Case report

Determining the timing and extent of amputation in symmetrical peripheral gangrene: a report of three cases from Korea

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Abstract

Symmetrical peripheral gangrene is a severe condition marked by symmetric acral necrosis without obstruction of the major blood vessels. This case report examines the critical decisions involved in choosing between early and delayed amputation, as well as determining the extent of the necessary amputation. We present three cases: one involving antiphospholipid syndrome, another with disseminated intravascular coagulation, and a third associated with diabetes mellitus. All three cases ultimately required amputation due to symmetrical peripheral gangrene. In the first two cases, amputation was delayed, which

is typically advantageous as it allows for the clear demarcation of necrotic tissue. However, in the third case, where infection was evident, immediate amputation was necessary despite the patient's overall poor health.

Keywords: Amputation; Antiphospholipid syndrome; Disseminated intravascular coagulation; Diabetes Mellitus; Gangrene.

Introduction

Symmetrical peripheral gangrene (SPG) is a devastating condition characterized by symmetric acral necrosis without large vessel obstruction, often associated with septicemic conditions [1] and disseminated intravascular coagulation (DIC) [2]. In this case report, we describe three cases: one of antiphospholipid syndrome, one of DIC, and one of diabetes mellitus, all of which resulted in amputation due to SPG. Our primary protocol is to delay amputation until the gangrene is well established. However, should signs of infection appear, early amputation is recommended.

Case presentation

Ethics statement

This case report was approved by the institutional ethics committee (IRB NO: KNUH 2021-10-026). Consent for publication was obtained from the patients or their family members.

Case 1

Patient information and clinical findings: A 76-year-old woman presented to the emergency department with pain in her bilateral fingers and toes, which began 1 day prior to admission.

Diagnostic assessment and final diagnosis: Photoplethysmographic examination revealed no flow in both the toes and fingers, with the exception of the right thumb. The patient's coagulation profile indicated a d-dimer level of 24.63 mg/dL and antithrombin III at 64.6%. A lupus anticoagulant value of 1.21 was also detected. Based on these findings, the patient was diagnosed with antiphospholipid syndrome.

Therapeutic intervention: Given the patient's high risk of developing sepsis, a central line was placed. The patient was treated with alprostadil and underwent heparinization. A dark discoloration appeared and

progressed symmetrically up to the middle phalanges (Fig. 1). Within 3 days after admission, the patient stabilized, and a clear demarcation line was established, leading to a series of amputations.

Follow-up and outcomes: The patient tolerated the procedures well and did not experience any recurrence.

Case 2

Patient information and clinical findings: A 49-year-old man diagnosed with rectal carcinoma (stage T3N2M0) underwent laparoscopic anterior resection of the colon. Three days post-surgery, the patient experienced anastomotic leakage. As his clinical condition worsened, he underwent an emergency segmental resection of the colon, coloanal anastomosis, and loop ileostomy. Following these procedures, he was transferred to the intensive care unit and placed on a mechanical ventilator. Blood cultures revealed the presence of Escherichia coli, and his hemoglobin level dropped to 5.9 g/dl. Treatment included a dobutamine drip and a norepinephrine drip, stabilizing his blood pressure at 100/60 mmHg.

Diagnostic assessment: Laboratory analysis indicated signs of DIC, with fibrinogen levels at 216 mg/dl, antithrombin III at 31.9%, D-dimer at 1216 mg/dL, PT at 35.2%, PTT at 57.6 seconds, INR at 2.15, and a platelet count of 70,000/cc.

Therapeutic intervention: Sixty units of platelets, two pints of packed blood cells, and 10 units of fresh frozen plasma were transfused. Treatment with vasopressors was continued, as both hands and feet became cold, and blue discoloration appeared. Within 2 days, dry gangrene appeared on the digits of all four limbs and symmetrically progressed up to the bilateral wrists and distal calves (Fig. 2). Once the patient's overall condition and the gangrene stabilized, bilateral open below-knee and below-elbow amputations were performed.

Follow-up and outcomes: The patient tolerated the procedures well and did not experience any recurrence.

Case 3

Patient information: A 53-year-old woman with end-stage kidney disease, who was undergoing dialysis, and had a long-standing history of diabetes mellitus, was admitted to the hospital. She had been receiving hemodialysis three times a week and had been on insulin injections for two years prior to her admission.

Clinical findings: One year before admission, the patient underwent percutaneous transluminal angioplasty in the right forearm, which was followed by the development of distal gangrene. Treatment included acetylsalicylic acid, clopidogrel, and warfarin. Six months before hospital admission, gangrene with infection appeared at the fourth fingertip of the right hand and on both feet (Fig. 3). Cultures from wound pus identified methicillin-resistant *Staphylococcus aureus* (MRSA), leading to the administration of oxacillin and vancomycin. A phase bone scan indicated a soft tissue infection in the left foot.

