


The Diabetic Foot Attack: “Tis Too Late to Retreat!”

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Abstract

The “diabetic foot attack” is one of the most devastating presentations of diabetic foot disease, typically presenting as an acutely inflamed foot with rapidly progressive skin and tissue necrosis, at times associated with significant systemic symptoms. Without intervention, it may escalate over hours to limb-threatening proportions and poses a high amputation risk. There are only best practice approaches but no international protocols to guide management. Immediate recognition of a *typical* infected diabetic foot attack, predominated by severe infection, with prompt surgical intervention to debride all infected tissue alongside broad-spectrum antibiotic therapy is vital to ensure both limb and patient survival. Postoperative access to multidisciplinary and advanced wound care therapies is also necessary. More subtle forms exist: these include the ischemic diabetic foot attack and, possibly, in a contemporary categorization, acute Charcot neuroarthropathy. To emphasize the importance of timely action especially in the infected and ischemic diabetic foot attack, we revisit the concept of “time is tissue” and draw parallels with advances in acute myocardial infarction and stroke care. At the moment, international protocols to guide management of severe diabetic foot presentations do not specifically use the term. However, we believe that it may help increase awareness of the urgent actions required in some situations.

Keywords

amputations, diabetic foot, foot attack, emergency, health care, multidisciplinary treatment

Diabetic foot disease (DFD), which comprises ulcerative and nonulcerative foot pathologies, is a major global challenge with the ever-increasing prevalence of diabetes. The annual incidence of diabetic foot ulceration (DFU) ranges between 1.5% and 2.2% in European studies.^{1,2} However, a much higher incidence rate has been noted in population studies in the United States of America and Asia.³ Prevalence rates for DFU are higher, highlighting the chronicity of the condition, with a global figure in excess of 6.3% in a recent systematic review.³ Even more recently, and displaying a worrying trend, the lifetime risk for a DFU has been estimated to be between 19% and 34%; a significant upwards revision from previous estimates, which put it between 15% and 25%.⁴ The recurrence rate of DFU is high with up to 40% recurring within 1 year, 60% at 3 years, and 65% at 5 years after healing.⁵ Individuals with diabetes are at 15 to 31 times greater risk of lower limb amputation (LLA) than those without,⁶ and it has been suggested that up to 85% of such LLAs precede a nonhealing DFU. There is also significant mortality associated with DFUs with up to 50% not surviving 5 years post LLA, an outcome measure worse than many common cancers.^{7,8} Therefore, the costs attached to the management of DFUs and their complications are

also considerably high. This holds true both for the health care system and for the individuals and their carers. Indeed, Diabetes UK has recently estimated that the cost to the National Health Service in England was approximately £1 billion in 2014–2015, which is a 30% higher estimate from costs for 2010–2011.⁹ Similarly, the direct costs of DFU care in the United States of America have been previously estimated to be between \$9 and \$13 billion, with higher costs attached to privately insured individuals.¹⁰ More recent estimations, however, suggest that they are as high as \$50 to \$70 billion (including indirect costs).¹¹

Despite all this and the increasing focus on limb salvage of the diabetic foot, the rate of LLAs remains unacceptably high. Many factors have been considered important indicators of

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poor outcome, such as the presence of peripheral vascular disease, longer ulcer duration, larger size/ulcer severity, underlying osteomyelitis, delay in presentation, and lack of adequate organizational care for the diabetic foot.^{9,12-14} Interpreted differently, they also indicate that care could be improved in many areas with the potential for improved outcomes. Early recognition and prompt referral to a multidisciplinary foot service are important initial steps in diabetic foot care. The Eurodiale study noted that the differences in amputation rates between European centers could be explained in part by the severity of disease at presentation to the specialist foot centers, a consequence of delays in the care process.¹⁴ Similarly, the recent National Diabetes Foot Audit (NFDA UK) noted that 40% of patients in the United Kingdom are referred >2 weeks after initial contact with a health professional, increasing the likelihood of higher ulcer severity and reducing the probability of early healing.¹⁵ Although DFD on its own can be considered an aggressive condition, one particular presentation stands out for its severity and need for emergency treatment, herein termed “diabetic foot attack.” In this article, we discuss what constitutes a diabetic foot attack, the ethos behind the nomenclature, and provide a discussion on the importance of early recognition and intervention.

