

## Nonhealing Wounds, Part 1: Diagnosis in the Urgent Care Center

**Urgent message:** Nonhealing wounds not only are prevalent but also are complex in terms of wound management and treating the accompanying comorbid disease. By both recognizing the diagnosis and understanding how to treat these wounds, urgent care providers have the opportunity to differentiate life-threatening illness from life-inhibiting disease and improve outcomes for patients.

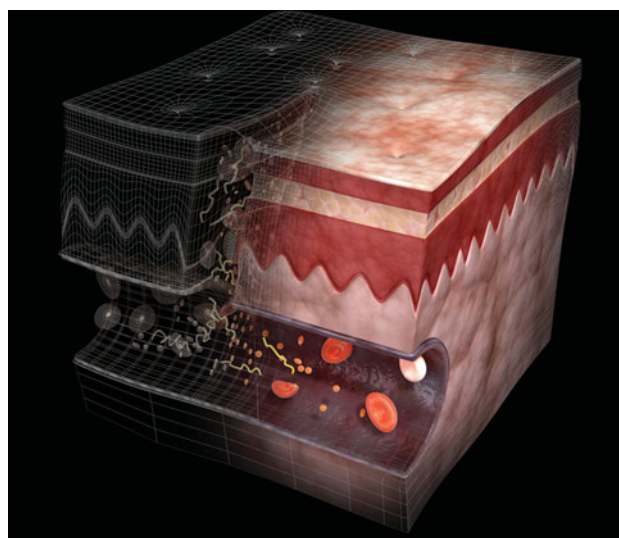
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### Introduction

An estimated 6 million people in the United States have a nonhealing wound, with a 1% lifetime incidence for the total population.<sup>1,2</sup> This number is expected to increase with the exponential growth of the population of older people.<sup>3</sup> The urgent care provider has a unique opportunity to improve quality of life and patient outcomes by understanding the fundamentals, diagnosis, and treatment of nonhealing wounds.

Nonhealing wounds (also called chronic wounds) are typically defined by the source of the wound (i.e., venous

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vs. arterial insufficiency) and have proven unresponsive to initial therapy or persist despite continued care.<sup>1</sup> The majority of nonhealing wounds affect the lower extrem-

ities and are associated with circulation problems.<sup>2</sup> Non-healing wounds are often a physical manifestation of a chronic illness. Failure to recognize the significance of such wounds and initiate care may decrease quality of life, increase morbidity and mortality, and increase health-care expense for the patient.<sup>3</sup> Understanding critical components of the medical history and physical examination, indications and best evidence for treatment, and the need for appropriate follow-up care is crucial for effective and efficient management of such a debilitating condition in the urgent care setting.

### Pathophysiology of Acute Versus Chronic Wounds

Although an in-depth understanding of the pathophysiology of chronic wounds is not necessary in order to provide treatment, a basic understanding of why some wounds become chronic and some heal normally is useful.

Normal healing of an acute wound begins with an injury that damages the blood vessels, initiating a cascade of blood clotting and platelet aggregation, which releases growth factors that draw inflammatory cells (neutrophils and macrophages) into the injured area, destroying bacteria. This phase peaks during the first 2 to 3 days. The activation of macrophages results in the release of growth factors and pro-inflammatory cytokines, which start wound healing.

The chronic wound, however, has a persistent pro-inflammatory stimulus that may be caused by

- Repetitive trauma
- Local tissue ischemia
- Necrotic tissue
- Heavy bacterial burden
- Tissue breakdown

In a chronic wound, the neutrophils and macrophages continue to secrete the inflammatory cytokines, which destroy the wound matrix and impair the deposition of connective tissue. This chronic inflammatory state can be self-sustaining and prevents wound healing.