The patient's condition continued to deteriorate, characterized by persistent fever and poor oral intake. Concurrently, the C-reactive protein (CRP) levels consistently rose, reaching values above 30.79 mg/dL.

Therapeutic intervention: Amputation was initially performed on the right hand and fourth finger, followed by the amputation of the first toe on the right foot, and subsequently, the fourth finger of the left foot. A stronger antibiotic, meropenem, was administered, along with regular incision and drainage procedures. Despite these measures, wound healing remained poor.

Follow-up and outcomes: The patient's general condition kept worsening until her death 3 months after admission.

Discussion

In the first case, antiphospholipid syndrome was identified as the underlying cause of gangrene. Lupus anticoagulants are associated with an odds ratio for thrombosis that is 5 to 16 times higher than that of controls. This increased risk applies regardless of the thrombosis's location and type, and whether systemic lupus erythematosus is present [3]. The "two-hit" model of thrombosis associated with antiphospholipid syndrome proposes an initial "first hit" that disrupts the endothelium, followed by a "second hit" that promotes thrombus formation [4]. The presence of sepsis in this patient exacerbated the reduction in blood supply to the most distal parts of the body. Heparinization was implemented to prevent further clot formation, although it could not reverse the existing damage.

The second patient had a neoplastic condition with *Escherichia coli* isolated from the blood culture. *E. coli* contains lipopolysaccharide in its outer layer, which can trigger endotoxic shock. This, in turn, activates the coagulation system, leading to consumptive coagulopathy. Fibrin thrombi were observed in skin

biopsy specimens or those from various organs with a history of SPG during the postmortem examination, suggesting DIC [2].

Despite recognizing the inotropic agent as the cause of gangrene progression in the second case, the cost of discontinuing the treatment was deemed too high. A prompt surgical approach was only considered once the patient's general condition had stabilized. It is also advisable to wait until a clear demarcation line of gangrene is established, as viable tissues may exist beneath the necrotic skin [5]. The extent of the early symptoms will likely decrease after revascularization around the gangrene. Therefore, early amputation could potentially extend the gangrene or lead surgeons to overestimate the necessary level of amputation.

In the third patient, the cause of gangrene was undetermined. However, the patient had diabetes mellitus. Microangiopathy in patients with diabetes mellitus impairs blood flow, especially to the most distal parts, and initially creates dry gangrene [6]. Additionally, diabetes mellitus increases susceptibility to infections [7].

In the third case, early amputation was warranted because the increasing CRP indicated infection. For patients with diabetes, many authors advocate early surgery since infections may further disturb local microcirculation and antibiotics cannot penetrate the site of infection [8,9]. Wound culture also revealed infection by MRSA, which is associated with worse outcomes in patients with diabetic foot infections.

The patients in the first two cases tolerated the procedures well and experienced no recurrence. With the aid of suitable prostheses, they were able to carry out their daily activities. Therefore, these cases highlight the importance of tailored assessments that consider the underlying condition, the progression of necrosis, and the status of infection to enhance outcomes and minimize morbidity in the management of SPG.

In conclusion, SPG is a severe complication that necessitates careful consideration of both the timing and level of amputation. The cases discussed here demonstrate that a delayed approach to amputation is generally advantageous in instances of antiphospholipid syndrome and DIC, as it allows for a well-demarcated border of necrosis to form. However, early amputation is imperative in the presence of infection, such as in diabetes mellitus with MRSA infection, to prevent further systemic deterioration. The

decision on the appropriate level of amputation hinges on achieving clear demarcation of necrotic tissue to avoid unnecessary removal of viable tissue, while also taking into account the patient's overall condition and response to revascularization efforts. In situations where infection impairs local blood flow or where antibiotics are ineffective in penetrating the affected area, early intervention at a higher level of amputation may be necessary to control the infection and improve the potential for healing.

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Conflict of interest

No potential conflict of interest relevant to this article was reported.

Funding

This research was supported by the Korea Health Technology R&D Project grant through the Korea Health Industry Development Institute (KHIDI), funded by the Ministry of Health & Welfare, Republic of Korea (grant number: HR22C1832).

Data availability

Not applicable.

Acknowledgments

Not applicable.

Supplementary materials

Not applicable.

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Figure Legend

Fig. 1. A 76-year-old woman with sharp aggravating pain and cyanotic changes on the tips of fingers and toes. She was diagnosed with antiphospholipid syndrome and later experienced dark discoloration with symmetric progression up to middle phalanges. The patient then underwent a series of amputations involving the fingers and toes on both sides.

Fig. 2. A 49-year-old man who later showed a septic manifestation and consumptive coagulopathy. On the second day of inotropic use, dry gangrene of the digits developed and progressed symmetrically up to (A) the bilateral wrists and (B) distal calf, including the ankles and feet.

Fig. 3. A 53-year-old woman with end-stage kidney disease on dialysis and a long history of diabetes mellitus had gangrene with infection at the fourth fingertip of her right hand and both feet. Due to the presence of an infection, the patient underwent prompt amputation.