

Allowing Demarcation in a Case of Pedal Gangrene Secondary to Vasopressor Use

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Abstract

Introduction: Limb salvage is often a topic of discussion in diabetic foot management, but certain cases of non-diabetes related foot complications also require limb salvage. The development of gangrene is one such disease. Gangrene can be caused by atherosclerotic disease such as peripheral arterial disease (PAD) or by the effects of vasopressor medications used in life saving measures. Treatment for gangrene is typically surgical intervention in the form of amputation. To preserve limb length and function a period of demarcation is usually employed before amputation. There is no specified time for complete demarcation so timing should be made on an individual patient basis.

Case Presentation: The authors present a case of vasopressor induced bilateral lower extremity vast gangrene in a 40-year-old female who had a Type 1A aortic dissection and subsequent surgical repair. The patient had a complicated hospital course including septic shock requiring vasopressor medication for life saving efforts. The patient developed bilateral lower extremity vast gangrene secondary to vasopressor use. She underwent a left below knee amputation (BKA) at 14 weeks after admission. Decision was made to allow complete demarcation of right sided lower extremity tissues before any surgical intervention. At 6 months post-admission the patient underwent a right transmetatarsal amputation (TMA) with hallux rotational flap. The patient healed all surgical sites and is ambulating with a left leg prosthesis and right foot custom accommodative orthotic.

Discussion: Current literature does not reveal a specified time to wait for demarcation before amputation in cases of lower extremity gangrene, as each patient presents a unique situation. Current literature does agree that higher level amputations correlate with increased disability and lower patient satisfaction and quality of life scores. Therefore, all efforts should be made to avoid high levels of amputation.

Conclusion: In this unique case report, a patient who was initially presented with the option of bilateral BKAs was able to avoid the double major amputation and likely increased disability by choosing to allow a 6-month period of demarcation of soft tissues.

Keywords: Demarcation; Gangrene; Vasopressor

Introduction

Limb salvage often requires a multi-disciplinary approach for success. Limb salvage plays an integral role in the population of patients with diabetes mellitus (DM), as this population is more

vulnerable to the development of diabetic foot ulcerations (DFU) and amputations. More than 60% of nontraumatic lower limb amputations occur in patients with diabetes [1]. While the population of patients with DM have the biggest rate of amputation, other disease processes such as malignancy, trauma, and peripheral arterial

disease (PAD), also place patients at high risk for lower extremity amputation. This case report focuses on a patient who had a Type 1 aortic dissection which led to bilateral lower extremity vast gangrene and the lower extremity limb salvage sequelae.

Gangrene is a clinical condition of ischemic and necrotic tissue, often circumferentially around a digit or extremity [2]. It is identified by tissue necrosis visibly causing dusky or black discoloration to tissues and associated sloughing of natural tissue planes [2]. There are two broad types of gangrene that clinically occur. Dry gangrene, also known as ischemic gangrene, occurs when there is escalating occlusion of the peripheral arteries [2]. Poor arterial perfusion to tissue, due to micro and macrovascular impairments, lead to arteriole dilation, vessel edema and endothelial damage [3]. Wet gangrene occurs when ischemic or necrotic tissues become infected [2]. Wet gangrene tends to have ill-defined demarcation and is clinically unstable compared to dry gangrene. Gas gangrene is a severe type of wet gangrene. Gas gangrene occurs when the infectious pathogen leads to a rapid, necrosing tissue loss with subcutaneous emphysema and often systemic illness caused by the production of exotoxins [2].

For patients requiring vasopressor medication, the precise pathophysiology of symmetrical peripheral gangrene development is unknown, but vasopressor use has been seen to affect the contraction of peripheral vasculature [4]. Treatment for gangrene is most commonly surgical intervention in the form of amputation. The incidence of patients requiring amputation within 90 days after being treated with vasopressors for septic shock is 2.2 per 1000 patients [5].

When a patient is diagnosed with gangrene, it is important for the treating surgeons to consider the timing and level of amputation that may occur. If limb or life-threatening infection are present in the ischemic extremity, then emergent amputation may be required for infection source control. In many cases of vasopressor induced gangrene there is no emergent infection process and thus seldom a need for emergent limb salvage amputation. In these cases, many surgeons will advocate for allowing tissues to demarcate to preserve limb length and function. Demarcation is the line that separates healthy tissue from gangrenous tissue [6].

