Below-The-Elbow Angioplasty for CLTI of the Hand: Indications, Techniques, Results

Timothy Clark, MD, FSIR
Associate Professor, University of Pennsylvania
Director of Interventional Radiology
Penn Presbyterian Medical Center
Philadelphia, PA

Disclosures
• Founder – Forge Medical
• Royalties - Merit Medical, Teleflex
• Consultant – Bard, Merit Medical, Teleflex

Critical Limb-Threatening Ischemia of the Hand

Risk factors
• Diabetes
• Hemodialysis access with PAD (fistulae > grafts)
• Vascular malformations with steal
• Buerger’s disease and vasculitis
• Connective tissue disorders – scleroderma
• Prior trauma

Indications for revascularization
• Nonhealing ulcer(s)/digital loss
• Intractable pain
• Delayed healing following partial digit resection

Assessment
• Physical exam
  • Allen/Barbeau tests
• Osimetry with perfusion index
• Noninvasive tests
  • Brachial-finger pressures
  • Pulse volume recordings
• Imaging
  • Duplex ultrasound
  • MRA/CTA

Percutaneous Intervention – Arterial Access

Angiosome concept – goal is to revascularize with in-line flow to superficial/deep palmar arch
• Existing HD access then antegrade into brachial/radial
• Antegrade brachial artery
  • Can treat radial, ulnar, interosseous, palmar arch
• Retrograde radial
  • Can treat radial
  • Up and down into ulnar
Technique

- Heparin to maintain ACT > 250
- Verapamil 2.5 mg, nitroglycerin 200 mcg IA
- 4F sheath if arterial puncture
- 0.014” wires
- Balloon diameters 2.0 – 4 mm (2.5 – 3 most common)
- Balloon lengths 12 cm – 20 cm

Hand pain following AVF creation
Persistent hand ischemia post AVF ligation

Nonhealing ulcer post distal phalynx amputation

Middle finger ulcer in diabetic male

Radial CTO recanalization

Radial CTO recanalization
Outcomes – Penn IR Experience

- 30 patients (47% male, mean age 63) with 38 revascularization procedures
- Indications
  - Steal symptoms and/or finger ulceration (n=24)
  - Acute critical ischemia (n=5)
  - Emboli during dialysis circuit thrombectomy (n=5)
  - Other symptoms (n=4)
- Median angioplasty diameter 3 mm (range: 2 – 5 mm)
  - Radial (n=33)
  - Ulnar (n=9)
  - Interosseous (n=1)

Outcomes - Penn IR Experience

- Technical success 34/38 cases (89%)
- Clinical success 21/30 patients (70%)
- Median primary patency 281 days (range 5 – 1652 days)
- Complications 9/38 cases (24%)
  - 8/38 (21%) minor
  - 1/38 (3%) major (radial artery rupture requiring surgical repair)

Outcomes: Forearm artery angioplasty

<table>
<thead>
<tr>
<th>Study</th>
<th>Number of patients</th>
<th>Vessels treated</th>
<th>Mean balloon diameter</th>
<th>Patency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present series</td>
<td>30 (38 arteries)</td>
<td>Radial/Ulnar/Interosseous</td>
<td>3 mm</td>
<td>89% technical success; median primary patency 281 days</td>
</tr>
<tr>
<td>Ferraresi</td>
<td>28 (34 hands)</td>
<td>Radial/Ulnar</td>
<td>2.5</td>
<td>65% hand healing at 13 months</td>
</tr>
<tr>
<td>Tomoi</td>
<td>18</td>
<td>Radial/Ulnar</td>
<td>N/A</td>
<td>56% amputation free survival at 12 months</td>
</tr>
<tr>
<td>Friere</td>
<td>18</td>
<td>Radial/Ulnar</td>
<td>4.3 mm</td>
<td>100% at 30 days</td>
</tr>
</tbody>
</table>

Summary

- Endovascular therapy of below-the-elbow arteries can achieve high rates of technical and clinical success
- Low rate of major complications
- Durable primary patency
- Wound healing achieved in majority of patients