Diabetic Foot Attack

One of the most devastating presentations of the DFD is the acutely inflamed foot with rapidly progressive skin and tissue necrosis, associated at times with significant systemic symptoms. Such a *typical* “diabetic foot attack” may start as an apparently simple injury, but it could rapidly escalate over hours to limb-threatening proportions. This may be an entirely new presentation or a sudden deterioration on the background of a known neuropathic DFU, limb ischemia, or both, wherein delays in recognition or intervention pose a significant risk of LLA (Figure 1).

However, more subtle presentations may exist. One such presentation is the “ischemic diabetic foot attack,” which would include an acutely ischemic limb, but more frequently in diabetes, would refer to critical limb ischemia at the severe end of the spectrum, with or without tissue loss. Here, infection is *not* the primary driver of deterioration, but severe ischemia is, and without relatively quick intervention, progressive tissue damage may occur. Although the development of an acute Charcot neuroarthropathy (CN) has not been traditionally recognized as a “foot attack,” it may lead to rapid deterioration secondary to bone collapse and loss of foot architecture. Despite the distinct pathophysiological process involved, CN could also be considered to represent a form of *atypical* “diabetic foot attack” in a more contemporary definition. Overall, immediate recognition and urgent aggressive management is of more than vital importance to improve limb and patient survival (Table 1).

Clinical Corollaries and “Time Is Tissue” Concept

Experts as well as patient support groups have likened the diabetic foot attack as the equivalent of an acute cardiac or cerebrovascular event in those with diabetes.^{16,17} Very much in line with the latter conditions, where individuals with diabetes may not recognize early symptoms, patients with a diabetic foot attack may report very minimal symptoms or simply describe feeling “flu like.” The presence of somatic and/or autonomic neuropathy, along with the immune paresis that may be present, could result in downregulation of local host defenses without obvious signs of a local inflammatory response.^{18,19} A systemic response may also be consequently damped. In addition, those with diabetic neuropathy may not exhibit typical features associated with peripheral vascular disease: in such patients distal limb tissue necrosis may regrettably be the first presenting sign. Therefore, despite the otherwise visual nature of the diabetic foot attack, inexperienced physicians may underestimate the severity, unless full-blown signs of sepsis are present, leading to delayed institution of appropriate treatment.

Development of golden hour concepts in combination with interventional strategies and dedicated hyper-acute units (chain-of-care) has transformed clinical outcomes in myocardial infarction²⁰ and acute ischemic stroke.²¹ However, the high rate of LLAs suggest that we are still to move forwards to embracing such an approach to the diabetic foot.²² More recently, the concept of “time is tissue” has been mooted, in an attempt to highlight foot vulnerability and to promote timely engagement of frontline physicians and surgeons. Unlike myocardial infarction or stroke, where minutes between care can be decisive, tissue loss in the foot typically (and fortuitously) progresses over hours, thereby allowing the scope for pragmatic early intervention and even transfer of care to a higher center, if necessary. This crucial time interval should be utilized.

The use of the “diabetic foot attack” terminology is a recent development.²³ However, it conveys a powerful sense of urgency, not only to physicians but also to allied health workers such as podiatrists, nurses, and paramedics, many of whom come into contact with diabetic foot individuals on a regular basis.

Management of Diabetic Foot Attack

Recognition and institution of timely intervention are key factors that will determine outcome including limb salvage.²⁴ Internationally recognized guidelines on management of DFD do not specify the term “diabetic foot attack,” but they provide clear instructions on how a severe presentation should be recognized and managed.²⁵⁻²⁸ As severe infection is the ubiquitous finding in the *typical*