In this case, we present a patient who had a type 1A aortic dissection and required vasopressors for life saving efforts. The pa-

tient subsequently developed vasopressor induced gangrene of the upper and lower extremities. After a period of demarcation to preserve lower extremity limb length, the patient underwent one major and one minor lower extremity amputation.

Case Presentation

The case of a 40-year-old female with a past medical history of asthma and uncontrolled hypertension is presented. She also has a past surgical history of right ankle surgery and cervical spine surgery. The patient presented to an outside hospital for a chief complaint of acute epigastric pain radiating from her back. Patient was hypertensive at 158/88 mmHg. On physical exam the patient had absent dorsalis pedis and posterior tibial pulses to the left lower extremity. A computed tomography angiography (CTA) scan of chest, abdomen and pelvis with runoff was performed and showed an extensive type A aortic dissection from the aortic root to the aortoiliac junction. The dissection had further extended into the left common carotid, subclavian, renal, common iliac, common femoral and superficial femoral arteries. There was complete occlusion of the left distal popliteal artery and throughout the tibial and peroneal arteries. The patient was transferred to the University of Michigan Medicine (Ann Arbor, MI) for emergent cardiothoracic surgery. She then underwent repair of the aortic dissection and right to left femoro-femoral bypass with ringed graft. The patient subsequently transferred to the cardiothoracic intensive care unit. The hospital course was complicated by necrotizing pancreatitis, bowel ischemia, and septic shock requiring the need for vasopressors to normalize blood pressure. She also underwent additional procedures including rerouting of aortic endoprosthesis, thoracic endovascular aortic repair and tracheostomy.

During the admission, she began to develop gangrenous changes to her lower extremities and podiatry was consulted for management of ischemia and associated wounds. Upon initial consultation with podiatry, the patient was non-verbal due to intubation. She was also evaluated by vascular surgery and infectious disease colleagues. The patient was on intravenous (IV) cefepime, metronidazole and fluconazole, for concerning pancreatic fluid collection in the setting of pancreatic necrosis. Vascular surgery recommended a non-urgent left below knee amputation (BKA). Non-invasive vascular tests showed absent posterior tibial (PT) and dorsalis pedis (DP) arteries with an ankle brachial index and toe brachial index (ABI/TBI) of 0 of the left lower extremity, the right lower extremity showed an ABI of 1.23 and TBI of 1.18 and a right great toe pres-

sure of 181mmHg. Lab work was significant for erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) of 37 mm and 12.5 mg/dL respectively. Bilateral foot radiographs did not show any erosive changes concerning for osteomyelitis and no soft tissue gas. On physical exam, the PT and DP artery were non-palpable to the left and the left toes were very cool with mottling, duskiness, and early mummification of the toes. The duskiness extended into the midfoot and ankle, along with being cool to touch. There was also a de-roofed bulla to the medial heel with mild serous drainage. (Figure 1) On the right foot, the DP and PT arteries were graded as 1/4. Right toes were cool, but the dorsum of the foot was appropriate temperature. The right toes were gangrenous, with early mummification and duskiness extending to the midfoot level. There was a large bulla with intact roof to the plantar aspect of the midfoot as well as a full thickness ulceration to the posterior Achilles tendon with mild serous drainage. (Figure 2) No purulent drainage or associated erythema was present to bilateral lower extremities. After review, Podiatry diagnosed bilateral lower extremity ischemia without signs of acute infection. Recommendations included conservative management with daily wound care consisting of betadine to the ischemic areas and Exufiber Ag weaved between all digits. Appropriate offloading with L'nard splints was also recommended as the patient was ventilated in the hospital bed. This plan would allow for full soft tissue demarcation prior to any surgical intervention as local infection was not present. Podiatry continued to follow the patient while admitted at least once a week for observation during her 14-week admission. As expected, her gangrene continued to demarcate to the point of complete mummification of the left ankle and foot (Figure 3). The right foot had complete mummification of the lesser digits as well as the plantar hallux, plantar forefoot, medial forefoot and posterior heel. (Figure 4) After her improvement, she was discharged with plan for re- admission when patient was more stable for left leg BKA with vascular surgery and continued right foot wound care in the outpatient setting with podiatry. One month after discharge, the patient was re- admitted for left leg BKA. Podiatry was consulted for continued wound care of right foot while she admitted. Any surgical intervention of the right foot was deferred as continued wound care and monitoring of her right foot would provide stability for her rehabilitation after the left BKA. The left BKA was performed without complication and patient was discharged to inpatient rehabilitation

The patient continued to follow with podiatry on an outpatient basis for right foot wound care.

