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Clinical Pathway for the Management of Diabetic Foot Infections in the Emergency Department

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Introduction

Diabetic foot ulcerations are an increasingly common problem that have profound consequences on patient quality of life. A recent systematic review found a reduced rate of major amputations at medical centers that initiated multidisciplinary teams with clear treatment algorithms and designated referral pathways to exclusively treat diabetic foot ulcerations.[19] However, the majority of community or even larger tertiary referral or academic centers do not have a standardized workup protocol, defined criteria for specialist referral, or specialized multidisciplinary teams. The implementation of such a system is often confusing and cost prohibitive.[10] In the acute setting, this can result in unnecessary admissions, either excess or inadequate workup, delay in care, prolonged hospitalization, and inappropriate management of diabetic foot disease.

The International Working Group on the Diabetic Foot (IWGDF) has produced evidence-based guidelines on the prevention and management of diabetic foot disease since 1999.[9] The guideline consists of 6 chapters aimed at directing clinicians providing care for the diabetic foot with management principles supported by current literature and a team of multidisciplinary experts. Despite the wealth of information in this guideline, the clinical utility and implementation is limited by the length and large number of asynchronous recommendations. This is often cumbersome and confusing to the clinician who frequently encounters, but does not necessarily specialize in diabetic foot disease. Therefore, the goal of this article was to create a succinct, comprehensive, and straightforward clinical pathway derived from these evidence-based guidelines that can be implemented to better guide clinicians in the acute setting.

Clinical Pathway

Our clinical pathway is adapted from the tenets of diabetic foot ulcer management proposed by the IWGDF (Figure 1). The fundamental chapters of the 2019 guideline relevant to acute management include the appropriate classification of ulcer severity, extent of infection, evaluating for peripheral arterial disease, prior wound healing interventions, and attempts at offloading. The pathway is designed to guide clinicians to triage diabetic foot ulcers that require further workup and admission vs diabetic foot ulcers that may be managed more appropriately as an outpatient. Although a multitude of diabetic foot ulcer classification systems exist, this pathway is derived from the IWGDF/IDSA classification system on infection severity, which is a strong predictor of the need for hospitalization.[14,17]

Triage

Assessment begins with evaluation by the emergency department physician to determine clinical severity of patient presentation. A plain-film radiograph of the affected foot is obtained to evaluate for bony deformity, previous operative intervention, and possible radiographic indicators of osteomyelitis. An initial workup involving vitals and laboratory studies is generally obtained by the emergency room and used to risk stratify the patient. The wound is assessed for any complicating features that may warrant more intensive assessment and parenteral antibiotics, including the presence of gangrene, limb ischemia, necrosis, rapidly progressive cellulitis, deep abscess, or any other clinical feature, which may suggest a more serious infection. Concurrent systemic conditions and comorbidities suggestive of a more complicated clinical picture (ie,

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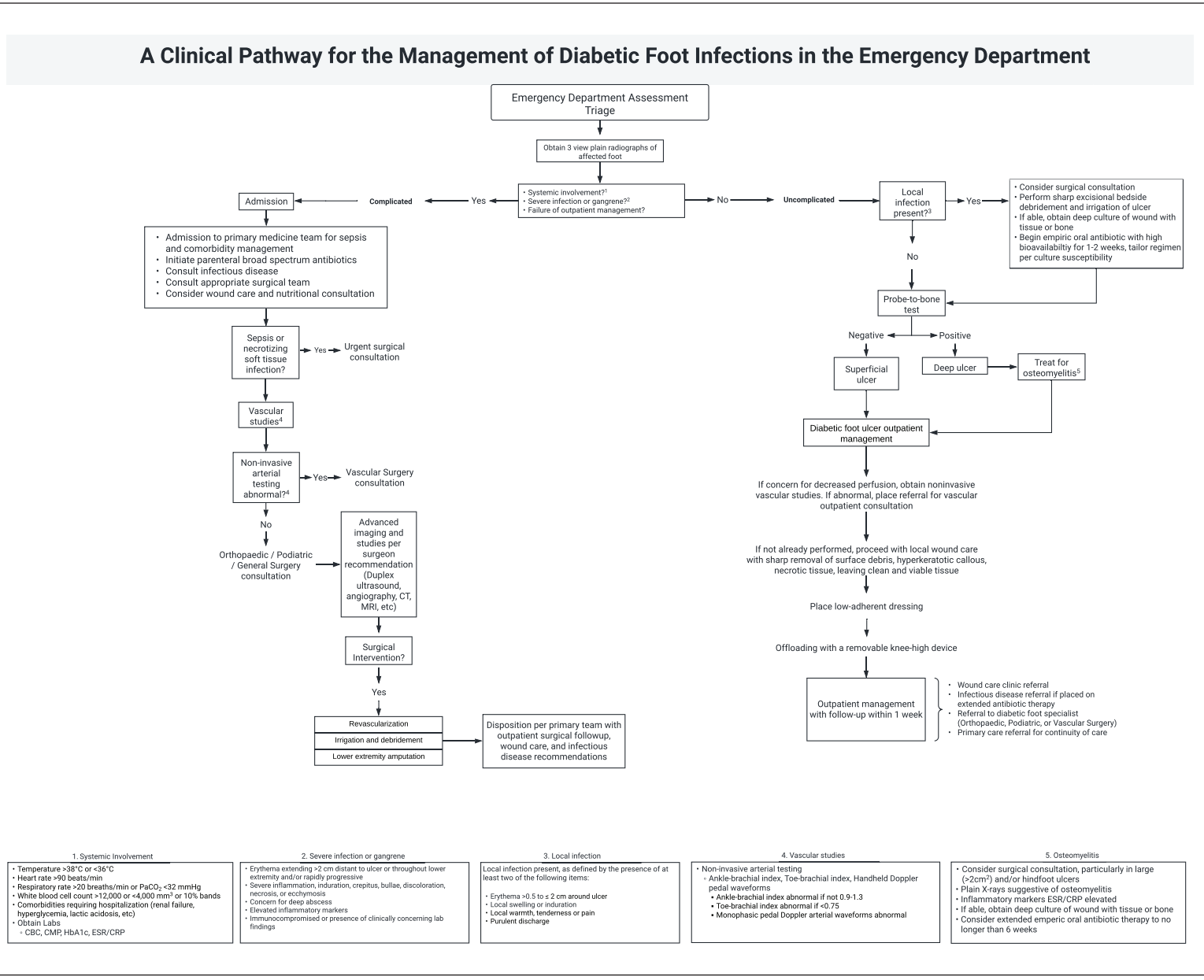

