

Assessment of Diabetic Foot Ulcer Prognosis and Management

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Abstract

Background: Diabetes is a highly prevalent disease, with its complications strongly correlating to the glycemic control of patients. **Objectives:** We aimed to review the literature for recent advances in the prognosis and management of diabetic foot ulceration. **Methodology:** PubMed database was used for articles selection. Papers were obtained and reviewed. PubMed database was used for articles selection, and the following keys terms were used: diabetic foot ulcer, prognosis, and management. **Conclusion:** Not all managed cases were cured, and some develop resistance to traditional methods and would require unconventional therapies. Nevertheless, this should not deter the physician from offering treatment as this improves prognosis.

Keywords: Diabetic foot ulcer, prognosis, management

INTRODUCTION

Diabetes Mellitus is a metabolic disorder ^[1, 2] characterized by increased blood glucose levels ^[3, 4]. It is a growing public issue around the world, in which a major complication is foot ulceration or the 'diabetic foot'. In Saudi Arabia, diabetes is rising at an alarming rate, with the country ranking seventh globally in the prevalence of diabetes ^[5]. Unfortunately, diabetes is not well controlled in many patients in Saudi Arabia ^[6, 7]. Many patients have reported subpar foot care, and therefore diabetic foot awareness and education are required for many patients ^[8, 9]. The prevalence of diabetic foot in Saudi Arabia is reported between (26-62%) ^[10, 11]. The global prevalence is similar (6%), with males having a prevalence of 4.5% ^[12].

Diabetic foot is an end-result of neuro-vascular compromise in the presence of injury and uncontrolled blood glucose. In Saudi Arabia, the occurrence of diabetic microvascular complications is not clearly documented ^[13]. Vascular complications have been reported to have an increased mortality risk in diabetic patients ^[14]. The estimated 5-year mortality reaches up to 30.5%; cost burdens of diabetic extremity care are as high as cancer ^[15]. Therefore, in this paper, we aimed to review the proper literature discussing the mechanism of diabetic foot ulceration, the pathophysiology behind it, management options, and prognosis for such cases.

METHODOLOGY

PubMed database was used for articles selection, and the following keys used in the mesh ("Diabetic Foot"[Mesh])

AND ("Prognosis"[Mesh]) OR ("Management"[Mesh])). In regards to the inclusion criteria, the articles were selected based on the inclusion of one of the following topics; diabetic foot ulcer risk factors and prevention. Exclusion criteria were all other articles that did not have one of these topics as their primary endpoint.

REVIEW

Pathophysiology

Diabetic foot ulceration results from uncontrolled hyperglycemia. It is a co-morbid complication of diabetes mellitus. In diabetic patients, evidence of complications should alert the surgeon to the plethora of potential micro and macrovascular complications. The patient would present with other complications of chronic diabetic status in tandem with ulceration ^[9]. The problem occurs when there is a loss of sensation due to chronic damage from peripheral neuropathy.

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Peripheral neuropathy would prevent the patient from sensing harmful pressure at the sole of the foot. Because of its location and loss of sensation, it would not be discovered until late.

Prognosis before Management

The surgeon should be wary of the potential development of infections. Risks of superimposed infection in otherwise non-infected ulcers include underlying neuropathy, foot deformity, and unhealed ulcers within three months of initial presentation [16]. When examining the patient for the first time, certain problems should be sought out. Multiple local and systemic factors that lead to the progression of DFU making the prediction of clinical outcomes a challenging task. A systematic review published in the British Medical Journal of Clinical evidence in 2011 states that for people with healed DFU, the 5-year cumulative rate of ulcer recurrence is 66% and amputation is 12% [17].

Diabetic foot ulcers (DFU) is an important complication of type 2 diabetes mellitus (T2DM); it results in major disability and increases the mortality rate [18]. The long duration of T2DM carries the risk of developing multiple complications, which DFU is one of them. A recent study confirms that a 10 years duration of T2DM was significant for a higher incidence of DFU [19]; not forgetting the course of the T2DM as poor/well-controlled, as outcomes can change [20]. The five years survival rate is estimated to be 24.6% in those with a history of DFU [21]. This shows the importance to identify the leading risk factors. This identification not only can help reduce the occurrence rate, delay the occurrence, or lessens the recurrence rate, but also a determinant of the risk helps in the prediction of the prognosis. According to the EURODIALE study done in 2011 which is the largest scale study done to date focused on ulcer outcomes [22], Ulcer prognosis is dependent on ulcer characteristics, epidemiologic factors, and comorbidities. These factors include adequate perfusion, extension, and depth of wound, superimposed infections, and loss of sensation [23, 24]. One study identified independent risk factors for recurrence including osteomyelitis, uncontrolled diabetes, and plantar site of the ulcer. [25]. Infection halts the healing process, in the context of a diabetic patient with uncontrolled glycaemic status. Other factors may also delay wound healing including hypertension, large ulcer of $\geq 2\text{cm}^2$, previous amputation, and ulceration on the sole [26].

