



Review Article

ISSN : 2277-3657  
CODEN(USA) : IJPRPM

## *An Overview on Diabetic Septic Foot: Clinical Features and Diagnostic Approach*

Alyazid Ahmed Alzahrani<sup>1\*</sup>, Abdullah Abdulaziz S Almalki<sup>1</sup>, Khalid Abdulrahman Almalki<sup>1</sup>, Mohammed Abdulaziz Alzahrani<sup>1</sup>, Ziyad Daifallah Alsubhi<sup>1</sup>, Riyadh Marzouq Alqurashi<sup>1</sup>, Hammad Turki Nizar<sup>1</sup>, Ahmed Talal M Barasayn<sup>1</sup>, Ziyad Mansour Alsadhan<sup>1</sup>, Motaz Fahad Almonshi<sup>1</sup>

<sup>1</sup>Faculty of Medicine, Umm Al Qura University, Makkah, KSA.

\*Email: [zidan.com@windowslive.com](mailto:zidan.com@windowslive.com)

---

### ABSTRACT

Diabetic Mellitus is one of the most common public health issues around the world. Thus, its complications are one of the most seen in health care settings. Nevertheless, the complications range from mild and up to life-threatening. One of the most notable complications is foot ulceration or the 'diabetic foot' which can lead to high morbidity or mortality. Even locally, diabetes is rising in Saudi Arabia at a disturbing rate which is reflective of the social lifestyle, and even though the population is only around 25 million the diabetes prevalence is seventh globally. Unfortunately, diabetes is not controlled in a lot of patients, which results in a higher rate of complications. Moreover, the awareness, education, and self-care of foot in these patients are very low. We wanted to analyze the literature for the recent advances in diagnosing, managing, and prognostic factors of diabetic foot ulceration. PubMed database was used for the selection of articles, papers were obtained and reviewed. PubMed database was used for articles selection, and the following key terms: diabetic foot ulcer, prognosis, and management. One of the most noticeable complications is diabetic foot ulcer which causes considerable life-affecting morbidity and even mortality. Even though many risk factors have been proposed as the etiology of the ulcer, nevertheless, the management plan is usually following the same pattern. However, teaching the diabetic patient about daily foot examination and an annual review is more beneficial to avoid and/or early diagnose any issues.

**Key words:** Diabetic foot ulcer, Clinical features, Prognosis, Diagnosis, Management

---

### INTRODUCTION

Diabetic Mellitus is one of the most common public health issues around the world [1, 2]. Thus its complications are one of the most seen in health care settings. Nevertheless, the complications range from mild and up to life-threatening. One of the most notable complications is foot ulceration or the 'diabetic foot' which can lead to high morbidity or mortality. Even locally, diabetes is rising in Saudi Arabia at a disturbing rate which is reflective of the social lifestyle, and even though the population is only around 25 million the diabetes prevalence is seventh globally [3]. Unfortunately, diabetes is not controlled in a lot of patients, which results in a higher rate of complications [4, 5]. Moreover, the awareness, education, and self-care of foot in these patients are very low [6, 7]. As a result, the prevalence of diabetic foot locally is reported between (2.6 – 6.2%) which is comparable to the global prevalence of around 6% with males having a higher prevalence [8-10]. Therefore, in this paper, we will review the mechanisms of diabetic foot ulceration, its clinical features, diagnosis, and management for these cases.

## MATERIALS AND METHODS

PubMed database was used for the selection of the articles, and the following keys words used in the mesh ((“Diabetic Foot”[Mesh]) AND (“risk factors”[Mesh]) OR (“diagnosis”[Mesh]) OR (“Management”[Mesh])). In regards to criteria of inclusion: one of the following topics must be in the article; diabetic foot ulcer, diagnosis, risk factors, management, and prognosis. Exclusion criteria were any other articles that did not have one or more of these topics as their endpoint.

### *Review*

Diabetic foot is one of the most important complications which sadly present late most of the time. It is an end-result of neurovascular compromise, with a preexistent injury and uncontrolled blood glucose in most cases. Moreover, these vascular complications have been described to show a higher mortality hazard in these patients. The approximate five-year mortality in these cases can reach up to (30.5%), and the cost-effectiveness of diabetic foot care is as much as cancer on the health care system [11-13].