Figure 1. Clinical Pathway Algorithm for Diabetic Foot Infections.

immunocompromised patient, renal failure, severe hyperglycemia, highly elevated C-reactive protein, lymphedema, venous insufficiency) may require hospitalization. In addition, failure of previous outpatient management should be considered criteria for admission for surgical evaluation or adjustment of antibiotic therapy.

Complicated Diabetic Foot Infection Pathway

If the initial triage demonstrates systemic involvement, evidence of a severe infection, or failure of outpatient management, the complicated clinical pathway should be followed. We define systemic involvement as the presence of Systemic Inflammatory Response Syndrome (SIRS) criteria or the presence of any comorbid condition that requires hospitalization. If SIRS criteria are present, as defined by the occurrence of at least 2 of the following: temperature $>38°C$ or $<36°C$, heart rate >90 beats/min, respiratory rate >20 breaths/min or $Paco_2$ <32 mmHg, white blood cell count $>12\,000$ or <4000 cu/mm^3 or 10% immature (band) forms, a thorough evaluation for a source of infection and management of sepsis should be initiated. Admission to a primary medicine service should be recommended to manage comorbidities, perform fluid resuscitation, correct metabolic abnormalities, initiate parenterally administered broad-spectrum antibiotics, and possible preoperative optimization. If the initial assessment is concerning for sepsis and/or a necrotizing soft tissue infection, immediate surgical consultation should be obtained based on the hospital policy, which designates the first-call surgical specialist for limb and life-threatening infections.

Vascular Evaluation

All patients with suspected diabetic foot ulcer should be worked up for peripheral arterial disease (PAD). The clinical presentation of diabetics with PAD may differ from that of PAD alone, without the classic preceding symptoms such as rest pain and claudication. It is estimated that up to 50% of diabetics may have undiagnosed or underlying PAD.[4,5,18,23] Unfortunately, clinical assessment alone may prove unreliable in excluding PAD in a diabetic, and no single bedside modality has been demonstrated to reliably exclude the presence of PAD.[30]

The ankle-brachial index (ABI) serves as an easily administered, noninvasive test in the detection of PAD.[6] The sensitivity and specificity in detecting PAD is increased by the inclusion of a toe-brachial index (TBI) and a handheld Doppler assessment of pedal waveforms.[6,30] The IDGWF concluded that the diagnosis of PAD is less likely with an ABI between 0.9 and 1.3; TBI ≥ 0.75; and triphasic pedal Doppler waveforms.[11] As the interpretation of Doppler waveforms requires a skilled examiner, which may not be available at many institutions, we suggest that ABI and TBI be performed at a minimum, with the recommendation to include a handheld Doppler evaluation when possible. Any detected abnormalities in noninvasive testing should prompt a consultation to a vascular surgeon for further advanced workup and possible surgical intervention. In the hospitalized patient where noninvasive arterial testing is normal, advanced workup and surgical treatment is made based on the institution's availability of subspecialty surgeons and their individual treatment decisions.

