

Wound treatment strategies during COVID-19 pandemic: An expert opinion

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ABSTRACT

The COVID-19 pandemic has presented a great challenge for the healthcare systems and healthcare workers worldwide. The resources and the infrastructure of the healthcare systems are reorganized to provide care for abundant number of pandemic patients. All elective procedures and treatments have either cancelled or postponed. Treatment of lower extremity ulcers may be misclassified as non-essential during this pandemic; however, without regular best wound care, these ulcers are at a great risk of becoming quickly infected, which may lead to an increased rate of septicemia, amputations, and even deaths in this fragile patient population. In this review, we discuss the treatment strategies for lower leg ulcers and vascular pathologies during pandemic and provide an algorithm for triage which may be a useful guide for vascular surgeons.

Keywords: COVID-19, lower extremity ulcers, pandemic, wound.

The severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2; COVID-19) pandemic has presented a novel challenge for the healthcare community across the world, creating significant change in systems, hampering the best practices for many disciplines and leaving large numbers of patients without care. The pandemic is expected to demand more hospital bed capacity.^[1,2] Currently, the healthcare system has attempted to adapt its sources and infrastructure to serve the anticipated of masses of pandemic patients, hence the governments advise to treat only urgent cases, postpone elective procedures, and to shut down all non-essential medical services. Providing the clinicians evidence-based guidance

during this COVID-19 crisis would ultimately help to use the resources and hospital beds efficiently.

The prevalence of lower extremity ulcers ranges from 0.18 to 2%, and it is up to 5% in patients over 65 years of age.^[3] Treatment of lower extremity ulcers can be misclassified as non-essential during this pandemic; however, without regular best wound care, these ulcers are at a risk of becoming quickly infected, which may lead to an increased rate of septicemia, amputations, and even deaths in this fragile patient population.^[4] On the other hand, how to treat these individuals during pandemic is a dilemma. Many wound care centers have started to use telemedicine to keep their patients away from the medical facilities,^[5]

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since these patients usually have comorbidities such as advanced age, cardiac problems, hypertension, chronic renal failure, chronic lung disease, neurological problems, and diabetes which make them vulnerable to become infected with COVID-19.^[6]

In the light of these data, we have already narrowed our in-hospital treatment indications and started to treat most of the patients as outpatients which we used to treat inpatient in the hospital; furthermore, we have changed our approach to follow patients in the outpatient clinic. We have also cancelled their appointments, postponed elective surgeries, and educated patients how to change their own dressings and started to use tele-medicine for the follow-up. There are similar approaches and practices all over the world where each country and associations have developed their own algorithms.

In this context, we have prepared an expert opinion paper regarding our recommendations on treatment strategies of lower extremity wounds during the COVID-19 pandemic.

We divide lower extremity wounds into three main subheadings as follows:

1. Wounds related to arterial problems/ischemic wounds
2. Wounds related to lymphovenous problems
3. Diabetic foot

In each section, we will discuss the following topics:

- a. Which patients should be treated as emergency and be operated?
- b. Which patients should be hospitalized?
- c. Which patients should be treated at the outpatient clinic and what should be the frequency of the hospital visits?
- d. How can we follow and treat patients at home? How is telemedicine used in wound care at home setting?

TREATMENT STRATEGIES IN ISCHEMIC WOUNDS

The most important factor which determines the timing of an imminent surgery is the presence of infection (Table 1).^[7] The increased consumption and the unmet need for oxygen in infected tissue lead to increase in pain and necrosis, eventually resulting in the overgrowth of infection and

deterioration of the patient's health condition. In an extremity with infection and necrosis, which is not salvageable, amputation (transmetatarsal, below-the-knee, or above-the-knee) should not be postponed. The level of amputation should be determined by a multidisciplinary team consisting of vascular surgeon, infectious diseases physician, orthopedic surgeon, plastic surgeon, endocrinologist or diabetologist, interventional radiologist (if present), podiatrist (if present), hyperbaric oxygen physician (if present). The arterial blood flow to the extremity, age and general condition of the patient, comorbidities of the patient, the anticipated length of postoperative hospital stay, and the anticipated need for re-amputations along with prolonged wound care, and postoperative morbidity that would render the patient hospital-bound are the major factors which are expected to influence and lead this expert group. Although the questions of when and how to revascularize this group of patients are beyond the scope of this article, the revascularization procedure harbors the same questions.

