CASE STUDY

Toe Necrosis, Etiologies and Management, a Case Series

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Abstract Toe necrosis may have vast different etiologies. These include ischemia, embolus, and others. (1) The most common etiology is ischemia. It is a reduction in blood supply to a viable tissue that can lead to susceptibility to infection and tissue death. Peripheral ischemia, which is rooted in the lower limbs, is a major risk factor for toe necrosis because the basal metabolic requirements of tissue are not being sufficiently met. As a result, pain, ulcers, and gangrene commonly occur. (2) Other causes of direct and indirect toe necrosis and related lower limb gangrene include mechanical trauma, infectious, pharmacological sensitivity, cancer, blue toe syndrome, and other granulomatous diseases, such as Churg-Strauss syndrome. We present a case series of toes necrosis which resulted from different etiologies and their management.

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Introduction

Toe necrosis may have vast different etiologies. These include ischemia, embolus, and others.¹ The most common etiology is ischemia. It is a reduction in blood supply to a viable tissue that can lead to susceptibility to infection and tissue death. Peripheral ischemia, which is rooted in the lower limbs, is a major risk factor for toe necrosis because the basal metabolic requirements of tissue are not being sufficiently met. As a result, pain, ulcers, and gangrene commonly occur.² Other causes of direct and indirect toe necrosis and related lower limb gangrene include mechanical trauma, infectious, pharmacological sensitivity,

cancer, blue toe syndrome, and other granulomatous diseases, such as Churg-Strauss syndrome. We present a case series of toes necrosis which resulted from different etiologies and their management.

Case 1

A 64-year-old male with poorly controlled type 2 diabetes and a previous history of toe amputation presented with an infected third left toe with osteomyelitis and soft tissue necrosis (Fig. 1A). He underwent toe guillotine amputation (Fig. 1B) and was placed on antibiotic regimen respecting the tissue culture results. His open wound completely closed within two weeks with daily dressing change using Silvadene cream (silver sulfadiazine) (Fig. 1C).

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Figure 1 A: Osteomyelitis and soft tissue necrosis of third left toe. B: Guillotine amputation. C: Completely healed amputation site 2 weeks after surgery.

Case 2

An 82-year-old female presented two black toes on her left foot that appeared overnight. Cardiac work-up revealed a blood clot in the left ventricle. The patient was treated with anti-coagulants and observed until she demonstrated demarcated necrosis in her second and third toes (Fig. 2A, B and C). Her toes dry gangrene was painted daily with betadine and her foot was off loaded. The patient was offered a conservative approach for her dry gangrenous toes but opted for amputation due to the likelihood of faster healing, rehabilitation, and recovery. Her two necrotic toes were amputated and her incision healed in two weeks (Fig. 2D and E). She received physical therapy and was able to ambulate three weeks later in a special shoe.

Case 3

A 76-year-old female was admitted to the ICU with septic shock due to pneumonia. She was immediately placed on Levophed (Norepinephrine) to treat her hypotension. She later began to develop symmetrical, bilateral

toe necrosis (Fig. 3A and B). The patient was taken off the vasoconstrictor medication and later recovered from the septic shock with antibiotic course. Bilateral transmetatarsal amputation for all toes was offered to her but she decided to follow the most conservative approach by allowing her dry gangrenous toes to come off gradually. The patient moved out of town to live with her daughter and lost follow up with us. The purpose here was to show the most common symmetrical presentation of this condition.

Another 45 year old female with history of diabetes and heavy smoking was also admitted to the ICU with severe pneumonia leading to septic shock requiring Levophed to maintain her blood pressure. She developed right foot multiple toes necrosis as shown in Fig. 3C and D. After appropriate antibiotic therapy and resuscitation she was taken off the vasopressors and ventilator support. Her dry gangrene was observed, toes were covered with betadine daily until clear demarcation took place. She then underwent transmetatarsal amputation under general anesthesia. Fig. 3E and F show the right foot one week after surgery. Postoperatively the incision was covered daily with Neosporin ointment, Adaptic and kerlex roll until sutures removal two weeks later. Two weeks later the incisions

Figure 2 A&B: two necrotic dry gangrenous toes (2nd and 3rd). C: Demarcation line of second and third toes. D&E: Healed incision after amputation of the second and third toes.

were completely healed and the patient was able to ambulate with custom made padded shoe (Fig. 3G and H).

Case 4

A 78-year-old male with a history of severe peripheral vascular disease underwent bypass surgery to salvage a foot with rest pain which was worsening. The synthetic Gore Tex graft got infected which required rerouting and antibiotic treatment. His foot was saved but he developed necrosis in all toes (Fig. 4A and B). After infection control and demarcation, the patient had all of his toes amputated and closed with plantar cutaneous flap (Fig. 4C and D). The incision was covered with Xeroform gauze and kerlex roll and the foot was off loaded. His incisions healed three weeks later and he was able to ambulate with padded orthotic shoe.