Uncomplicated Diabetic Foot Infection Pathway

For the diabetic foot ulcer without systemic involvement or severe infection, the uncomplicated pathway to outpatient management is established. In localized wound infections, a sharp excisional debridement should be performed with irrigation of the wound bedside. It has been well established that superficial swabs of wounds often contain a high level of contaminant bacteria not concordant with the offending pathogen.[12,20–22] A better specimen involves culturing the deep tissue or bone, though these are also often polymicrobial. For uncomplicated local soft-tissue infections without bony involvement in patients who have not recently received antibiotic therapy, empiric oral antibiotic therapy targeted toward aerobic gram-positive pathogens (β-hemolytic streptococci and *Staphylococcus aureus*) for a period of 1-2 weeks is recommended.[16] Definitive therapy targeted at the causative pathogen should then be tailored based on the results of the collected culture. If extended therapy is warranted because of a slowly resolving soft tissue infection, adjustments to the antibiotic regimen should be based on infectious disease recommendations. Clinically uninfected ulcers should not receive any antibiotic therapy as there are no current data to support that antibiotic therapy advances healing.[1,16]

Osteomyelitis Evaluation

A probe-to-bone test is a simple and effective way to determine the depth of the ulcer and possible bony involvement.[3,8,13,24] Using a sterile, blunt, metal probe that is gently inserted into the wound, a positive test is defined by the evaluator detecting a rock-hard and gritty structure.[8,16] The most useful blood test suggestive of a bone infection is an elevated erythrocyte sedimentation rate at >70 mm/h, often in combination with an elevated C-reactive protein.[28] In conjunction with plain radiographic findings suggestive of osteomyelitis (ie, bony erosion, periosteal reaction, and demineralization), a positive probe-to-bone test, and elevated inflammatory markers, a diagnosis of osteomyelitis

can be made without advanced imaging.[16] Although surgical resection of infected bone has been considered the gold standard, evidence has recently demonstrated that, in the properly selected patient, antibiotic therapy is an effective treatment choice.[2,7,15,25,27] Although parenteral antibiotics have been prescribed traditionally, recent evidence suggests that oral antibiotic therapy with high bioavailability in bone is an acceptable alternative.[26]

Although obtaining a biopsy of the infected bone, either through surgical or transcutaneous methods, is a commonly accepted practice to definitively identify the causative pathogen, there are significant practical considerations in the acute setting. First, the procedure requires significant coordination, experience, and cost if done in an operating room. If a properly collected aseptic sample identifies a single pathogen, such as *S aureus*, or if the ulcer is responding appropriately to empiric antibiotic therapy, a biopsy may not be needed.[16] We recommend reserving the biopsy for cases where the diagnosis is equivocal, or the ulcer is failing to heal in the first few weeks despite adequate adjunctive treatment. In the carefully selected patient with an uncomplicated diabetic foot ulcer with osteomyelitis, a course of empiric oral antibiotic therapy in conjunction with local wound care and offloading is an acceptable treatment option. Surgical bony resection in the acute setting may potentially be deferred in favor of this conservative management with close outpatient follow-up.

Bedside Debridement and Outpatient Management

Although a variety of debridement methods exist, sharp excisional debridement of the ulcer is an effective, readily available, and inexpensive technique.[9] The goals of debridement include removing the peripheral hyperkeratotic callus, foreign debris, removal of any nonviable necrotic tissue, and reduction of bacterial burden, leaving behind clean and viable tissue to support healing.[9,29] To reduce the cost and expertise required of the variety of dressings, a basic nonadherent dressing is placed after debridement to protect the wound. To simplify the selection of orthotics, a removable knee-high offloading device is recommended, particularly because it is presumed many cases that present to an emergency department require frequent monitoring for infection. Lastly, outpatient follow-up is arranged to a wound care clinic, a diabetic foot care specialist, and primary care physician for continued management of diabetes. If there is concern for decreased perfusion to the limb, noninvasive vascular studies should be obtained with a referral to a vascular specialist if abnormal. In the cases where extended antibiotic therapy is recommended, such as for osteomyelitis, infectious disease specialist involvement is recommended to guide antibiotic selection tailored to culture results.

Limitations

A main limitation of our clinical pathway is that it does not guide surgical decision making. Operative treatment such as revascularization, debridement and bone resection, lower extremity amputation, and deformity reconstruction are at the discretion of the consulting surgeon. The pathway is not intended to diagnose or manage the critically ill patient, and the level of care is left to the discretion of the emergency and admitting physicians per individual hospital guidelines. The pathway is not meant to specifically classify, offer prognosis, or predict wound healing of the infected diabetic foot ulcer. Antibiotic therapy, particularly for osteomyelitis, should be determined by specialists with expertise in the field. Wound care interventions, dressings, and offloading options are simplified to expedite care, despite the abundance of treatment options available to the diabetic foot care specialist.

Conclusions

The diabetic foot ulceration clinical pathway incorporates facets of the most recent evidence-based guidelines into a simple flowchart diagram, directing the clinician in the acute setting to appropriately triage the severity of the ulcer, obtain the proper surgical evaluation when necessary, and potentially avoid unwarranted and prolonged hospitalization.

Ethical Approval

Ethical approval was not sought for the present contemporary review article as no patient information was used in the creation of this manuscript.

Declaration of Conflicting Interests

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