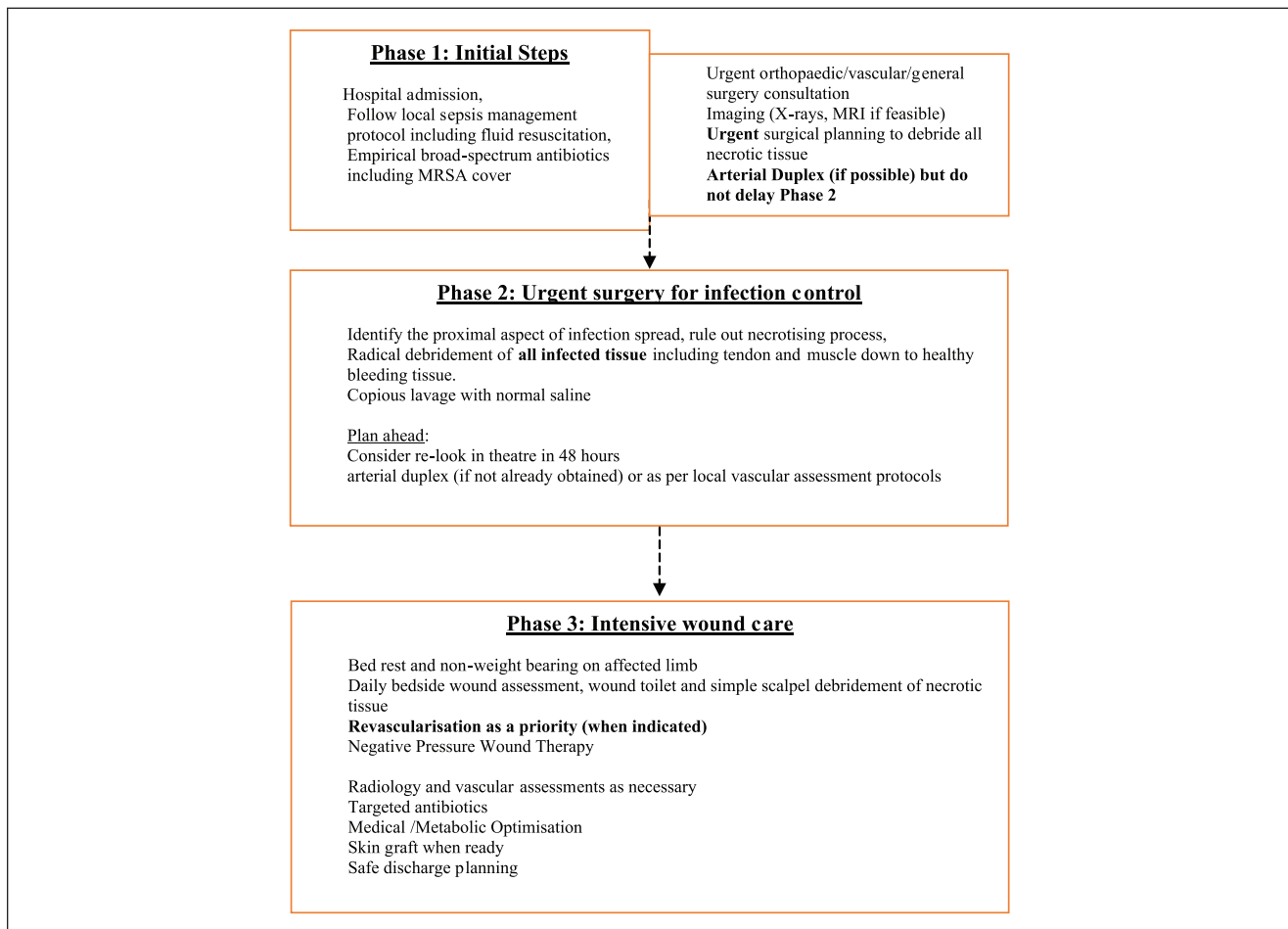
Figure 1. (A) Presentation of a *typical* diabetic foot attack with demonstrable gas on foot X-ray in this patient with neuropathic plantar ulceration; the patient has an old first ray amputation. (B) Presentation of an *atypical* ischemic diabetic foot attack—acute on chronic ischemia. There is significant necrosis but no severe infection. X-ray is surprisingly normal despite significant tissue loss. Nonetheless, the foot requires urgent attention. Delayed intervention in these instances can be limb and life threatening.

diabetic foot attack, the initial steps should be centered on rapid control of infection including early access to surgery, debridement of all infected necrotic tissue, and exploration of tracking paths alongside the initial use of broad-spectrum antibiotics. This is followed by culture-guided antibiotic

therapy.^{26,28} This should be the case even when severe ischemia is present: when deemed necessary, surgery for infection control should not be delayed until further vascular investigations are complete. Metabolic and glucose control and treatment of any associated medical complications

Table I. Types of Diabetic Foot Attack.

