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C3 - Core Curriculum in Cardiology

How to tackle complications in radial procedures: Tip and tricks

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ABSTRACT

Transradial interventions (TRI) are becoming increasingly popular because of accumulating recent evidence suggesting improved survival and reduced morbidity. Complications, though rare, do occur, especially for operators on their learning curve. The complications are best prevented by utilization of proper technique. Forearm hematoma are preventable and easy to treat, but a delay in detecting and managing them can lead to disastrous consequences compartment syndrome being the most dreaded one. This review deals with tips and tricks to prevent as also treat the common and rare complications.

1. Introduction

Transradial access for percutaneous coronary interventions (PCI) has gained popularity over the last few decades due to its enhanced safety, reduced morbidity, mortality and overall reduced procedural costs.[1,2]

Complication rates are low with transradial procedures and a majority of them can be prevented with appropriate training, techniques and hardware selection.[2]

Adequate experience with transradial procedures has been shown to correlate well with reduced vascular complications and improved procedural success.[3,4]

Pre-procedure[5] planning, which involves adequate assessment of forearm arteries by color doppler imaging; though not mandatory, helps quantify vessel diameters and/or forearm vascular anomalies, aiding in the selection of adequate (largest, straightest, least anomalous) vascular access (radial or ulnar), access side (right or left) and catheter dimension (5F, 6F, 7F).

Planning helps reduce radial artery spasm, minimizes sheath: artery mismatch, radial artery occlusions and prevent vascular trauma/extravasation while maneuvering through complicated cubital loops or anomalies. In appropriate case an alternate access may be chosen which may be ipsilateral ulnar or contralateral radial artery.

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The complications are listed in Table 1. The commonest complication is radial artery spasm and is discussed first, following which forearm hematomas and finally rarer miscellaneous complications are presented.

2. Radial artery spasm

Radial artery spasm has been shown to be responsible for upto 38% of all transradial procedure failures.[6] Once severe it can make catheter manipulations difficult, causing undue procedural delays & discomfort to the patients leading to cross-overs and procedural failures, hence is better prevented than treated. It can potentially be avoided if the sheath diameter: internal artery diameter ratio is kept <1:1,[7] thus emphasis on adequate catheter selection is essential.[5]

Patients that have a short stature, small access artery diameters, low body mass indices, small wrist circumferences should be identified preoperatively as carrying a higher risk of radial artery spasm, puncture failure, and potential cross overs.[8]

Even though the adequacy (size) of a radial artery can be appreciated by experienced operators (through simple palpation), the use of pre-procedure ultrasound of arm arteries (PPUAA) can be crucial for assessing access artery diameters and associated anomalies. Selecting the straightest and biggest artery can help avoid severe (grade 3 to 4 per Chugh's grading of radial artery spasm) access spasm and procedure failure.[5]

2.1. *Spasmolytic agents*

Spasmolytic "cocktails" used judiciously after sheath insertion, with each catheter exchange and prior to sheath removal is of paramount importance in preventing spasms.

Spasmolytics commonly used include 1–5 mg of intra-arterial injection of Verapamil or Diltiazem. The use of nitroglycerine (100 mcg) alone vs verapamil (1.25 mg) with nitroglycerine showed a similar reduction in incidence of radial artery spasm when compared to placebo.[9]

Similarly, there was no significant difference between the use of Intravenous Nitroglycerin (100 mcg) or Intravenous Nitroprusside (100 mcg) alone or in combination.[10]

Additionally, Nicorandil and Verapamil were found to be equally effective[11]; unlike phentolamine which was inferior in its action.

Further, if clinically severe spasm is encountered (grade 3–4), the use analgesia and sedation, apart from spasmolytic agents must be initiated (Table 2).

Table 1 – List of common access site complications.

Complications of Transradial Interventions
Radial Artery Spasm
Radial Artery Occlusion
Access Site Hematoma
Forearm Hematoma
Miscellaneous Complications

2.2. *Hardware selection*

The use of shorter, hydrophilic coated sheaths, appropriately sized pre-operatively (Table 3), are also beneficial in preventing arterial spasms.[12] Again, minimizing catheter exchanges is useful in reducing the risk of development of significant spasm which can be achieved by anticipating and choosing an appropriate catheter. For example if a patient is short, usually the smallest curve should be taken; but it helps to know the aortic root diameter, which if dilated usually modifies the choice to a bigger curve. Again, in an unfolded aorta, right sided aortic arch or tortuous subclavians, a smaller catheter curve often fits better, for the left coronary artery.

2.3. *What can you do when access artery spasm develops?*

1. Sedation and analgesia: we commonly use small doses of injectable Midazolam in alicots of 0.5 mg, and Fentanyl in small doses of 25 micrograms. Caution is advised for those with respiratory disorders and obstructive sleep apnea.
2. With grade 3 or significant spasm, it's best to pause for a minute or two before proceeding.
3. Intrarterial Diltiazem or Verapamil in doses of 3–5 mg, sometimes combined with 50–100 μg of injectable nitroglycerine intra-arterially is usually enough to relieve significant spasm.
4. With development of grade 3 spasm, it is usually best to downsize catheters to a lower French (F) size, which for diagnostic angiogram may mean downsizing to 4F catheters.
5. It is important to use exchange length (260 cm) 0.035″ or 0.038″ Teflon or Terumo glide wire for exchange of catheters, because with the shorter 180 cm guide wire, the wire often comes back too far into the segment of spasm in the access artery making re-advancement of the guidewire difficult.

3. Radial artery occlusion

The incidence[7,12] of Radial artery occlusion (RAO) has been reported in recent literature as between 3 and 10% of all transradial interventions (TRI).

The utilization of appropriate anticoagulation, proper sheath selection,[7] and non-occlusive/patent hemostasis can