Case 5

A 73-year-old male with a history of coronary artery disease and peripheral vascular disease presented gangrenous toes on his left foot (Fig. 5A). Laboratory investigation revealed multi-segment disease, so angioplasty and stenting were not indicated. The patient was a poor candidate for a surgical bypass graft as well. He was treated

conservatively with anticoagulant and anti-aggregate medications. His dry gangrenous toes were monitored closely at the wound center. No acute infection was detected. The great toe was treated with daily dressing changes with Silvadene cream and the third necrotic toe was painted daily with betadine. The third toe distal phalanx detached spontaneously as shown in Fig. 5B. The final pathology report on the tissue that auto-amputated confirmed tissue necrosis. The remaining open wounds on toes tips were treated conservatively until healed (Fig. 5C and D).

Case 6

57-year-old male presented to his family physician with a new onset of atrial fibrillation. He was placed on Coumadin (warfarin sodium). In the following days he developed warfarin-induced tissue necrosis. The patient was admitted to the hospital with acute renal failure as well which required hemodialysis. He was started on daily wound care including cleansing of his wounds with normal saline then application of silver sulfadiazine cream with dressing changes to his completely necrotic second toe and partially necrotic third toe (Fig. 6A). After demarcation of his tissue necrosis he underwent multiple surgical debridements to remove the necrotic tissue followed by skin grafting to the dorsum of his foot. He also underwent amputation of his right second toe and partial amputation

Figure 3 A&B: Symmetrical, bilateral toe necrosis due to Levophed. C&D: Multiple toes necrosis of right foot due to Levophed. E&F: Right foot one week after TMA. G&H: Healed right foot TMA.

Figure 4 A&B: shows toe necrosis due to severe peripheral vascular disease and occluded bypass graft. C&D: 3 weeks after toes amputation with healed incision.

of his third toe. Xeroform gauze with kerlex roll was used to cover his dorsal foot skin graft and amputation sites at second and third toes until completely healed two weeks later (Fig. 6B).

Case 7

A 31-year-old male with poorly controlled type 2 diabetes with HbA1C over 10, peripheral neuropathy and hypertension who presented to the emergency department with an infected diabetic ulcer on his right great toe with acute osteomyelitis and necrotizing infection (Fig. 7A and B). X-ray revealed an osteolytic lesion of the phalanges of the great toe (Fig. 7C). He was admitted

for IV antibiotics and amputation of the great toe with partial closure with fillet of toe flap based on the lateral neurovascular bundle (Fig. 7D and E). The open wound was treated with daily alginate dressing changes with off-loading until it completely healed one month later (Fig. 7F, G, and H).

Discussion

Lower limb ischemia can be classified into two categories: acute limb ischemia and chronic limb ischemia. Ninety percent of acute limb ischemia is either thrombotic or embolic. Exacerbation of pre-existing chronic diseases such as atherosclerosis may cause acute limb ischemia and

Figure 5 A: shows gangrenous third toe of the left foot due to severe peripheral vascular disease. B: Shows the third distal phalanx with spontaneous detachment. C&D: The third toe monitored closely until healed.

allow it to progress into chronic limb ischemia. The transition into chronic limb ischemia, which occurs over a two week period, may range from being entirely asymptomatic to characterize by severe lower limb gangrene.¹

Muscle pain due to lower extremity ischemia is the most cardinal symptom of arterial insufficiency, especially

during exercise. Intermittent claudication caused by a decrease or obstruction of the arterial blood supply to the muscle will eventually cause the patient to experience pain. Mechanical trauma is the often a result of physical insult to an artery or occlusion by the sustained application of pressure, as in the case of neglected tourniquet syndrome.³ Previously undiagnosed allergic reactions

Figure 6 A: shows tissue necrosis, second toe gangrene, partial necrosis of third toe tip. B: Healed amputation sites of the second toe and third toe tip of the right foot.

Figure 7 A&B: shows diabetic ulcer with acute osteomyelitis of the right great toe. C: X-ray reveals osteolytic lesion of the phalanges of the great toe. D&E: Amputation of great toe with partial closure with fillet of toe flap. F, G, & H: show completely healed wound of the great toe.

Figure 7 Continued

have been connected to some cases of toe necrosis. Levophed (norepinephrine bitartrate) has been implicated as a cause for toe necrosis in multiple reports.² Cannabis consumption even without vascular risk factors may lead to digital necrosis.⁴ Large cell lung cancer was recorded as a potential root cause of fifth right toe necrosis in an individual who was originally admitted to a hospital for a painful left hand. Blue toe syndrome has been reported to occur as an uncommon complication of acute pancreatitis and other case related to using intra-arterial chemotherapy. One case detailed systemic multi-organ diseases accompanied by a cyanotic toe due to small vessel occlusion by cholesterol crystals in an alcoholic individual.⁵ Blue toe syndrome has been reported as a complication of chemotherapy with intra-arterial Melphalan to treat retinoblastoma.⁶ Mediterranean Spotted Fever (MSF; also

known as Boutonneuse fever) has been linked to multiple toe necroses in one individual. MSF is a notable risk factor for clinicians because it is derived from a tick-borne pathogen and may easily go unnoticed due to absence of an associated rash.⁷ The “six P” system is recommended for clinicians to use to diagnose acute limb ischemia in patients who present sudden-onset leg pain. These signs and symptoms are pain, pallor (cyanosis), perishing (with cold), pulselessness, paresthesia, and paralysis (or reduced function).⁸

