Fluorescent Angiography: Practical uses in the Clinical Setting

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Disclosures

• No relevant financial relationship reported
Perspective

**Practical Uses in the clinical setting**

- Fluorescent Angiographic Studies provide information that can be useful in the clinical setting when combined with other clinical information

- Fluorescent Angiography has become an important tool in our Wound Care and Limb Preservation Service
Traditional measurement of Tissue Perfusion

- Clinical Judgment
- Physical exam
- ABIs, Toe Pressures, Toe Wave Forms
- Forefoot PVR
- Duplex scan
- tcP02
- SPP
Measurement of Tissue Perfusion

• Current methods utilized to evaluate tissue perfusion are often limited by
  • medial calcinosis
  • scarring
  • wounds
  • prior amputations
  • infection

• Current methods can be technically challenging, costly and time consuming and don’t measure global perfusion of the foot

• Fluorescence Angiography offers an additional option to measure tissue perfusion
Clinical Role of Fluorescence Angiography

• Utilized in outpatient clinic
  • Is there adequate perfusion to heal a wound
  • Does the patient require revascularization to heal a wound or prior to a minor foot amputation?
  • Was revascularization successful in improving perfusion to the foot?
  • Predict what level of minor foot amputation will heal?

• Utilized in OR
  ✓ Spy assisted Amputation
    ✓ Prevention of suture line complications
Fluorescence Angiography

Visualize and quantitate micro-circulation
Fluorescence Angiography

Fluorescent dye ICG) is injected IV

The injected agent lights up blood flowing through the veins and arteries in real time, and the camera captures live images of the patient’s vasculature.

These images can be captured on a computer screen, analyzed and saved and printed for medical reference.
Practical Uses in the Clinical Setting
Heel Ulcers

Fluorescent Angiography provides perfusion assessment of the Heel that can’t be obtained with traditional methods of measuring perfusion.
Perfusion Assessment in Heel Ulcers

• Measurement of tissue perfusion can help assess the healing potential in patients with heel ulceration
• Traditional methods of measuring tissue perfusion are a poor indicator of heel perfusion.
• Fluorescence angiography can measure tissue perfusion in a heel ulcer

Heel Ulcers - Heel Angiosome

The heel is a unique angiosome due to it having two sources of arterial blood supply:

- posterior tibial artery
- peroneal artery

no direct artery to artery connections

Heel Ulcers
“Orphan Heal Syndrome”

• Regional malperfusion of the heel has been termed “Orphan Heal Syndrome”
• Most common in patients with diabetes and/or renal failure
Heel Ulcers – Identification of Ischemia

- A palpable DP pulse doesn’t r/o heel ischemia
- Normal ABI or toe pressures do not predict heel ischemia
  - ABI – measure the pressure where the cuff is located.
  - Toe pressures – Anterior tibial perfusion
- Patients with heel ulcers having arteriography
  - 14% - severe malperfusion about the heel
  - 33% undergoing endovascular intervention

Case Study

• 81 year-old female with a history of poorly-controlled insulin-dependent DM type II with neuropathy with a painful right posterolateral heel ulceration that had been present for three weeks
• Physical Exam ➔ non-palpable pedal pulses
• ABI – 0.5
Presentation
Pre Revascularization Fluorescence Angiogram

• Pre revascularization
  No fluorescence in wound bed and minimal inflammatory response
• Heel demonstrates blotchy uptake
Pre Revascularization
Fluorescence Angiogram
Revascularization

- An arteriogram demonstrated popliteal occlusion and severe infra-popliteal disease
- Popliteal stent and angioplasty of the tibial peroneal trunk
- The only runoff vessel was a peroneal artery reconstituting the distal dorsalis pedis artery. The posterior tibial artery was totally occluded
- Indirect revascularization – Is there perfusion to the heel?
Revascularization
Revascularization
Revascularization

• Post Stenting, arterial flow to the foot was improved with a triphasic dorsalis pedis arterial signal and after several days a monophasic posterior tibial signal.
  • Question – what is the perfusion to the heel