Typical or infected diabetic foot attack	Classical severely infected diabetic foot with rapidly spreading necrosis. Usually in neuropathic feet, but it also may affect those with ischemia. Primacy is given to infection treatment interventions, followed by rapid correction of ischemia, when present.
Atypical Ischemic	Severe critical limb ischemia with or without tissue loss with a narrow window of opportunity to prevent progression to limb threatening ischemia. Primacy here is to prioritize revascularization options.
Charcot neuroarthropathy	Usually presents as a hot swollen foot, without ulceration. In its earliest form, there are no abnormalities noted on plain radiography. Primacy is given to diagnostic confirmation and off-loading.

**Figure 2.** Management of a typical diabetic foot attack.

(such as acute kidney injury) should be carried out with the help of specialists. After initial infection control is achieved, the vascular status needs to be assessed (if not already done): should this be compromised, urgent revascularization is required. Any ongoing necrosis may require further explorative surgery (Figure 2). After infection control, wound stabilization can be achieved through advanced wound care therapies, including negative pressure wound

therapy. At the same time, culture-guided adjustment of antibiotic therapy is useful.^{26,29} Consistent and daily multi-disciplinary input at the patients' bedside is also an important aspect of care.

The management of the *atypical* ischemic foot attack includes prioritizing rapid revascularization to prevent further proximal tissue loss. Acute limb ischemia may need much more rapid intervention, either through emergency