### Initial Assessment

Emergency complications of nonhealing wounds include rapidly progressive infection, sepsis, limb ischemia, deep vein thrombosis (DVT), and pulmonary embolism. Tachycardia, hypotension, or tachypnea

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(1) alone or (2) in conjunction with each other or with associated fever is considered an overt sign of clinical instability or systemic illness. A progressing chronic wound may also be the physical manifestation of exacerbation of an underlying medical condition. These can include poorly controlled

diabetes, peripheral vascular disease, malnutrition, and the simple inability of the patient to care for herself or himself. In any such case, the patient would likely benefit from rapid intervention and treatment in a setting of higher acuity.

### Differential Diagnosis

The differential diagnosis is broad and includes many entities, such as acute trauma, autoimmune disorders, and cancer. The list provided here is not comprehensive, but it delineates some key diagnoses that should be considered in the initial approach to a nonhealing wound.

- **Trauma:** Acute injuries may be mistaken for chronic wounds if they are contaminated with debris or discolored, as in the case of partial-thickness and full-thickness burns.
- **Viral infection:** Herpes zoster (shingles) and herpes simplex infections may present with cutaneous wounds or ulcers. Confirmation is made with a viral culture.
- **Bacterial infection:** Patients may have simple streptococcal infections (as in the case of impetigo), methicillin-resistant *Staphylococcus aureus* infections, or, even more concerning, polymicrobial necrotizing infections. Bacterial infections may affect any layer of tissue, from the dermis through the muscle fascia (fasciitis) and to the bone (osteomyelitis).
- **Fungal infection:** The most common fungal infection causing a lower-extremity wound is tinea pedis. Interdigital lesions are highly suggestive of this condition. Topical antifungals are the recommended initial treatment.
- **Atypical infections:** Tuberculosis, leprosy, syphilis, leishmaniasis, amebiasis, blastomycosis, and coccidioidomycosis may all manifest with resistant cutaneous lesions in the right patient population or location or with the right travel history.
- **Bites:** Spider, tick, and scorpion bites and snakebites may present with acute wounds or may be mistaken for chronic wounds. Scabies may also manifest as

nonhealing wounds, which are typically extremely pruritic and affect the hands, feet, and flexor surfaces.

- **Vascular issues:** Venous-insufficiency and arterial-insufficiency ulcers are among the most common nonhealing wounds. However, septic or thrombotic emboli may also manifest as nonhealing wounds.
- **Inflammatory issues:** Vasculitis, polyarteritis nodosa, dermatitis, psoriasis, lichen simplex chronicus, erythema nodosum, pyogenic granuloma, lupus, and bullous pemphigoid are all typically inflammatory conditions and not infections (though they may be confused with infectious disorders) and vary widely in etiology and treatment.
- **Malignancy:** Cancers may manifest as nonhealing wounds. These are commonly cutaneous in origin (squamous cell carcinoma, basal cell carcinoma) but may also be caused by lymphoma and melanoma.

### History of Present Illness

As you interview the patient, consider the following items as they pertain to the patient's chronic wound.<sup>3</sup>

- Wound characteristics:
  - How long has the wound been present?
  - Is the wound changing? Redness, drainage, foul odor, progression, and discoloration can all be signs of acute infection.
  - Is it painful? Pain and progression of the wound have the highest correlation with bacterial infection.<sup>4</sup>
  - What therapy has already been tried, and has it been effective?
- Associated symptoms:
  - Fevers or chills can be indications of systemic infection.
  - Numbness or paresthesias may suggest vascular compromise.
  - Polyuria, polydipsia, and polyphagia may be manifestations of underlying hyperglycemia.
- Medical history:
  - Is there a history of nonhealing wounds? If so, how were they treated?
  - Is there a personal or family history of DVT or clotting disorder?
  - Malignancy, chemotherapy, sickle cell disease, previous organ transplantation, and human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) are only a few of the disease states or conditions that lower a host's immunity and increase susceptibility to acute infections and nonhealing wounds.

