Radial procedure for coronary angio-PCI Complications

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Disclosures

• None to declare
Introduction

- Transradial interventions (TRI) are becoming increasingly popular because of accumulating recent evidence suggesting improved survival and reduced morbidity-mortality (RIVAL, RIFLE-STEACS, STEMI-RADIAL & MATRIX)

- Complications, though rare, do occur, especially for operators on their learning curve

- The complications are best prevented by utilization of proper technique
Here are the things to worry about…

<table>
<thead>
<tr>
<th>Common complications</th>
<th>Rare complications</th>
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</thead>
<tbody>
<tr>
<td>✓ • Radial artery spasm</td>
<td>✓ • Arterial perforation/dissection</td>
</tr>
<tr>
<td>✓ • Radial artery occlusion</td>
<td>✓ • Compartment syndrome</td>
</tr>
<tr>
<td></td>
<td>• Catheter entrapment</td>
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<tr>
<td></td>
<td>• Arterial eversion</td>
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<tr>
<td></td>
<td>• Atheroembolism/thromboembolism</td>
</tr>
<tr>
<td></td>
<td>• Pseudo-aneurysm</td>
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<td></td>
<td>• Radial arterio-venous fistula</td>
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Radial Spasm

- Discomfort to the patients
- Catheter manipulations difficult
- Procedural delays
- Leading to crossovers and procedural failures (38% of all transradial procedure failures)
Radial Spasm

• Operator: experience
• Patient: anxiety, pain
• Prevention:
  - Sedation (midazolam)/education
  - Minimize puncture attempts
  - Minimize catheter exchanges (TIGER)
  - Hydrophilic sheaths
  - Sheath diameter: internal artery diameter ratio is kept <1:1 (Saito)
  - Use of pre-procedure ultrasound of arm arteries
  - (+/-) Vasodilators/anti-spasmodics: Nitrates, CCB, Nitroprusside, Nicorandil, phentolamine, NACl 0.9% (FMD)
<table>
<thead>
<tr>
<th>Radial Artery Spasm Grading</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grade-4</strong></td>
</tr>
<tr>
<td><strong>Grade-3</strong></td>
</tr>
<tr>
<td><strong>Grade-2</strong></td>
</tr>
<tr>
<td><strong>Grade-1</strong></td>
</tr>
</tbody>
</table>
Radial Artery Occlusion

- Depending on technique, can occur ~3-10% of cases (<1% PRIMA-FACIE TRI)
- Likely related to arterial injury and/or thrombotic process
- Rarely symptomatic, but will limit future TR access
- Simple pulse check is not sufficient to detect it. Should be documented by ultrasound doppler post procedurally and on follow-up
- Need to do reverse Barbeau test, or
Radial Artery Occlusion Prevention: Best Practice

<table>
<thead>
<tr>
<th>Proven practices to reduce RAO</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low sheath to artery ratio</strong></td>
<td>Keep sheath as small as possible</td>
</tr>
<tr>
<td><strong>Systemic anticoagulation</strong></td>
<td>Administer full dose UFH (50U/kg or 5000U) or bivalirudin</td>
</tr>
<tr>
<td><strong>Avoid prolonged occlusive pressure</strong></td>
<td>Patent hemostasis</td>
</tr>
<tr>
<td>May reduce risk</td>
<td>Hydrophilic sheaths, limiting duration of RA compression</td>
</tr>
<tr>
<td>No effect or may increase risk</td>
<td>Sheath length, sheathless guide catheters</td>
</tr>
</tbody>
</table>

✓ Strategies are often cumulative
✓ Implementation of 1 or more of these have led to RAO rates of <1%

A comparison of low versus standard heparin dose for prevention of forearm artery occlusion after 5 French coronary angiography. Int J Cardiol. 2015;187:404-10
Radial Artery Occlusion: Treatment

- Extremely rare Symptomatic (dual blood supply through the palmar arch) (40% spontaneous recanalization)
- Prolonged anticoagulation (Zankl et al. enoxaparin 4 weeks)
- Ulnar compression for 1 hour (Bernat et al)
- Surgical/percutaneous revascularization not uniformly successful
Access site hematomas

- Small ecchymosis occur in approximately 5% of cases annually, following the use of non-occlusive hemostasis.

- These cases are generally minor and of no clinical consequence.
• It is imperative to have a low threshold to perform a radial artery arteriogram when any resistance to guide-wire or catheter insertion is encountered.
Forearm Hematoma

- Usually from a perforation of a small side branch
- Incidence of this is 3 per 1000 TRIs
- None requiring blood transfusions
- Commonly managed conservatively in the lab or holding area
- Needs to be recognized early
- Patient complains of pain/fullness/tightness in arm
# EASY Haematoma Classification after Transradial/Ulnar PCI