Similarly, in a patient with acute limb ischemia and wet gangrene where there is progressive tissue loss and ascending cellulitis, urgent surgical debridement should be performed to diminish the bacterial load and to save the extremity and the patient's life. The debridement procedure should precede the revascularization. The timing and the type of revascularization is a case-by-case decision. A broad-spectrum antibiotic treatment must be administered immediately via the intravenous line and continued postoperatively. The treatment should be planned under the supervision of an infectious diseases specialist. The duration of the antibiotic treatment and route of administration are at the discretion of the treating physician depending on the pandemic circumstances.

Another group of patients which demand urgent surgery (amputation) are those with chronic limb ischemia and non-salvageable limbs. Non-salvageability can be attributed to advanced lower extremity arterial disease, advanced tissue loss, poor health status of the patient precluding timely intervention or all of the above. The rationale of primary and precedent amputation should be to save the life and avoid further clinical deterioration of the patient, which is usually inevitable if left untreated. Furthermore, delaying surgery may lead to an in-elective emergent intervention in the near future, resulting in higher morbidity and mortality related to the scant pandemic circumstances of healthcare systems. The hospitalization period of this group should be limited. The preoperative management and evaluation can be on the outpatient

Table 1. Infection criteria according to WIfI classification^[13]

Signs of local infection (mild and moderate infection)	Signs of systemic infection (severe infection)
Local swelling or induration	Local infection with the signs of SIRS, as manifested by two or more of the following:
Erythema >0.5 to 2 cm around the ulcer	1. Temperature >38 or <36°C
Local tenderness or pain	2. Heart rate >90 beats/min
Local warmth	3. Respiratory rate >20 breaths/min or PaCO ₂ <32 mmHg
Purulent discharge (thick, opaque to white, or sanguineous secretion)	4. White blood cell count >12,000 or <4000 mm ³ or 10% immature band forms
<i>Moderate infection</i>	
Local infection (as described above) with erythema >2 cm, or involving 2 structures deeper than skin and subcutaneous tissues (eg, abscess, osteomyelitis, septic arthritis, fasciitis), and no systemic inflammatory response signs	

WIfI Classification: Wound, Ischemia, and foot Infection Classification.

basis and the postoperative hospitalization should be shorter than optimal hospital stay for these procedures. We recommend discharging these patients within three to five days after the operation and to follow through telemedicine. Prolonged treatment with oral antibiotics and daily dressing change may be a legitimate practice in early discharged patients.

There is a huge group of patients who are admitted to vascular surgery outpatient wards with chronic peripheral vascular disease. Some of these patients describe claudication and have non-healing ulcers, whereas some have rest pain in the lower extremity along with ulcers or necrotic or infected toes. In this group of patients, the best medical care includes revascularization first, which is followed by amputation of the affected toes and wound care.^[8] During COVID-19 pandemic, it would be unwise to follow the same algorithm, since pandemic-related risks outweigh the risks which are brought forth by this chronic disease. We recommend postponing surgical interventions in this group and following patients on the outpatient basis. Pain killers and broad-spectrum oral antibiotics may be prescribed in excessive amounts and in advance for extended treatment and to keep the patient away from the medical facilities.

The same approach is true for patients with non-healing and/or necrotic surgical incision wounds. These wounds are usually the tip of an iceberg of an underlying chronic arterial insufficiency. The treatment strategy for these wounds is revascularization first (if possible), and debridement and wound treatment next. Revascularization and surgical debridement should be postponed, unless the wounds are infected. Hydrogels, gels with alginates or antiseptics, antibiotic creams can be used to debride and keep the necrotic

tissue clean in the interim. Zinc oxide can be used to prevent moist in the perimeter of the wound. The periwound skin must be kept dry to avoid ischemic wounds from getting infected.^[9] Prophylactic antibiotic treatment can be initiated in case of suspicion or history of secondary infection. If the non-healing wound is a slow healing one with a granulated wound bed, skin grafting procedure may be considered. Of note, we recommend postponing these procedures, unless there is a great concern about uncomplicated, secondary wound healing and proper wound care. The patient can be followed in the outpatient clinic at regular intervals.

Patients should be questioned in detail about whether they can do wound care and change dressings at home on their own. The patients and/or their caregivers should be trained to apply wound care and change the dressings, preferably daily to avoid wound infection. If the caregiver does not live with the patient, he/she should be also trained about social distancing, providing wound care under sterile conditions, using a face mask all the time during wound treatment, and ventilating the room during or after each visit by the caregiver. The patient or the caregiver should be informed about how to use telemedicine such as shooting appropriate photographs and sharing with the healthcare staff.

TREATMENT STRATEGIES IN LYMPHOVENOUS WOUNDS

Edema, exudation, and exudation-related skin problems are common in both venous and lymphedema ulcers. Compression therapy is the mainstay of the treatment for these ulcers and, therefore, these two types of leg ulcers are considered in the same section.