- Surgical history:
  - Recent surgery should raise suspicion for retained or infected surgical equipment.
  - Recent acute wound closure should raise suspicion for infection or a retained foreign body.
- Social history:
  - Poor sanitation
  - Poor diet
  - Inability to perform activities of daily living
  - Elder abuse
- Overall goals of care: Some patients with end-stage or terminal illnesses may seek only to keep wound drainage and odor under control, as opposed to undergoing the process of complete wound healing.

### Physical Examination

The physical examination should begin with obtaining a complete set of vital signs and assessing the patient's general appearance. Unstable vital signs, altered mental status, cachexia, mottled or ashen skin, and acute distress from pain are all indications for rapid intervention and transfer to an acute-care setting. Most patients who present with a nonhealing wound are elderly or have multiple comorbidities, and thus a complete examination is recommended. Here we focus on critical elements most likely to guide treatment.

### Systemic Inflammatory Response Syndrome

Systemic inflammatory response syndrome (SIRS) is the body's response to an acute insult (e.g., infection, burn, surgery). SIRS is defined by the presence of two or more of the following:

- Temperature >100.4°F (38°C) or <96.8°F (36°C)
- Heart rate >90 beats/min
- Respiratory rate >20/min or arterial carbon dioxide concentration <32 mm Hg
- White blood cell count >12,000/μL or >10% immature band forms

The presence of two or more SIRS criteria and a presumed source of infection (this may or may not be from a nonhealing wound) have traditionally been the accepted definition of sepsis and should prompt rapid intervention and transfer to an acute-care setting, though new definitions have been published.<sup>5</sup>

### Lower Extremities

#### Look

The examination of the lower extremities should begin with the general appearance of the legs.

- Dark blue, red, or purple discoloration can be characteristic of venous insufficiency or long-standing edema. This discoloration is worsened in the dependent position and lessens with elevation. In contrast, arterial insufficiency is typically characterized by pale skin.
  - Hemosiderin staining (reddish-gray or brown discoloration of the skin, most commonly on the anterior portion of the lower leg and the ankle) is a cardinal sign of venous insufficiency.
  - Dilated, enlarged, palpable, and often bluish veins (varicose veins) are characteristic of venous insufficiency.
  - Cellulitis is typically bright red and should be considered if erythema is noted farther than 1 cm from the edge of the wound.
  - Thin and shiny skin, pale color, an absence of hair growth, and thickened and/or brittle nails can be a sign of arterial insufficiency or diabetic neuropathy.
  - Unilateral edema should raise concerns for DVT, because most chronic forms of edema are symmetrical.
  - Deformity of the foot may indicate repeated trauma and suggests neuropathy.
- Common pitfalls when identifying pulses:
    - The pads of digits 2, 3, or 4 should be used to reduce the tendency to mistake the health-care provider's pulse for the patient's pulse.
    - Correlation with the patients' upper-extremity pulses or continuous monitoring should be used to further avoid mistaking the provider's pulse for the patient's pulse.
    - Excessive pressure over the artery may falsely produce nonpalpable pulses.
  - Assess capillary refill. The normal range is 2 to 3 seconds. Delayed return may indicate arterial insufficiency, whereas rapid return may be seen in cellulitis.
    - Evaluate the nerves by checking sensation in the web space, lateral heel, and sole of the foot. Diabetic neuropathy is symmetrical and often follows a "glove-stocking" distribution. Unilateral nerve deficits should prompt a more detailed neurologic examination. Proprioception (Is the patient able to identify movements of the toes?) is also lost symmetrically with neuropathy.
    - Test motor function via plantarflexion and dorsiflexion of the foot. Symmetrical weakness and/or muscle atrophy can be seen with chronic immobility, poor nutrition, and arterial insufficiency.