Management

An evidence-based approach is applied when managing diabetic foot; these include controlling blood glucose level, managing co-morbid conditions, improving blood supply, removing necrotic tissue, and applying appropriate foot care. Ulcers, as previously stated, could be subdivided by characteristics such as depth of the wound, i.e. superficial and deep ulcers. Superficial ulcers undergo debridement of dead tissue until bleeding starts—a sign of healthy tissue. Negative-pressure wound closure is applied to extract any infectious residue. Gangrene may develop in superficial ulcers with underlying critical limb ischemia; this is an

indication for urgent therapy. Deep ulceration in a diabetic foot is an end-result of inappropriate treatment of an ulcer or infected gangrenous condition [18]. It is a well-known concept that blood supply is the most important factor in wound healing. Therefore, re-vascularisation is a cornerstone in the management of diabetic foot. Endovascular re-vascularisation, performed by a radiologist and vascular surgeons, is done to reduce the need for amputation [27].

DFU is complicated in nature, requiring strict surgical debridement and therapeutic care. One important aspect here is the wound healing accelerating interventions. Therapeutic footwear is one of the very common techniques. It has been demonstrated that it reduces the risk of recurrence of foot pathologies and ulcerations in all patients with diabetic foot, and especially in those with foot deformities [28]. Another common technique is dressings. Despite having slight evidence to support [28], it is a common practice. Comparative researches have demonstrated no significant differences between dressings in the outcome of DFU [29]. The offloading approach is another treatment technique [30]. It helps reducing pressure over the affected area of the foot. Many techniques can be utilized here, such as surgical shoes, immovable glass splints, or total contact splints [31-33]. The last is the most-backed by strong evidence, but perhaps due to its requirement of full immobilization both at home and work, the first is more common [30]. A more invasive DFU treatment option includes debridement. This can be classically achieved by surgery, but some researches recommend utilizing hydrogels as debridement [33]. Hydrogel has been shown to have higher cure rates of DFU compared to gauze dressings. Autolytic and larval are other available debridement techniques [34, 35].

Other concerns with DFU include infection and neuropathic pain. Antibiotics are recommended in cases of failure to heal or signs of local infection. Generally, the choice of drug depends on culture and sensitivity results [28]. For neuropathic pain, a drug that can be used include antidepressants, anticonvulsants, or opioids combined with gabapentin. However, only duloxetine and gabapentin are approved by the Food and Drug Administration (FDA) [28]. New novel therapies are evolving too as adjuvant treatment. Granulocyte-Colony Stimulating Factor (G-CSF) is one example. G-CSF drugs work by increasing the release of endothelial progenitor cells from bone marrow and improves neutrophil function, which is usually affected in diabetic patients [28]. Negative Pressure Therapy (NPT) is another effective adjuvant treatment, but it is mostly reserved as the last alternative [28, 36].

Prognosis after Management

Good glycemic control is known to favor the prognosis of complications in diabetics [37]. Many patients suffer from ulcer recurrence, while this is multifactorial, it would inevitably increase the wound healing period [38]. This recurrence commonly occurs within three years from the previous ulcer, regardless of the management effectiveness of the primary incident [25, 38]. The current approach of treatment

has shifted to the multidisciplinary model. A multidisciplinary approach has been shown to reduce the rate of major amputations in 94% of the studies, although these were of different protocols and varying rate reductions^[39]. Delayed or absent referrals, poor patient compliance, and poor communication between physicians may contribute to halting the healing process^[40].

Resistance

In some cases, foot ulceration is resistant to conventional management mentioned above, and therefore surgeons could consider vacuum-wound closure and maggot therapy. Maggot therapy is used for debridement of dead tissue, leaving only healing tissue. Systematic reviews and meta-analyses showed maggots' ability to stimulate rapid healing, and shortening wound healing duration in chronic ulcers^[41].

CONCLUSION

Physicians should monitor patient compliance with treatment and lifestyle changes. They should educate patients on the consequences of poor glycemic control—including diabetic foot ulceration.

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