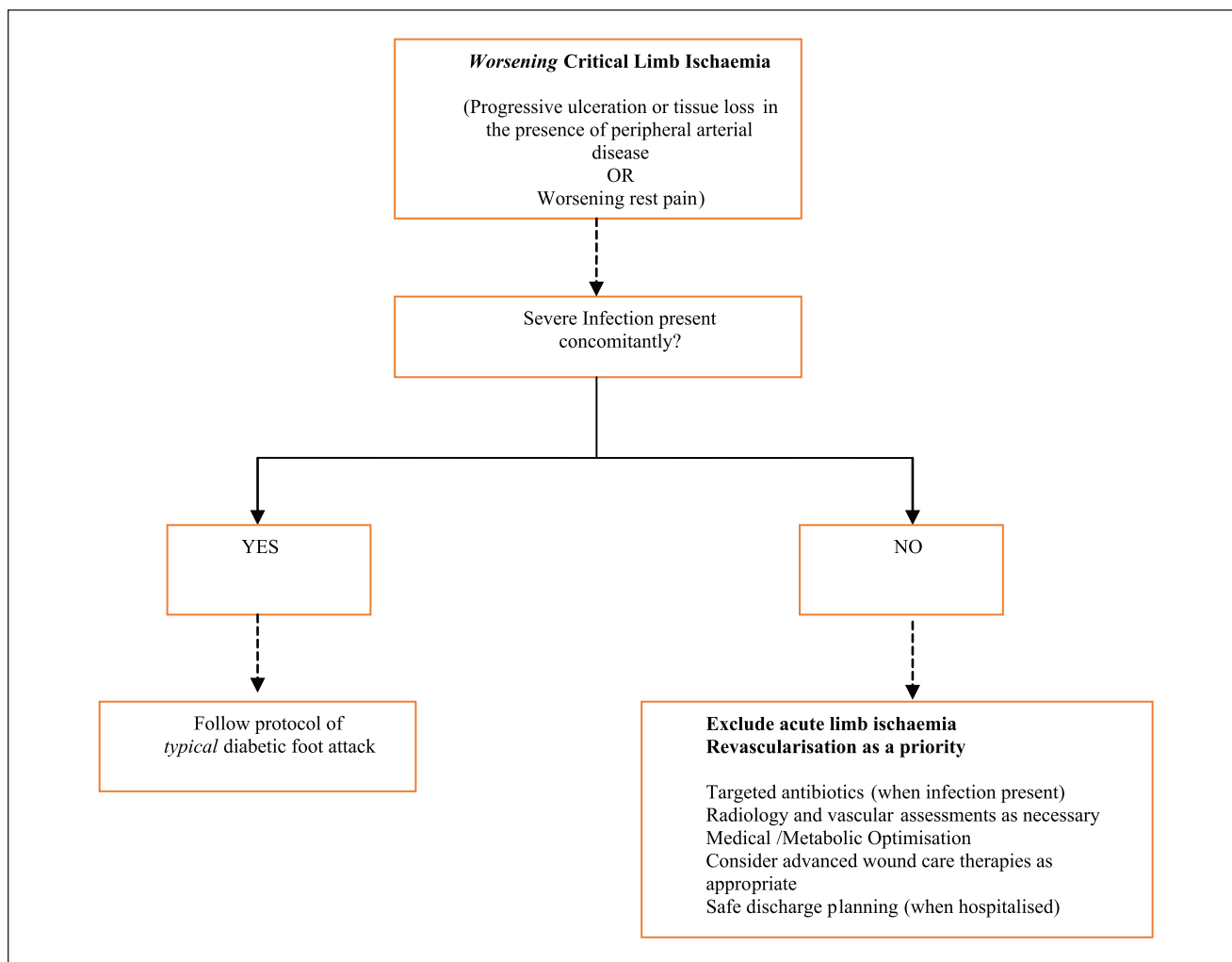


Figure 3. Management of an atypical ischemic diabetic foot attack.

surgery or thrombolysis (Figure 3). Once recognized, off-loading in a nonremovable total contact cast is the gold standard for the management of CN.

Raising Awareness and Improving Access to Appropriate Care

Ideally, the ultimate management scenario would be the prevention of a diabetic foot attack. This would require education of all patients with diabetes but also ensuring there are robust care structures for facilitating best practice of DFD. Research from the United Kingdom has demonstrated a wide variation in the rate of major amputation not only between the different local regions but also between hospitals,³⁰ and the situation is likely to be similar elsewhere. The development of a clearly described foot care pathway is an important process and has been shown to be a key factor in diabetic foot-related outcomes. Such foot care pathway should include foot screening guidelines, in order to

provide an adequate foot protection service for those who are determined to be moderate or high risk for future DFD. It should also ensure rapid access to multidisciplinary care to patients with active ulceration. Sadly, there is suboptimal utilization of such a planned multidisciplinary approach globally,^{14,31} despite the unequivocal evidence that the cost of care delivery increases with the increasing severity of DFD.^{31,32} The recently published data from the United Kingdom National Diabetic Foot Audit suggest that the basic framework for effective prevention and management of DFD is often missing, with only 43% of the responders confirming all required care structures were in place.¹⁵ Hence, engagement of health policy makers is pivotal to ensure equity of access and foot care delivery of the required standard.

Effective patient education and advocacy has the potential to drive improvement through direct demand for better foot health services. This aspect has been taken up by many diabetes-related charities, notably the “Putting Feet

First” campaign by Diabetes UK¹⁷ and the “Stop Diabetes From Knocking You Off Your Feet” initiative by the American Diabetes Association.³³ Both have produced information material to patients describing how to spot a “foot attack” and what to do if they think if they are experiencing one. The message is to get all individuals with any new foot lesions to self-present immediately to their primary physician or foot protection team, inasmuch as this will ensure prompt assessment and/or referral, ultimately aiming to avert a true diabetic foot attack. Furthermore, the increased focus on national audit outcomes (such as amputation rates, time to first expert review, ulcer healing, and variation between providers) is prompting hospital services to develop better integrated care provision for DFD.

Future Overview

An integrated responsive care structure with an informed patient at the center, supported by highly trained staff along with proximate cooperation between primary care and multidisciplinary foot specialist services, is necessary to improve diabetic foot outcomes. We also need well-informed, engaged health care policy commissioners and providers to drive longer term strategy. Development of hyper-acute units has demonstrated significant improvement in functional as well as mortality outcomes for cardiovascular disorders.^{34,35} Similar hyper-acute foot units with well-developed protocols and closely supported by medical and surgical services may be the future. Whether introduction of such care will really reduce amputation rates and hospital length of stay and whether it will provide value-based care still needs to be ascertained. In addition, there is a need for further clarity of what constitutes a “diabetic foot attack” (or debate if a formal definition is required, given that multiple definitions currently exist) and to understand factors associated with favorable outcomes. Importantly, however, the focus should remain on prevention through clear risk categorization and patient education.^{36,37} The “diabetic foot attack” constitutes a new presentation or a sudden deterioration on the background of a known DFU and/or limb ischemia. It should be considered as a medical emergency, given that delayed recognition or intervention increases the risk of adverse outcomes.³⁸ Conversely, urgent intervention and/or referral to a specialist multidisciplinary team may improve success rates of therapy.^{39,40} What is now indispensable is wider awareness of the diabetic foot attack, clearly described intervention, and referral algorithms, as well as improved organization of urgent health care provision by expert teams.⁴¹ Indeed, in the setting of dangerous foot attacks, the physician needs to wage war, because it is “too late to retreat.”⁴²

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