Complications in the cath lab and what the team learned from it

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Disclosure

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I have the following potential conflicts of interest to report:

Scientific Advisory Board (non-paid): Cardinal, Abbott, Medtronic

Royalty (modest): Cook

Co-founder and Chief Medical Officer: Intact, Cagent

Enter patients into studies: NIH, Bard, Gore, Medtronic, BSI, Silk Road (no financial relationship).

VIVA Board member (nonprofit)
Complications During Vascular Interventions

Acute Mechanical Complications
• Access site
• Treatment site
• Runoff bed

What Can Happen at These Sites?
• Vessel Rupture/Hemorrhage
• Dissection
• Thrombosis
• Spasm
• Embolization
Access Site: Femoral Artery Pseudoaneurysm
Femoral Pseudoaneurysm

- Duplex guided thrombin injection
- Duplex guided compression
- Open surgical repair
Guidance of Puncture Site Placement
Avoid Retroperitoneal Hematoma
Obtain a Spot Film with the Needle in Place

Puncture site:
must be inferior to
the top of the femoral head

Avoid retroperitoneal hematoma
Avoid Puncture Site Thrombosis

Half way through the case, she developed severe right leg ischemic pain. This resolved after removing sheath.
Open Repair: Femoral Artery Dissection
Lower Extremity Intervention
Causes of Sudden Failure

At the target site
- Dissection/Thrombosis
  - Clues from angiographic image
    - Filling defect
  - Check anticoagulation status
  - Re-inflate balloon
  - Mix TPA
  - Aspiration catheter, nitroglycerine
Anterior tibial artery dissection after long segment recanalization

Above knee popliteal artery dissection at re-entry site

SFA dissections

Treatment Site: Dissection

Achilles heal of balloon angioplasty = dissection
Dissection: Rx Options

• Propagation of subintimal tear
  – Occurs with all angioplasties
  – Not always clinically significant

• Identify the origin point
  • How:
    – Angiography
      • Use Multiple Views
      • Selective catheter injection
      • Pull back angiography
      • Add vasodilators to increase flow
    • IVUS
Dissection: Imaging

- Intravascular Ultrasound
  - Volcano (Volcano Therapeutics, Medtronic)
    - 4 French 0.014” probe
  - Galaxy 2 (Boston Scientific)
    - 40 mHz 0.014” monorail probe
Treatment Site: Extravasation or Rupture
<table>
<thead>
<tr>
<th>When Did It Fail?</th>
<th>Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before PTA</td>
<td>Failure to cross</td>
</tr>
<tr>
<td>Immediately after PTA</td>
<td>At the PTA site: Usually dissection occasionally thrombosis or perforation</td>
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<tr>
<td></td>
<td>Distal runoff: Could be embolization, spasm, flow phenomenon</td>
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<tr>
<td>After the procedure</td>
<td>Could be technical or antiplatelet</td>
</tr>
<tr>
<td>Much later</td>
<td>Restenosis</td>
</tr>
</tbody>
</table>
Treatment Site: Rupture

• How bad is it?
  Not all perforations are the same
  Adventitial staining
  Small Perforation
  Substantial flow to extravascular tissues
Treatment Site Rupture: Balloon Tamponade
Rupture

• First Line Therapy
  – Gentle balloon inflation to tamponade
    – Consider reversal of anticoagulation

• Second Line Therapy
  – In flow balloon occlusion
  – Covered Stents (depends on vessel size)
  – Balloon Expandable, Self Expanding, Stent-graft limb
 Covered Stents

- EVAR Limbs
- Viabahn
- Icast (Advanta V12)
- Fluency
Iliac Artery Rupture
Aortic Occlusion Balloon Options

- **Q 50 Balloon**
  - Max diameter: 50 mm
  - Profile: 12 Fr
  - Shaft: 8 Fr

- **Reliant Balloon**
  - Max diameter: 46 mm
  - Profile: 12 Fr
  - Shaft: 8 Fr

- **Coda Balloon**
  - Max diameter: 32 mm - 40 mm
  - Profile: 14 Fr
  - Shaft: 10 Fr
Rupture of Access Vessel

Embolic Agents

- Useful for branch perforations
- Options:
  - Platinum coils
  - Polymer coated coils
  - Plugs
  - Gelfoam
  - Glue
Runoff Vessels: Embolization
This is the case that convinced me that embolization occurs more often than we think.
Embolization

- Embolization with SFA intervention using Doppler
- 60 patients
  - 10 PTA alone
  - 40 PTA and stenting
  - 10 SilverHawk or laser atherectomy
- Emboli noted in every patient during wire crossing, angioplasty, stent deployment and atherectomy

- Embolization was statistically higher during stent deployment vs wire crossing or balloon angioplasty but equivalent to atherectomy
- Clinically significant in only one case
- Findings do not support the routine use of protection devices

Embolization Treatment

- Aspiration
  - MPA 110 cm 6 & 7F guide
  - Export Catheter 6F, 7F (Medtronic)
  - Diver Catheter 6F (ev3)
  - Rinspiration (ev3)
  - Angiojet (Possis)
Aspiration Catheter Export

6 Monorail
AngioJet

- Percutaneous mechanical thrombectomy
- Removal of acute clot
- Can be used to delivery pulse spray of thrombolytic agents
Rescue After Failure
Thrombolytics

• No approved drug for thrombolysis in PAD
• TPA most commonly used
  – Immediate 4-8 mg
  – Infusion 0.5-1.0mg/hr
    • Single or dual level infusions
    • Concomitant low dose heparin 300-500u/hr via sheath
      – prevents pericatheter clot
  – Retevase, TNKase
  – Urokinase
  – IIb/IIIa inhibitors
Embolectomy
• Prevention Emboli Protection
  – Percusurge
  – Emboshield
  – EPI Filterwire
  – Accunet
  – Angioguard
  – SpideRx
This is the case that convinced me to use a filter when performing atherectomy.
Lower Extremity Angioplasty: Causes of Sudden Failure

Distal to the PTA site

• Embolization
  – Check anticoagulation status
  – Finish work at PTA site
  – Place wire across
  – Aspiration catheter
  – Administer nitroglycerine, thrombolytic
Runoff Vessels: Thrombosis

• Prevention is key
• Adequate anticoagulation
  – Heparin 100units/kg
    • Check ACT’s
    • Keep >250-300
  – IIb/IIIa inhibitors (abciximab, integrilin)
  – Thrombolysis-chemical or mechanical
Vasospasm

• May be difficult to distinguish from emboli and dissection
  – Nitroglycerine
    • 50-600 mcg
      – Can give more if delivered infrageniculate
  – Papaverine
    • 30-60 mg
  – Calcium channel blockers
    • Verapamil etc
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