hours x 24 hours • Consider 2 to 6-hour bed rest (Individualize duration based on factors such as hemostasis technique, success of hemostasis etc) • Notification of provider immediately of changes such as: • External bleeding at the site • Neurovascular complications (sensory or motor changes in the affected extremity) • Internal bleeding (e.g., localized hematoma)



	<ul style="list-style-type: none"> ○ Obtain pre discharge or first follow up Doppler US if covered stent is placed.
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SECONDARY NON-LARGE BORE ACCESS:

Trans-Radial Access (TRA)

Pre procedure	<ul style="list-style-type: none"> • Allen’s/Barbeau testing may be considered although there is growing evidence that TRA may be used with abnormal Allen’s/Barbeau tests • If available, prior imaging should be reviewed for anatomic considerations that may influence decisions especially evaluation of right Radial artery for cerebral embolic protection device use. Consider left RA for secondary arterial access for angiography and balloon occlusion technique for facilitating hemostasis¹⁵ • Consider left distal radial depending on operator experience. Once inserted, confirm on Fluoroscopy before sheath insertion in-case wire is looped in the palmar arch • Consider US guidance for access. • If radial artery is patent but small, consider ulnar artery as secondary access.
Intra procedure	<ul style="list-style-type: none"> • Cautious use of Spasmolytic in severe aortic stenosis. Consider Intra-arterial 200 mcg of Nicardipine after obtaining access in case of stable hemodynamics • May use Ultrasound guided access if radial artery is not readily palpable. Ultrasound may also be considered for routine use • Single (modified Seldinger) or double wall (true) techniques can be utilized for access
Post procedure	<ul style="list-style-type: none"> • Patent hemostasis or minimum pressure in the wrist band are acceptable techniques for hemostasis¹⁶

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DISCLAIMER

BMC2 Best Practice Protocols are based on consortium-wide consensus at the time of publication. Protocols will be updated regularly, and should not be considered formal guidance, and do not replace the professional opinion of the treating physician.



ADDENDUM

- Consider the following steps for double Perclose technique:
Removal of sheath over an 0.035-inch guidewire with two operators involved in this process. One to compress the femoral artery while removing the sheath (leaving the guidewire in the aorta), and the other to manage the preclose knots. If hemostasis is achieved with knots pushed to vessel wall, wire may be removed and iliofemoral DSA angiography is performed with Pigtail or another catheter placed via secondary access. If there are no complications, knots are tightened. If there is persistent significant bleeding, Angioseal VCD can be deployed over the wire¹⁷
- For single Perclose technique, steps are the same as double Perclose technique except there is higher incidence of second VCD for continued bleeding which is performed over the 0.035-inch wire still in place through the arteriotomy.
- Consider the following steps for Crossover Balloon Occlusion Technique (CBOT) :
After preclose of large bore access site, place a 0.014-inch wire from contralateral femoral or ipsilateral radial access 'up and over' to ipsilateral SFA taking care not to trap the wire in the Perclose sutures at the beginning of the procedure and leave the wire in place for the remaining procedure. At the time of closure, withdraw the TAVR delivery sheath to ipsilateral external iliac artery and place a crossover sheath from the contralateral femoral or ipsilateral radial access to ipsilateral External iliac artery and insert an OTW balloon sized to ipsilateral EIA. Use oversized or 1/1 balloon to tamponade. Inflate the balloon to low pressure and remove the TAVR delivery sheath with dilator in place especially if sheath tip is visually split and advance the Perclose knots to the vessel surface. Now deflate and advance the balloon to the arteriotomy site. If the 0.014 inch wire is trapped by the Perclose sutures, retract the wire and re-cross the arteriotomy site free of the sutures and again advance the balloon to the CFA. Now, tighten the knots and inflate the balloon to nominal pressure while holding moderate manual pressure at the access site for 1-2 minutes. Withdraw the balloon and perform angiogram via the crossover sheath with the wire still across the arteriotomy and if no issues are identified, consider repeating angiography with the wire withdrawn. Lower extremity peripheral pulses are checked before radial sheath is removed, incase further angiography or PVI is required to either femoral access site via radial to peripheral approach. Consider 0.035 compatible balloon, so they can be delivered over 0.014 wire and at the same time use it for angiographic purposes,
Transradial balloon occlusion technique is a slight modification of the above technique and can be utilized for achieving hemostasis using long shaft (140cm, 200 cm) balloons preferably from left but also from right radial artery as secondary access¹⁸.
Determination of required balloon shaft length that will reach the point of interest can be made by delivering a long 125 cm MP catheter. If it reaches the EIA or CFA, most 0.035 compatible balloons will reach given their shaft is 135cm. If a covered stent is needed ,



Transradial balloon can be kept inflated until contralateral or ipsilateral SFA access is obtain to deliver covered stent.

- Consider the following steps for Transcaval access technique:
Meticulous technique for transcaval access includes using coaxial crossing system (Piggyback catheter, 0.014-inch guidewire eg. Confienza Pro 12, 0.035-inch 90cm microcatheter eg. Navicross, electrocautery to penetrate the aortic wall, Single loop snare in the aorta, and careful advancement of the sheath across cavo-aortic tract. Closure involves using an Amplatz closure device deployed at the aortic side of the aortocaval tract using a deflectable sheath. Aortography is performed and pattern of fistulous flow or extravasation is noted. More than mild extravasation or hemodynamic instability is treated with Low pressure occlusive balloon inflation or oversized, underinflated angioplasty balloon tamponade in the aorta to facilitate hemostasis. Covered stent in the aorta can be used for persistent aortic extravasation especially heavier bleeding. Self-expanding covered stents with outer surface graft material are preferable. Covered stent should be oversize by at least 10-20%.



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