### *Pathophysiology*

Diabetes is when the pancreas cannot afford enough insulin or there is an increase in cellular resistance to insulin's actions. This will result in hyperglycemic status (high sugar in the blood) that causes damage all over body tissues which reaches systemic level. In diabetic patients, any evidence of complications should caption the attention of the physician to the overwhelming potential of micro and macrovascular problems. Diabetic foot ulceration results from many factors but mainly hyperglycemia (which is uncontrolled in most cases), and thus, it is a co-morbid disease in the diabetic population. Thus, usually, the patient would come to the clinic with other endpoint sequelae of diabetes with the ulcer at the time of diagnosis. For example, some patients may present with a loss of sensation mainly because of the longtime damage from peripheral neuropathy. This complication is the main reason patients present late, this is because neuropathy will stop the patient from feeling the damaging pressure and/or sensations at the feet and mainly the sole. These multiple factors may lead to the worsening of diabetic foot ulcers which predicts outcomes a very difficult task. A review published by the British Medical Journal of Clinical evidence in 2011 reported a five-year rate of ulcer recurrence of around 66% for people with healed ulcers and a 12% amputation rate [5, 7, 14, 15].

### *Risk scoring*

There have been scoring systems developed to help physicians in the diagnosis and management of diabetic foot ulcers. Some main risk factors like diabetic neuropathy are major risk factors especially since these patients already have a decreased healing compared to the normal population. Generally, several scoring criteria are available, however, each of them has some disadvantages and advantages. Many classification systems emphasize, for example, the local pathology of the ulcer while not caring about the ulcer healing parameters. Others incorporate standardized definitions of ischemia, infection and consider systemic wound healing variables. The most common adapted scores worldwide are the PEDIS score and the Wagner-Meggitt classification. These scores categorize the ulceration in line with the severity and extension of the lesion. Nevertheless, no consensus has been made to universally use the same score. The clinician should recognize these common classifications, and similarly the risks associated with the development of the ulcer, particularly in in-patient cases [8, 15, 16].

### *Clinical features*

The surgeon should be cautious of risks of superimposed infection in ulcers that are not infected and of any corresponding red flags within three months of initial presentation, these include any foot deformity, underlying neuropathy, and unhealed ulcers [14]. Physicians shall ask about the duration of diabetes in these patients, their compliance, and recent sugar levels. Studies have confirmed that a 10 years duration of diabetes (type 2) along with poor control were significant for a higher incidence of DFU [17, 18]. Early identification of ulcers is vital especially since the five-year survival rate in these patients is around 24% [19]. This identification can help in controlling the risk factors that will reduce, delay the occurrence rate, and/or lessen the recurrence rate. Patients may have a range of symptoms, starting from a long-standing un-healing ulcer, up to osteomyelitis and sepsis. When the patient presents with the infected ulcer, the clinician must culture the wound, performs an x-ray to rule out any bone involvement. Any signs of sepsis shall raise extra caution by the clinician. Generally, the physician shall do a total vascular and neurological examination to establish the patients' baseline.

### Management

An evidence-based approach is adopted when handling patients with diabetic feet. It starts with controlling the main risk factors. These include; controlling blood glucose levels, improving blood supply, removing any necrotic tissue, managing co-morbid conditions, and applying suitable foot care. Ulcers can be divided by features like depth of wound into superficial and deep. In superficial ulcers, debridement of dead tissue is done till bleeding is noticeable, and this is a sign of reaching a healthy tissue. The surgeon shall apply negative-pressure wound closure to remove any infectious remains. Generally, gangrene can develop even in superficial ulcers especially with underlying critical ischemia. This is because the blood supply is a major factor in the overall healing process of wounds. These patients are indicated for urgent therapy before reaching further life-threatening complications. One of the results of mistreatment is deep ulceration which can reach bone levels and travel proximally [16]. Consequently, re-vascularization is a keystone in the management of these cases. Endovascular revascularization is usually done by vascular surgeons and radiologists to reduce the overall need for amputation [20]. Moreover, wound healing acceleration interventions are vital in these cases and therapeutic footwear is one of its more used examples. It has been established that it decreases the recurrence rate of ulcerations in patients with diabetic feet, and particularly those with foot deformities. Another common technique is dressings even though that there has been minimum evidence supporting it, it remains a common technique in practice [21]. Nevertheless, some comparative studies have shown no significant difference between dressings in the overall outcome [22]. Another technique is the offloading approach, which provides less pressure on the ulcer area, moreover, other techniques like; immovable glass splints, surgical shoes, or total contact splints are used in today's practice [23-25]. Total contact splints have been proven to be very beneficial by evidence, however, due to its requirement of full immobilization, it remains a less popular option among the other techniques [23]. In addition to these techniques, invasive treatment option like debridement is on the table for these patients. This is usually attained by surgery, however, some researchers recommended the use of hydrogels as a debridement agent [25]. This agent has shown much higher success rate of treatment when compared to gauze dressings; and other available agents include autolytic and larval [26, 27].