Figure 1: Left foot at time of initial podiatry consultation.

Figure 2: Right foot at time of initial podiatry consultation.

Figure 3: Left foot at time of discharge.

Figure 4: Right Foot at time of discharge.

Figure 5: Right foot after TMA and rotational skin flap.

After 6 months of close follow up with podiatry, the patient's right medial forefoot and hallux ulcerations had healed. She recovered well from her left BKA and was now using a prosthesis for ambulation. After the right foot demarcation, she elected for a transmetatarsal amputation (TMA) of the right foot with open bone cultures and hallux rotational skin flap. The patient remained in the hospital while proximal bone cultures were processed. The final cultures were negative for any aerobic, anaerobic, fungal or acid-fast bacilli (AFB) growth. Physical therapy evaluated the patient to assist with her non-weight bearing status to the right foot while the amputation healed. The patient was seen weekly in the outpatient podiatry department weekly for post-operative appointments and dressing changes. Sutures were removed at 4 weeks and a small dehiscence was noted to the medial aspect of the incision. The wound had a granular wound base and did not probe to bone. The dehiscence went on to heal within 2 weeks with close wound care (Figure 5) The posterior heel ulceration healed 6 months after the TMA. She was then fitted for custom accommodative inserts with rigid foot plate and toe filler. Since the TMA and healing of the posterior heel ulceration, she has remained ulcer-free and is ambulating with left leg prosthesis and right foot accommodative inserts.

Discussion

Deciding when to move forward with amputation for treatment of gangrene is a topic of debate. Current literature does not reveal a specified time to wait before amputation. In situations with dry and stable gangrene, the time to wait for appropriate demarcation

is one that needs to be made on an individual basis with close monitoring. In the presented case, close wound care and regular monitoring over several months allowed the patient to avoid a major leg amputation and have a functional limb for rehabilitation after the left BKA. Functionality of a remaining limb after amputation is an important discussion to have with the patient prior to the surgery. Limb salvage is a viable option when retaining a functional limb and maintaining quality of life is the goal. Limb salvage is a difficult course as it does require a reduction in weight-bearing and regular clinic visits for wound care and close monitoring. These could lead to a decrease in quality of life for the patient. The prolonged course and risks of limb salvage need to be compared to those of a major leg amputation, such as an increase in energy expenditure, greater difficulty with transfers and subsequent lower ambulatory rates [7]. After the patient has been appropriately educated, then he or she can make an informed decision.

The World Health Organization defined quality of life as an individual perception of everyday life in the context of culture and system of values as well as it relates to personal goals and common standards [8]. There is an abundance of current literature regarding a patient's perceived quality of life after amputation. Poljak-Guberina, *et al.* found that patient satisfaction is directly related to the level of amputation [9]. The highest degree of satisfaction is found in those with minimal disability (amputations of the foot level) and the lower satisfaction in the those with the greatest disability (bilateral above knee amputation) [9]. In the case of our pa-

tient, limb salvage was attempted to avoid bilateral lower extremity amputation and increased disability.

Conclusion

This was a unique case in which a patient developed bilateral lower extremity gangrene, one leg likely caused by occlusion from the aortic dissection and the other limb likely caused by vasopressor medication that was administered during septic shock. Bilateral BKA was presented to the patient but initially. To maintain functionality and quality of life, the patient elected to pursue limb preservation. After a period of demarcation, unilateral BKA and unilateral TMA was performed. This period of demarcation allowed the patient to have a functional limb for rehabilitation after the BKA and to establish clear lines of demarcation to preserve viable skin and tissue coverage for the TMA flaps for primary closure. The patient healed well from both amputations and is now functioning with a left leg prosthesis and a custom accommodative orthotic in a stiff soled shoe for the right foot.

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