• Fluorescence angiography demonstrated improved perfusion to the heel with an improved inflammatory response and increased uptake to the wound bed.
Post Revascularization - Fluorescence Angiogram
One Month Post Revascularizations
## Changes in Perfusion

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Healed Ulcer

Ulcerc healed 6 weeks post stenting
Practical use Fluorescence Angiography in Heel Ulcers

- Documented severe ischemia of heel and the need for revascularization
- Documented adequate perfusion to the heel following indirect revascularization
- With indirect revascularization, documented the increased perfusion over time
- Appropriate identification of regional ischemia and revascularization can prevent major amputation or support calcanectomy in more severe ulceration
Practical Uses in the Clinical Setting
Digital Amputations

• Significant incidence of readmission and revision to higher levels of amputation following digital amputations
• Significant incidence of suture line complications
• Fluorescence angiography pre and intra op may decrease these complications

Predictors of hospital readmissions after lower extremity amputations [www.jvascsurg.org/article/S0741-5214(15)01967-9](http://www.jvascsurg.org/article/S0741-5214(15)01967-9)

Andersen et al publication pending
Case Study - Hallux Amputation

• 79 y/o diabetic male with multiple comorbidities admitted with
  • Gangrene
  • Osteomyelitis
  • Cellulitis right great toe and dorsal foot

• 2-3 week history of pain and swelling

• Poor historian – not sure of trauma

• History of
  • DVT with chronic venous insufficiency
  • PAD
  • Atrial fibrillation
Case Study - continued

- Positive blood cultures for MRSA
- Started on broad spectrum IV antibiotics with resolution of cellulitis on dorsum of foot
- Vascular assessment
- Fluorescence angiography
- Right hallux amputation
Pre-op
Pre-op
Pre-op MRI

- Abscess surrounding the flexor hallucis longus
- Tendon is concerning for infective tenosynovitis
- Moderate osteoarthritis of the right foot
Pre op Vascular Assessment

• ABIs – non compressible vessels with ABIs greater than 1.5
• Biphasic wave forms at right ankle
• Right toe pressure not obtainable
Pre–op Fluorescence Angiography
Intra – op Fluorescence Angiography
Amputation

Flap revision following intra-op Fluorescence Angiography
Amputation

Amputation following excision of ischemic distal flap
Amputation

Flap Closure
Fluorescent Angiography Following Closure
Post Op

2 days post op

5 days post
Practical Uses in the Clinical Setting

TMA

- Historically TMAs have up to a 50% incidence of suture line complications
- Can the use of Fluorescence Angiography decrease the suture line complication rate?
Case Study - TMA

• Severe poorly controlled diabetes
• S/P hallux amputation with severe deformity with recurrent ulceration and cellulitis
• Vascular studies and fluorescent angiography demonstrated adequate perfusion to heal a TMA
• Elective TMA
Pre op

Post Hallux amputation with deformity of residual toes exposed hardware and chronic osteomyelitis
Fluorescent Angiography Assisted Amputations
Fluorescent Angiography Assisted Amputations
Suture Line Modification
TMA
Ten days post op
Two months post op
Conclusions

• Fluorescence Angiography has become an important component of our Limb Preservation/Wound Care practice
• Fast and accurate evaluation of tissue perfusion of the foot
• Fluorescence Angiography can assess the need for revascularization and document the post procedure results
• Assesses perfusion to determine amputation level
• Help prevent suture line complications with amputations
References


- The role of fluorescein angiography in the management of orphan heel syndrome Authors: Nicole Byerley, DPM*. Col (Ret) Charles A. Andersen, MD, FACS, FAPWCA1, Mario N. Ponticello, DPM, FACFAS, FAPWCA2, LTC, MC, Peter Kreishman, MD3 The Journal of Diabetic Foot Complications, 2016
THANK YOU!

Mt. Rainier at Sunrise

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