### *Feel*

- Cool (hypothermic) skin suggests arterial insufficiency. Normothermic skin is common with venous insufficiency. Cellulitis is typically characterized by warm (hyperthermic) skin.
- Autonomic dysfunction leads to decreased secretions, causing dry, cracked, and calloused skin.<sup>3</sup>
- Edema may be pitting (when impressions made by fingers remain after compression) or nonpitting. In long-term, poorly controlled venous insufficiency, soft tissue may harden and develop a woody-textured, nonpitting edema termed lipodermatosclerosis. Lymphedema is also typically nonpitting.
- Palpate the distal pulses. If they are not palpable, they should be identified and marked via Doppler ultrasound. An absence of pulses on Doppler ultrasound represents a vascular emergency, for which transfer to an acute-care setting is indicated.
  - The dorsalis pedis artery is located on the dorsum of the foot, lateral to the extensor tendon of the big toe.
  - The posterior tibial artery is located on the medial aspect of the foot, posterior to the medial malleolus.

### *The Wound*

- Document the location, length, estimated depth, and general shape of the wound. Wound characteristics vary by etiology, but nonhealing wounds typically have a rounded edge and calloused appearance.
- Proximity to or involvement of underlying tendons, nerves, or arteries should be investigated.
- Assessment for the presence of foreign bodies should be performed, as should irrigation of the wound. Local anesthesia can be used as indicated.
- A nonhealing wound represents a chronic inflammatory condition as the wound attempts to heal. Thus, mild surrounding erythema is expected. Cellulitis should be considered if inflammation or erythema is noted farther than 1 cm from the edge of the wound.
- Is the ulcer mobile, or is it fixed to deeper layers of tissue? Mobile ulcers are typically superficial, whereas fixed ulcers suggest involvement of deeper structures.
- Dead tissue and debris may make debridement necessary for accurate assessment of the wound base.

### Examination Techniques

- **Ankle-brachial index (ABI):** The ABI is the ratio of lower-extremity to upper-extremity systolic blood pressure (Table 1). ABIs should be obtained for all leg ulcers, because clinical examination findings are not independently sufficient to include or exclude the diagnosis.<sup>6,7</sup>
- **Toe-brachial index (TBI):** A TBI is used when the ABI is abnormally high because atherosclerosis has caused the formation of plaque and calcification in the leg arteries. Because the toe vasculature does not develop calcifications, the TBI can be a more reliable predictor of extremity blood flow.
- **Probing:** The depth of the wound should be assessed by inserting a sterile (ideally metal) instrument into the wound to identify involvement of deep structures. If the probe reaches bone, osteomyelitis should be strongly suspected and arrangements should be made for further evaluation and definitive diagnosis.
- **Elevation:** Simple elevation of the lower extremity

**Table 1. Ankle-Brachial Index**

Category	Value
Normal	>0.96
Mild obstruction	0.71–0.96
Moderate obstruction	0.31–0.71
Severe obstruction	<0.31

can provide valuable information.

- Pain related to venous insufficiency is worsened in the dependent position and lessened with elevation.
- Pain related to arterial insufficiency is lessened in the dependent position and worsened with elevation.
- Dependent rubor can be differentiated from cellulitis by placing the patient in the supine position and elevating the leg approximately 60°. If the discoloration fades, dependent rubor is more likely than cellulitis.



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**Table 2. The Levine Technique**

1. Irrigate the tissue with normal saline solution.
2. Swab a 1-cm<sup>2</sup> area of viable tissue for 5 minutes with enough force to produce exudate.

- **Homans sign:** Homans sign has been defined as pain in the calf (posterior compartment) with passive dorsiflexion of the foot. Its presence may suggest DVT in the right clinical context; however, the absence of Homans sign does not rule out DVT.

### Diagnostic Work-Up

The diagnosis of a nonhealing wound is largely clinical and is based on findings from the medical history and physical examination. Diagnostic studies should be tailored to elaborating the suspected causative or confounding diagnosis (e.g., lower-extremity ultrasonography if DVT is suspected). Once the diagnosis of a nonhealing wound is made, the provider must determine whether the wound is infected and to what extent. Similarly, infection in a nonhealing wound is primarily clinical, with fever, redness (>1 cm beyond the wound margin), drainage, foul odor, progression of wound severity, and discoloration serving as signs and symptoms of infection. Pain and progression of the wound have shown the highest correlation with bacterial infection.<sup>4</sup>