<table>
<thead>
<tr>
<th>GRADE</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INCIDENCE</strong></td>
<td>≤ 5%</td>
<td>&lt; 3%</td>
<td>&lt; 2%</td>
<td>≤ 0.1%</td>
<td>&lt; 0.01%</td>
</tr>
<tr>
<td><strong>DEFINITION</strong></td>
<td>Local hematoma, superficial</td>
<td>Hematoma with moderate muscular infiltration</td>
<td>Forearm hematoma and muscular infiltration below the elbow</td>
<td>Hematoma and muscular infiltration extending above the elbow</td>
<td>Ischemic threat (compartment syndrome)</td>
</tr>
<tr>
<td><strong>TREATMENT</strong></td>
<td>Analgesia, Additional bracelet, Local ice</td>
<td>Analgesia, Additional bracelet, Local ice</td>
<td>Analgesia, Additional bracelet, Local ice, Inflated BP cuff</td>
<td>Analgesia, Additional bracelet, Local ice, Inflated BP cuff</td>
<td>Consider surgery</td>
</tr>
<tr>
<td><strong>NOTES</strong></td>
<td>Inform physician</td>
<td>Inform physician</td>
<td>Inform physician</td>
<td>STAF call to physician</td>
<td></td>
</tr>
</tbody>
</table>
| **REMARKS** | - Control blood pressure (BP) (importance of pain management)  
- Consider interruption of any antiaggregation and/or antiplatelet infusion  
- Follow forearm and arm diameters to evaluate requirement for additional bracelet and/or BP cuff inflation  
- Additional bracelet(s) can be placed alongside artery anatomy  
- Ice cubes in a plastic bag or washcloth are placed on the hematoma  
- Finger O₂ saturation can be monitored during inflated blood pressure cuff  
- To inflate blood pressure cuff, select a pressure of 20 mmHg < systolic pressure and deflate every 15 minutes  
- After bracelet removal, use "Velpeau bandage" around forearm/arm for a few hours to maintain mild positive pressure |
Forearm Hematoma

**In the lab (sheath in)**

- Attempt to take an image (dilute contrast)

- If you can identify it, attempt to quickly cross the area with a wire/catheter, then wait/complete case

- Reversing anticoagulation is debatable

- Can put a manual BP cuff around arm to provide some external pressure

- Pain and BP control
Fig. 3 — A) Radial artery perforation with extravasation noted on contrast injection. B) Contrast injection in radial artery after angioplasty shows that the radial artery perforation sealed by the end of procedure.
Forearm Hematoma

- Apply a BP cuff at site of induration
- Inflate cuff up to 15mmHg below SBP for 15 min
- Monitor arterial flow with pulse off. Adjust cuff to obtain signal
- Adjunctive therapies:
  ▫ Treat high BP
  ▫ Stop anticoagulants if possible
  ▫ Consider reversal agents if possible
  ▫ Treat pain
  ▫ Examine patient for change in signs or symptoms
- If persistence of swelling, pain, or induration after 15-30 minutes, consider urgent surgical consultation
Figure 2. A and B. Two patients with compartment syndrome managed surgically (A, patient #2) and conservatively (B, patient #3). Arm swelling with hematoma (A₁), surgical view (A₂ and A₃). Arm swelling with forearm hematoma and contact dermatitis (B₁), patent right radial artery (B₂).
Figure 4. Ulnar artery pseudoaneurysm (patient #5). Patient with large ulnar pseudoaneurysm and ipsilateral radial artery stenosis: extensive hematoma of the right forearm (A1, red arrow), large pseudoaneurysm communicating with a patent right ulnar artery on echocardiography (A2 and A3).
Miscellaneous complications
Figure 6. Right arm arteriography depicting occlusion of the distal brachial artery in a patient presenting with critical hand ischemia (patient #7). The proximal and midportions of the brachial artery appear patent and smooth (yellow and brown arrows, respectively). The distal portion of the brachial is abruptly occluded indicating an embolic rather than a thrombotic event (red arrows). Faint collaterals allow for some forearm perfusion. Surgical removal of the embolus established complete patency of both forearm arteries.
Miscellaneous complications

- Chronic regional pain syndrome 1 (reflex sympathetic dystrophy)
- Sterile abscess formation at the radial artery access site had been reported
- Radial artery avulsion due to intense spasm is extremely rare
- Catheter Entrapment
  - (NTG/Diltiazem, propofol, sedation)
Cuff application to induce FMD

Radial avulsion

Vascular Complications Following Transradial and Transulnar Coronary Angiography in 1600 Consecutive Patients

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Abstract

Background: Major, noncoronary complications are rarely encountered following transradial coronary procedures. Methods and Results: Among 1600 prospectively studied patients with complete follow-up, 7 patients experienced major complications following coronary forearm procedures corresponding to an incidence of 0.44%. We found inadvertent symptomatic intramyocardial contrast medium injection, 2 cases with compartment syndrome of which 1 was managed surgically, exertional hand ischemia due to radial artery occlusion, a large ulnar artery pseudoaneurysm, an ulnar arteriovenous fistula, and 1 critical hand ischemia due to late occlusion of the distal brachial artery. Conclusions: Although infrequent, surveillance for major complications should be encouraged after forearm coronary procedures.
- RAUST Trial - multicenter randomized controlled trial; 698 pts undergoing TR cath
- Randomized to palpation v US-guidance
- Endpts:
  - # of attempts
  - 1st-pass success
  - Time to access
- Fewer attempts
- Decreased time to access
- More success with first pass attempts
- No difference in clinical events/outcomes (spasm, bleeding or pain)
Conclusions

• Complications are rare performing TRI

• They are often related to a failure to follow basic principles (and not a function of access site)

• The advantages of radial approach far outweigh the infrequent complications
You have to know how to do it