

Pre- and Postoperative Lower Extremity Flow Measurements Using the FlowMet Intraprocedural Monitoring System: A Case Report

Matthew Namanny, DO^{1,2}; Christopher Sullivan, DPM^{1,3}; Mehera T. Hormuz, DPM, PGY-2¹

¹Tucson Medical Center/Midwestern University, Tucson, Arizona; ²Arizona Vascular Specialists, LLC, Tucson, Arizona; ³The Sonoran Foot and Ankle Institute, Tucson, Arizona

Abstract: Peripheral arterial disease (PAD) is a significant cause of nonhealing lower extremity ulcerations. Recent literature indicates that PAD may be associated with increased mortality and postoperative complications.¹ Here, we present the outcome of a patient who underwent revascularization of the right lower extremity for the treatment of a necrotic derotational skin flap following a first metatarsal head amputation. Pre- and post-revascularization perfusion pressures were measured with a flowmeter device to assess for wound healing.

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Key words: flow dynamics, limb preservation, lower extremity intervention, peripheral arterial disease

Case Report

A 70-year-old man with a history of hypertension, coronary artery disease (CABG 1995), hyperlipidemia, diabetes mellitus type 2, chronic kidney disease stage 3, Paget's disease of the right forearm, congestive heart failure, peripheral arterial disease (PAD), and tobacco abuse presented with bilateral pedal pain and erythematous discolored of his right foot. Arterial duplex of the right lower extremity (RLE) showed monophasic waveforms at the level of the right common femoral artery, with concern for a more proximal stenosis or occlusion of the aorta or iliac arteries. RLE ankle-brachial index (ABI) was 0.56 and 0.83 of the left lower extremity. Clinical exam revealed 1+ femoral and popliteal pulses with nonpalpable dorsalis pedis and posterior tibial pulses to bilateral lower extremity. Biphasic dorsalis pedis and monophasic posterior tibial pulses were audible on Doppler to bilateral lower extremity. Capillary refill was greater than 4 seconds to all pedal digits, bilaterally. Medial and plantar first metatarsal head ulcerations of the right foot appeared to communicate, penetrate through the subcutaneous layer to probe to bone, and present with exposed flexor tendon, plantarly.

Procedure

The communicating dorsal and plantar right first metatarsal head ulcerations were concerning for osteomyelitis of the right hallux and first metatarsal head. An angioplasty of the right common iliac, distal abdominal aorta, and right external iliac arteries with a 6 x 60 balloon was performed (**Figure 1** and **Figure 2**). Following revascularization, the patient underwent a right hallux and first metatarsal head amputation. Flap necrosis of the surgical site resulted, postoperatively (**Figure 3**). Repeat revascularization of

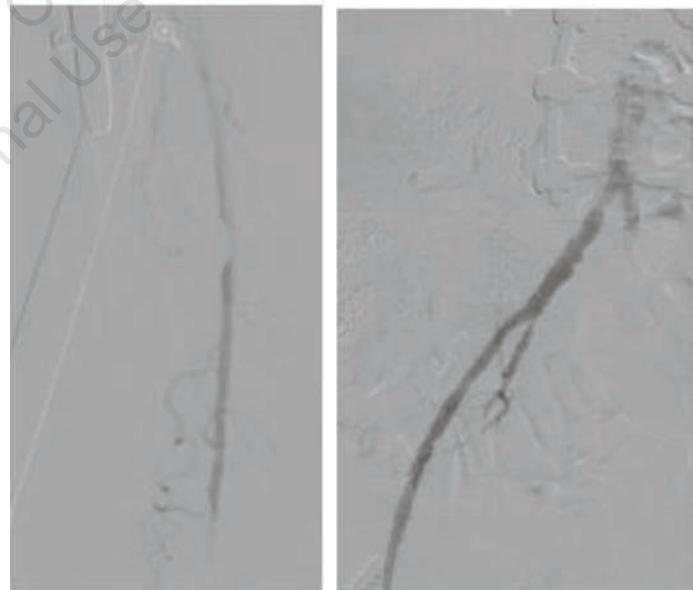


Figure 1. (left) The communicating dorsal and plantar right first metatarsal head ulcerations were concerning for osteomyelitis of the right hallux and first metatarsal head.

Figure 2. (right) An angioplasty of the right common iliac, distal abdominal aorta, and right external iliac arteries with a 6 x 60 balloon was performed.

the RLE through angioplasty of the right femoral popliteal region and anterior tibial artery with a 3 x 100 balloon, atherectomy of the right femoral popliteal region, and proximal anterior tibial artery with a HawkOne atherectomy system (Medtronic), angioplasty of the right femoral popliteal region with a 5 x 100



Figure 3. Following revascularization, the patient underwent a right hallux and first metatarsal head amputation. Flap necrosis of the surgical site resulted, postoperatively.

balloon, and deployment of a 6 x 100 self-expanding stent in the distal right superficial femoral artery and proximal popliteal artery with post-balloon angioplasty of the stent were completed (Figure 4 and Figure 5).