For suspected infection, consider the following:

- Wound biopsy for culture analysis is the reference standard for the diagnosis of infected tissue and should be done when possible, especially if topical or systemic antibiotics will be initiated. However, tissue culture often requires special preparation and analysis that may not be available in the urgent care setting. As an alternative, the Levine technique (Table 2) has shown favorable sensitivity for wound culture.<sup>8</sup>
- Best available evidence suggests that a normal erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) level in a low-risk patient population provide reassurance that no further urgent investigation is required.<sup>9</sup> However, the patient with a nonhealing wound is at increased risk for osteomyelitis, and therefore a normal ESR or CRP level cannot rule out the diagnosis.<sup>9</sup>
- If the urgent care provider strongly suspects osteomyelitis or there is an unexplained elevation in ESR or CRP level (ESR >30–70 mm/h and/or CRP level >10–30 mg/L), further evaluation is recommended and transfer to an acute-care facility is indicated.<sup>9</sup>

- A white blood cell count is not helpful in the evaluation of osteomyelitis.<sup>9</sup>
- Abnormal findings on plain radiographs in the correct clinical setting increases the likelihood of osteomyelitis but cannot definitively confirm or rule out the diagnosis.<sup>10</sup>
- Normal findings on magnetic resonance images can reasonably be used to rule out the diagnosis of osteomyelitis, and abnormal findings can confirm the diagnosis.<sup>10–12</sup>

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### Conclusion

The diagnosis of a nonhealing wound is largely clinical, with diagnostic studies tailored to the suspected cause as well as to the underlying process. Once the diagnosis is made, the first step is to determine whether the wound is infected. Part 2 of this article, in next month’s issue, will focus on wound treatment, with specific case scenarios. ■

### References

1. Greer N, Foman NA, MacDonald R, et al. Advanced wound care therapies for nonhealing diabetic, venous, and arterial ulcers: a systematic review. *Ann Intern Med.* 2013;159:532–542.
2. Forster R, Pagnamenta F. Dressings and topical agents for arterial leg ulcers. *Cochrane Database Syst Rev.* 2015;6:CD001836.
3. Hartoch RS, McManus JG, Knapp S, Buettner MF. Emergency management of chronic wounds. *Emerg Med Clin North Am.* 2007;25:203–221.
4. Gardner SE, Frantz RA, Doebbeling BN. The validity of the clinical signs and symptoms used to identify localized chronic wound infection. *Wound Repair Regen.* 2001;9:178–186.
5. Singer M, Deutschman CS, Seymour CW, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA.* 2016;315:801–810.
6. O’Meara S, Cullum N, Nelson EA, Dumville JC. Compression for venous leg ulcers. *Cochrane Database Syst Rev.* 2012;11:CD000265.
7. Khan NA, Rahim SA, Anand SS, et al. Does the clinical examination predict lower extremity peripheral arterial disease? *JAMA.* Feb 1 2006;295(5):536–546.
8. Gardner SE, Frantz RA, Saltzman CL, et al. Diagnostic validity of three swab techniques for identifying chronic wound infection. *Wound Repair Regen.* 2006;14:548–557.
9. Harris JC, Caesar DH, Davison C, et al. How useful are laboratory investigations in the emergency department evaluation of possible osteomyelitis? *Emerg Med Australas.* 2011;23:317–330.
10. Kapoor A, Page S, Lavalley M, et al. Magnetic resonance imaging for diagnosing foot osteomyelitis: a meta-analysis. *Arch Intern Med.* 2007;167:125–132.
11. Butalia S, Palda VA, Sargeant RJ, et al. Does this patient with diabetes have osteomyelitis of the lower extremity? *JAMA.* 2008;299:806–813.
12. O’Meara S, Al-Kurdi D, Ologun Y, et al. Antibiotics and antiseptics for venous leg ulcers. *Cochrane Database Syst Rev.* 2013;12:CD003557.