INTRODUCTION

A critical precursor to amputation upon developing a foot ulcer is the presence of peripheral arterial disease. Compromised vascularity is detrimental to healing due to a decreased ability to fight infection and provide proper nutrition supply for healing. This can result in further tissue loss. Vascular assessment should be done prior to any surgical intervention whenever the suspicion exists for vascular compromise. Multiple noninvasive vascular tests can be performed to evaluate pedal blood flow. An ankle-brachial index (ABI) of ≤ 0.90 suggests the presence of peripheral arterial disease. Values > 1.1 often represent a falsely elevated pressures secondary to medial arterial calcinosis. Toe brachial index (TBI) and systolic toe pressure of ≥ 30mmHg are indicative of the likelihood for primary healing, however, cannot be performed in patients with a forefoot amputation, toe ulcers, or gangrenous digits. Transcutaneous oximetry (TcPO2) >30 mmHg correlates with a high likelihood of primary wound healing, however, inherent limitations exist. The test is time consuming, difficult to reproduce, technician dependent, and may yield inaccurate results if marked edema, hyperkeratosis, dry flaky skin, cellulitis, or the probes are placed over bones, tendons, or areas of scarring. All these factors can reduce thermal conductivity capillary flow and cutaneous oxygen transmission. We hypothesize that the ability to assess cutaneous perfusion to the foot with fluorescent angiography in addition to traditional non-invasive vascular testing may lead to the ability to assess adequate perfusion to perform a more distal level of amputation yielding a high rate of limb salvage.

METHODS

Fluorescent angiography is a diagnostic technique that uses IV fluorescent dye to allow sequential visualization of cutaneous blood flow. After clinical assessment, 2.5 mg indocyanine green dye is administered parentally followed by a 10mg flush of normal saline. The dye binds to large plasma proteins. A laser source causes the dye to fluoresce which is detected by a charge-coupled camera. A video of normal saline. The half-life of the dye is 2.5-3 minutes and can be safely administered multiple times with very low risk of adverse reactions. The dye should be used in caution with patients with a history of sensitivity to iodides.

Presented here are two cases in which fluorescent angiography was used during the pre-operative, intra-operative, and post-operative phases.

CASE 1

92 year-old male with a left hallux full thickness wound; measures 2.5cm x 2cm x 1.5cm; probed to bone

The wound continued to deteriorate despite advanced local wound care.

PMH: gout, venous insufficiency, PVD, uncontrolled diabetes with peripheral neuropathy, CKD Stage III

Radiographs revealed osseous changes concerning for osteomyelitis.

ABI unobtainable due to non-compressible vessels

TcPO2, hallux base = 19mmHg, 2nd toe base = 23mmHg

Fluorescent angiography: adequate perfusion for a left hallux amputation

Patient underwent left hallux amputation with an uneventful post-operative course

CASE 2

92 year-old female with dry gangrene of the plantar medial left hallux.

Patient reported ulceration began as a callus.

PMH: hypothyroidism, PVD

PSH: Prior amputation of the left 2nd digit

ABI = 0.5; TBI = 0.38; biphasic doppler wave form

Fluorescent angiography: adequate perfusion for a left hallux amputation.

Patient underwent left hallux amputation with an uneventful post-operative course.

DISCUSSION

Peripheral arterial disease is a critical component of morbidity and mortality related to pedal ulcerations. Non-invasive vascular testing is the first step in determining a viable level of amputation when a patient presents with a diabetic foot ulceration compromised by arterial insufficiency. Current non-invasive vascular testing methods have significant limitations. The cases above demonstrate how non-invasive vascular studies would have prompted for a higher level of amputation. However, the use of fluorescence angiography revealed adequate distal perfusion resulting in a more distal procedure for limb salvage. Fluorescent angiography is a useful tool to assess areas of viability and determine a level of amputation most likely to heal. The procedure is an easily reproducible qualitative study which is minimally invasive, has minimal patient risk, and can be used in patients with renal insufficiency to provide site specific assessment of cutaneous arterial perfusion for limb salvage procedures.

REFERENCES: Available upon request