Patients with lymphovenous edema usually have a dry, itchy skin which is vulnerable to lose the skin integrity. After an unnoticeable physical trauma such as insect bite or itching, the skin integrity is lost and a bacterial infection rises. Once the infection starts, the wound enlarges rapidly, and the exudation increases. Lymphovenous ulcers are usually heavily exuding ulcers. This increased amount of exudation causes periwound skin damage, leading to maceration, eczematous skin change, and increase in wound depth and diameter. Eventually local infection may turn into systemic infection and local wound care may be insufficient in breaking this vicious cycle.^[10]

The most optimal treatment in venous ulcers had three main components according to the American Venous Forum Guideline:^[11]

1. Treating the underlying venous disorder surgically, when possible
2. Compression therapy
3. Best wound care

We strongly recommend postponing all the venous surgical procedures during COVID-19 pandemic. The only exception for this can be abundant bleeding of the varicosities due to ulcer, where most of these bleeding episodes can be stopped with prolonged topical compression on the site of bleeding or suturing the veins under local anesthesia.

Regarding which patients should be hospitalized, we recommend that priority should be given to the wounds: (i) with signs of systemic infection (Table 1); (ii) heavily exuding wounds with local skin infection requiring dressing change more than once a day; and (iii) lymphovenous wounds with arterial insufficiency (mixed wounds) that need urgent revascularization, close follow-up, and intravenous administration of broad-spectrum antibiotics.

The patients with lymphovenous ulcers are usually treated at the outpatient clinics where compression treatment is applied either with two- or four-layer bandages.^[12] The frequency of the hospital visits is determined by many factors, such as the status of the wound, amount of wound exudation, patient's social circumstances and economic status, or availability of the healthcare facilities. The most common practice is to change the compression bandages twice a week.^[13] In the time of pandemic war, the indications should be narrowed and the frequency of dressing should be reduced for the rest of the lymphovenous ulcer patients. Based on these data, our recommendations are as follows:

1. Shifting from bandages to compression hosiery and wraps

The patients and their caregivers should be encouraged to change their own dressings. Absorbent dressings such as alginates, hydrofibers, and foams which can stay on the wound for more than three days may be preferred. Silver dressings can be combined to treat local infections or to prevent the wound from getting infected.^[9] The frequency of dressing change can be determined according to the amount and nature of the exudation. In case of a suspicion of a local infection and highly exudation, it would be wise to perform daily wound cleansing and dressing change. Swap cultures from the exudation or tissue cultures from different sites of the wound should be obtained in each hospital visit. Antibiotics should be given, when a local infection is suspected or systemic signs of infection are present (Table 1).

It is quite unusual for a patient or non-medical personnel to apply two- or four-layer compression bandages in the right manner alone. This option can be attempted by the first hand. The most reasonable and frequently used options are compression hosiery and self-adjustable wraps.

There are pros and cons in the use of both garment types. Ulcer stockings are difficult to wear, particularly in highly edematous legs, ulcers with stasis dermatitis, highly exuding ulcers, infected ulcers, irregular shaped extremities, patients with peripheral arterial disease, patients with orthopedic problems, in elderly population who are unable to wear these tight stocking alone and in large ulcers due to pain caused by the stockings.

Self-adjustable wraps are available in the market for more than five years and their use has been increasing worldwide. They are more expensive, compared to compression hosiery, work similar to short stretch bandages, and can be, thus, safely and effectively used for lymphedema as well with a longer durability than stockings and can easily be applied even by an elderly individual with reduced muscle power.^[12] We recommend using compression wraps for highly exuding wounds, infected wounds, and wounds with periwound dermatitis that need frequent dressing change and application of creams.

Intermittent pneumatic compression devices can be another option. The indications listed for compression wraps apply for this treatment. However, the high sale price of the device, lower effectivity compared to bandages, and long durations of being bed ridden and immobile during treatment are the major drawbacks.

2. Shifting to more sparse follow-up intervals by keeping the bandages *in situ* for more than four days (between 5 to seven days at most)

We recommend prolonging the follow-up intervals of patients who are not capable of changing their dressings and applying any form of compression treatment at home for any reason. Superabsorbent dressings made of polymer and cellulose or multi-layers of standard absorbent dressings such as alginates, hydro fibers and foams should be used to avoid leakages, ruining the integrity of the bandages, and precluding dressing change earlier than planned. Non-adherent paraffin or silicon embedded interface dressings should be preferred in low exuding or dry wounds to avoid sticking of the gauze or other types of dressings to the wound. Silver-containing dressings can be chosen in suspicion of local wound infection or bacterial contamination.