Noninvasive methods such as the use of Doppler Ultrasound and contrast angiography are recommended to determine the severity of ischemic disease. Doppler Ultrasound is widely used in North America and Europe. It compares segmental pressures to measure ankle brachial pressure index (ABI or ABPI). ABI values are calculated as

the ratio of systolic blood pressure in the leg to that of the arm. Normal values are equal or greater than one. In patients with intermittent claudication, ABIs can range from 0.5 to 0.9. A toe systolic blood pressure index measurement less than 0.6 will then confirm a diagnosis of peripheral vascular disease. ABIs may be lower than 0.5 in patients with rest pain or tissue damage. The gold standard imaging method is contrast angiography, which measures the size of the lesion, determines the pressure gradient, and produces an image of the entire area. This technique generates valuable clinical data but can be expensive, time-consuming, and cause allergic reactions in patients sensitive to contrasting agents.

An annual foot exam is recommended for all of patient who has risks of diabetes and peripheral vascular diseases in order to decrease the risk of future amputation. A physician should examine the patient for other possible risk factors like, fissured or dry skin, calluses, and tinea infections. It is important to educate high risks patients with diabetes and peripheral vascular disease on foot hygiene and shoe ware. Tight shoes may have grave consequences on these patients.

As we previously mentioned, there are numerous causes which can lead to toe necrosis. Management is entirely dependent on the cause, for example in the case of norepinephrine treatment, there is a high risk of foot ulcers among diabetic patients which might results in infection, toe necrosis and gangrene. Therefore, in order to decrease the complications associated with diabetic ulcers, the highest standard of diagnosis and care must be provided. In addition, other infection must be eradicated, any vascular occlusion hazards must be avoided, and pressure removal from the load must be addressed. These steps are very crucial for treatment protocols.⁸

Dry gangrene is not an emergency and can be treated conservatively before final surgical intervention is undertaken. Wet gangrene is a semi emergency because it may cause cellulitis and sepsis, often needing immediate surgical attention such as the case of necrotizing osteomyelitis. Often for better functional outcomes and faster rehabilitation, amputation may be the best approach.

Tumors may be associated with gangrene. Periosteal osteochondroma, a rare benign lesion involving the small bones of the feet was reported as a condition leading to necrosis. The mechanisms by which this tumor may cause toe gangrene include the tumor contributing to occlusion of blood vessels by either pressure, trauma, or possibility by malignancy transformation.⁹ Malignant melanoma can present as a pigmentation of the toes without any pain or discomfort. A case report presented with pigmentation of the left nail bed of her big toe. A diagnostic biopsy was taken and showed lentigo melanoma. Amputation of the big toe was performed at the interphalangeal joint.¹⁰ Another reported case presented with painless swelling of the left big toe. It was misdiagnosed as ingrowing toe nail at the beginning. After a core biopsy, a grade

two pleomorphic liposarcoma was diagnosed. The patient was treated with radiotherapy and amputation of the big toe and proximal half of the first metatarsal bone.¹¹ Another case report addressed blue toe syndrome where a 7-month-old boy was diagnosed with retinoblastoma. He received intra-arterial chemotherapy via a femoral artery. On the third day post-treatment, patient presented with blue, tender left foot toes. The patient was then diagnosed with a blue toe syndrome. Anticoagulant therapy commenced and after ten days post-therapy, the blue color of the toes had completely disappeared.⁶ In addition to this case, blue toe syndrome has also been reported in relation to complications of acute alcoholic pancreatitis. The rationale for this is that tissue ischemia is might be related to cholesterol crystals and thrombotic emboli which occlude small vessels.⁵ Toe necrosis is a very serious and potentially fatal condition which can occur as the result of a variety of causes. Albeit there is no consistent single treatment for the condition itself, there are many potential treatments for the underlying causes.

In summary before any surgical approach to toe necrosis the etiology must be addressed. For patients with peripheral vascular disease, smoke cessation must be encouraged, extremity reperfusion must be established with bypass grafts or angioplasty before any amputation is performed to allow healing of the surgical site. In embolic events, arrhythmias must be corrected and anticoagulation therapy must be instituted and of course demarcation of the gangrene must be observed before any surgical intervention. Patients with advanced osteomyelitis should be started on antibiotics course based on wound cultures. Radiological images should be obtained before any surgical planning to help determine the level of amputation. Patients with potential cancers a biopsy must be obtained to confirm the diagnosis and prognosis of the patients prior to surgical removal of the toe. Patients with systemic and immune processes, those must be addressed prior to any surgical approach. Traumatic injuries must be evaluated with radiographs to assess the extent of the damage and determine the level of amputation. When indicated toe or limb amputation will allow faster healing and rehabilitation of the patient.

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