The Modern Endovascular Approach to Infrapopliteal Occlusive Disease

Mark W. Burket, MD
University of Toledo Medical Center
Toledo, Ohio
The CLI Team...Not Just a Good Idea

No single specialty can deliver complete, state-of-the-art infrapopliteal care

Wound care, vascular specialist, infectious disease, etc
Vascular Specialist Basics

Antegrade Femoral Access

Small Wire Skills

Knowledge of Anatomy
Vascular Specialist Basics

Dorsalis Pedis Access

Posterior Tibial Access
CLI 202: Peroneal Artery Access

Line of approach

Anterior

Lateral
CLI 202: Transcollateral Access

Wire passed through collateral, into PT, through occlusion, and into popliteal
CLI 303: Plantar Loop Technique

Images courtesy of Lanfroi Graziani, MD
Angiograms Are Nice...

Before

After Intervention
But What The Patient Cares About Is Healing...

...and healing requires oxygenated blood delivered to tissue

Before

After Intervention

“The life of the flesh is in the blood” Leviticus 19:11
Going Beyond Arteries and Angiosomes

...to Perfusion
Contrast Angiography

Ideal: In-Line Flow to Affected Angiosome

Reality:

- Your patient’s angiosomes may not match the textbook
- In-line flow may be unachievable
- Collateral, plantar arch, wound blush matter
We Have a Long Way to Go...
Blood Oxygenation Level-Dependent CMR-Derived Measures in Critical Limb Ischemia and Changes With Revascularization

Adnan Bajwa, BSc, 3 Roman Wesolowski, PhD, 3 Ashish Patel, PhD, 3 Prakash Saha, PhD, 3 Francesca Ludwinski, PhD, 3 Mohammed Ikram, PhD, 3 Mostafa Albayati, MBBS, BSc, 3 Alberto Smith, PhD, 3 Eike Nagel, MD, PhD, 3-v Bijan Modarai, PhD

“Currently, no reliable method for measuring the adequacy of lower-limb perfusion exists.”
Noninvasive Methods

• Physical Exam
• ABI (ankle brachial index)
  – Whole limb
  – Unreliable with calcification
• PVR (pulse volume recordings)
  – Region of limb
  – Qualitative only
Importance of an Intact Plantar Arch: Data from the OLIVE Registry

In OLIVE registry, a total of 314 patients were enrolled. (312 patients evaluated)

- O vessel run off, n=32
- 1 vessel run off, n=137
- 2 vessel run off, n=79
- 3 vessel run off, n=37
- Impossible to evaluate, n=27

With pedal arch, n=76
  - Group A
Without pedal arch, n=61
  - Group B
One Vessel Runoff
No Plantar Arch

One Vessel Runoff
Plantar Arch Present
Limb Salvage Predicted by Plantar Arch
Wound Blush

Slide courtesy of John Rundback, MD
Wound Blush Predicts Limb Salvage…

Rutherford 5 or 6
Endovascular therapy

p = 0.001

Wound Blush Predicts Limb Salvage... Better Than Direct Flow into Angiosome


\[ p = 0.001 \]  \[ p = 0.063 \]
Transcutaneous Oxygen Pressure

- First reported 1982
- Electrodes on chest, feet
- Higher values correlate with healing
- Limitations:
  - Small area
  - Superficial

Transcutaneous Oxygen Pressure

- Highly variable measurements
- Normal ~ 60 mm Hg
- > 40 predicts healing
- < 20 predicts failure
- Falsely low with:
  - Edema
  - Inflammation
  - Cold, vasoconstriction

Newer Options

- Perfusion angiography
- Methylene blue
- Indocyanine green
- MRI
- PET
- Ultrasound
Perfusion Angiography

- Modification of standard angiography
- Catheter placed in popliteal artery
- Standardized injection (3ml/sec iodixanol)
- Lateral imaging of foot
- Post-processing (Philips Allura Xper FD20)

Jens Cardiovasc Intervent Radiol 2015;38:201-205
Murray, T. J Endovasc Ther 2016;23:58-64
Perfusion Angiography

- Hampered by foot motion
- Region of foot
  - Not angiosome
  - Not specific vessel

Jens Cardiovasc Intervent Radiol 2015;38:201-205
Murray, T. J Endovasc Ther 2016;23:58-64
Perfusion Angiography

Example:
Successful intervention
Greater contrast density

Jens Cardiovasc Intervent Radiol 2015;38:201-205
Perfusion Angiography

Example:
Successful intervention
Greater contrast density

Example 2:
Successful intervention
Earlier appearance of contrast
Greater contrast density
Perfusion Angiography

Failed intervention: identical before and after curves

Example:
Successful intervention
Greater contrast density

Example 2:
Successful intervention
Earlier appearance of contrast
Greater contrast density

Jens Cardiovasc Intervent Radiol 2015;38:201-205
Methylene Blue

Lateral Malleolar Foot Ulcer

Case provided by John Rundback, MD
Lateral tarsal artery

Occluded distal peroneal
Proximal peroneal injection
Anterior tibial injection
Anterior Tibial Injection
Indocyanine Green Angiography

Heat-map Images

Pre-Intervention

Post-Intervention

Benitez. Seminars in Vascular Surgery 2014;27:3-15
BOLD-CMR
Blood Oxygen Level-Dependent Cardiovascular Magnetic Resonance

Calf imaging pre and post intervention
Positron emission tomography (PET) of the calf using 15Oxygen-labeled water in healthy volunteers and patients with peripheral arterial disease (PAD).
Contrast-enhanced ultrasound with continuous infusion in a healthy volunteer (A) and patient with peripheral arterial disease (PAD; B).
Summary: Modern Endovascular Therapy for Infrapopliteal Disease

- Absolutely requires a CLI team, including wound care
- Requires comfort with complex access and imaging
- Gets best results when attention focuses on tissue perfusion