Discussion

PAD affects over 200 million people worldwide. Symptoms of PAD include rest pain, claudication, diminished or absent pedal pulses, monophasic Doppler signals, toe-brachial index < 0.7, or ABI < 0.92. PAD affects a large proportion of patients with diabetes mellitus, with its most severe progression to critical limb ischemia (CLI).^{3,4} CLI is frequently caused by obstructive atherosclerosis.⁵ Endovascular treatment is typically first line-therapy, followed by balloon angioplasty and/or stent placement.⁶

The FlowMet monitoring system (Medtronic) is a type of light-based technology that measures peripheral blood flow. In the hands of vascular surgeons, it provides real-time data for the efficacy of a revascularization procedure. To use the device, a sensor is placed on the patient's toe, while a laser light is transmitted through the tissue volume, creating a speckled pattern on the screen. As the red blood cell velocity increases during revascularization surgery, the FlowMet creates a velocity waveform on the screen, which interprets the blood flow as normal or abnormal. The more severe the vascular disease, the more abnormal the velocity waveform appears. The flow index quantifies blood flow, with higher values indicating better perfusion and wound healing potential. The FlowMet device is a tool that provides continuous blood flow measurements with a quantifiable value, which angiography cannot provide.

Results

Prior to additional revascularization, the FlowMet device measured the flow value of the right foot to be 3.4, indicating nonoptimal oxygen levels for wound healing (Figure 6). After repeated revascularization, the flow value was 20, indicating op-

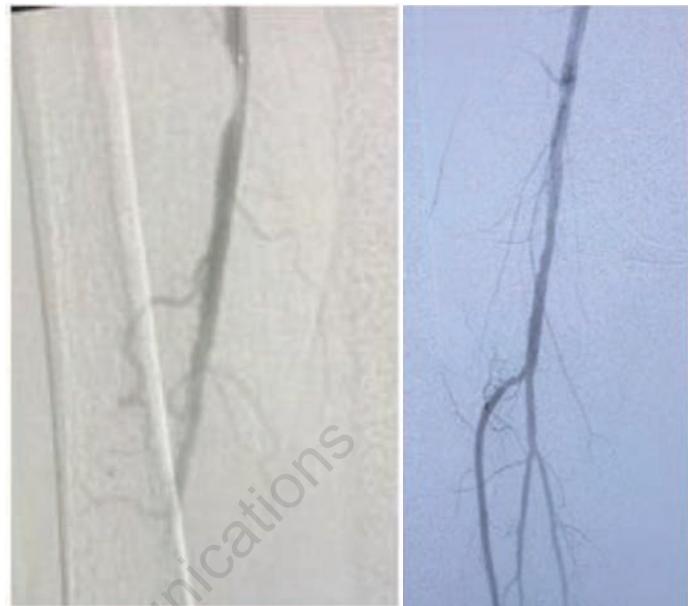


Figure 4. (left) Repeat revascularization of the right lower extremity through angioplasty of the right femoral popliteal region and anterior tibial artery with a 3 x 100 balloon, atherectomy of the right femoral popliteal region, and proximal anterior tibial artery with a HawkOne atherectomy system (Medtronic), and angioplasty of the right femoral popliteal region with a 5 x 100 balloon were completed.

Figure 5. (right) Deployment of a 6 x 100 self-expanding stent in the distal right superficial femoral artery and proximal popliteal artery with post-balloon angioplasty of the stent was completed.



Figure 6. Prior to additional revascularization, the FlowMet device measured the flow value of the right foot to be 3.4, indicating non-optimal oxygen levels for wound healing.

timal oxygen levels for perfusion and wound healing (Figure 7). On postop day 21, the surgical flap appeared with reduced ischemic changes and improved perfusion to the right foot (Figure 8). On postop day 65, the skin flap appeared healthier and well perfused, with a remaining 0.7 cm x 0.5 cm x 3 cm wound to the medial aspect of the surgical site (Figure 9).

Conclusion

PAD is marked by intermittent claudication, which may progress to CLI. Management of the disease includes smoking cessation

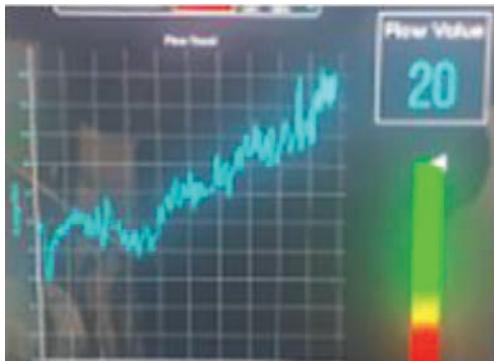


Figure 7. After repeated revascularization, the flow value was 20, indicating optimal oxygen levels for perfusion and wound healing.



Figure 8. On postop day 21, the surgical flap appeared with reduced ischemic changes and improved perfusion to the right foot.

and control of dyslipidemia, hyperglycemia, and hypertension. A common complication of PAD and diabetes includes development of lower extremity ulcerations, which may progress to amputation. The FlowMet monitoring system was used to measure perfusion pressures before and after revascularization to evaluate a wound's healing potential. A greater than 50% increase in perfusion pressures was observed in this case study as well as improved healing to the patient's right pedal surgical site. ■

Disclosure: The authors have completed and returned the ICMJE Form for Disclosure of Potential Conflicts of Interest. The authors report no conflicts of interest regarding the content herein.

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Address for correspondence: Christopher Sullivan, DPM, Tucson Medical Center, 5301 E. Grant Rd., Tucson, AZ 85712; Email: sullivandpm@gmail.com



Figure 9. On postop day 65, the skin flap appeared healthier and well perfused, with a remaining 0.7 cm x 0.5 cm x 3 cm wound to the medial aspect of the surgical site.

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