If the patient or the caregiver desire to apply his/her own multilayer bandage, he/she can be trained in the outpatient clinic on how to apply bandages, the pitfalls of self-bandaging, and maintaining the integrity of the bandages. Each wound clinic can shoot informative videos on how to apply self-bandages and share them with their patients or on the internet.

If passive wound dressings are not available, negative pressure wound treatment (or vacuum-assisted closure [VAC]) can be used under compression bandages as an option, unless the patient has accompanying peripheral arterial disease. The foam can be left in place up to five to seven days.

TREATMENT STRATEGIES IN DIABETIC FOOT

Diabetic foot ulcer treatment regarding vascular revascularization procedures, debridement and amputations during pandemic circumstances can be neglected; however, diabetic patients are a fragile group of patients who are at a high risk of getting infected, losing a limb, or die if not treated promptly.^[14,15] On the other hand, treating these patients in the hospital setting may result in an increased risk of mortality from COVID-19.^[16]

Diabetic foot ulcers present with broad-spectrum of clinical symptoms. We recommend triaging the diabetic foot patients according to the presence of infection and limb ischemia. If limb-threatening ischemia is suspected, the benefit of revascularization to improve blood perfusion, increase wound healing rate, and avoid amputation outweighs the risk of getting

infected in the hospital from COVID-19 infection and the mortality risk caused by this infection.

If the patients present with foot ulcer, severe systemic infection and acute limb-threatening ischemia, we consider these patients to have a high risk for mortality and limb loss; hence, we advise urgent debridement followed by the revascularization procedure. These patients must be hospitalized; tissue and blood cultures must be taken; intravenous broad-spectrum antibiotic therapy must be initiated, and blood glucose must be monitored closely and treated with short-acting insulin promptly.^[17]

If the patients present with foot ulcer with mild/moderate infection and acute/chronic limb ischemia, they should be accepted to have a moderate risk for limb loss and these patients must be hospitalized and the same aforementioned algorithm must be followed and elective revascularization must be performed during the hospitalization period.

The other group of patients with infection are the ones who present with acute/chronic osteomyelitis and those with acute Charcot foot. These patients belong to the low-risk group; however, both clinical presentations require timely elective foot surgery and proper offloading with total contact casts and, therefore, they should be treated at the hospital.

The last group is the non-healing foot ulcers without infection or ischemia. We recommend following these patients in the outpatient clinic every two to three weeks or at home through telemedicine follow-up with pictures and/or videocall with them or their caregivers.

FOLLOW-UP CONSULTATIONS VIA TELEMEDICINE

Telemedicine has been used worldwide for a long time. With the uprise of COVID-19 pandemic, many clinicians have to adopt the use of telemedicine. The most frequently used method by the authors of this document are the photos in combination with text messages.

1. Before starting telemedicine follow-ups, inform your patient and the caregivers that telemedicine does not replace standard treatment. Teach the patient and/or the caregiver how to shoot proper photos of the wound and the foot (i.e., adjusting lighting and focus and shooting from different angles).
2. Ask them to shoot the photo of the removed dressing to evaluate the amount and nature of the pus or the exudation.

3. Be aware that diagnosing based on a photo is not very reliable. Try to obtain additional information about the wound such as the temperature of the foot, presence of swelling (compared to the contralateral extremity), malodor, pain, depth of the wound cavity, presence of tunneling, or undermining in the wound, etc.
4. Try to obtain information about the general condition of the patient such as presence of fever, shivering, dizziness, fatigue, or loss of appetite, etc.
5. Tell your patients to contact your clinic, if they experience any unusual change in the patient or the wound.
6. Always register telemedicine consultations in the medical file of the patients and upload the photos indicating the dates, if possible.

COVID-19 AND WOUNDS AT THE DISTAL EXTREMITIES

There is some concern that some of patients during childhood have skin lesions on their hands and feet which may be linked to COVID-19. The lesions resemble ischemic or necrotic lesions and are possibly due to a distal necrosis process. Some of these patients with lesions seem to have no other accompanying symptoms. These findings were first described by an Italian physician during the COVID-19 crisis.^[18] Some physicians have also suggested that COVID-19 may induce deterioration of the coagulation system and integrity of endothelium, thereby, resulting in the formation of these lesions.^[19] Although the exact etiology of these lesions still remains to be elucidated, it will be beneficial for our colleagues to keep this rare entity in mind as a reminder in the interim, when they encounter ischemic distal wounds.

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