In cases of failure to heal the local infection of the ulcer, antibiotics can be given to avoid sepsis and other complications. Generally, and like most infections, the choice of antibiotic will depend on culture and sensitivity results from the wound [21]. For neuropathic pain, a drug that can be used include antidepressants, anticonvulsants, or opioids along with gabapentin. Nevertheless, the only approved medications by Food and Drug Administration (FDA) are duloxetine and gabapentin [21]. Granulocyte-Colony Stimulating Factor (G-CSF) is one of the novel therapies explored as adjuvant therapy in this disease. Generally, these G-CSF works on bone marrow by increasing the release of endothelial progenitor cells and will improve the neutrophil function, which is both functioning less in diabetic patients [21]. Negative Pressure Therapy (NPT) has been recognized as a great adjuvant treatment option but unfortunately, it is saved as a last option in most cases [21, 28].

### Prognosis

Overall, the prognosis is dependent on many epidemiologic factors including; ulcer depth, extension, perfusion, and comorbidities like any superimposed infection and any neuropathies [29, 30]. Some risk factors for recurrence include uncontrolled diabetes, osteomyelitis, and if the ulcer was on the plantar side of the foot. Infection is a major prognostic factor because it delays the overall healing process, which is already halted with uncontrolled glycemic status. Other factors delaying the healing include; ulcers larger than 2cm<sup>2</sup>, history of hypertension, and amputation [31, 32]. Thus, good control of blood sugar is favorable for the overall prognosis and in avoiding complications [33]. Recurrence of the ulcer is high and this is usually a multifactorial issue that ultimately increases the overall wound healing period [34]. The recurrence interval is usually within three years of the preceding ulcer, regardless of whether the therapy was successful or not [31, 34]. This has risen the need for a multidisciplinary approach that will involve more health care professionals to address this multifactorial issue. This method has shown a reduction rate of all major amputations by 94% as per some studies [35]. However, some factors like delayed or absent referrals, poor communication between physicians, and poor patient compliance can result in the delayed overall healing of these lesions [36]. Unfortunately, and even under perfect conditions, some ulcerations can be resistant to the conventional treatment methods. Thus, surgeons could explore the possibility of more radical treatment like a vacuum- closure of the wound and maggot therapy which can be effective as a debridement therapy. Some studies have shown that these maggots will result in shortened healing period even in chronic wounds [37, 38].

**CONCLUSION**

Today, diabetic patients have been increasing in number and thus the complications seen have been considerably higher. One of the most noticeable complications is diabetic foot ulcer which causes considerable life-affecting morbidity and even mortality. Even though many risk factors have been proposed as the etiology of the ulcer, nevertheless, the management plan is usually following the same pattern. However, teaching the diabetic patient about daily foot examination and an annual review is more beneficial to avoid and/or early diagnose any issues. Early diagnosis and treatment of DFU are vital to choosing the best antibiotic depending on the culture and reducing the need for debridement and surgical options including amputation.

**ACKNOWLEDGMENTS :** None

**CONFLICT OF INTEREST :** None

**FINANCIAL SUPPORT :** None

**ETHICS STATEMENT :** None

**REFERENCES**

1. Allah MA, Abdeen HA, Abdelhady AA, Hosam M, Maghraby MA. Response of inflammatory markers to circuit weight training in Diabetic patients. *J Adv Pharm Educ Res.* 2019;9(2):37-40.
2. Farah R, Amira S, el Houda HN, Mahfoud HM. Blood Biochemical Parameters Effect of Sahara Myrtle on Diabetic Rats. *Pharmacophore.* 2019;10(1):71-7.
3. Al Dawish MA, Robert AA, Braham R, Al Hayek AA, Al Saeed A, Ahmed RA. Diabetes Mellitus in Saudi Arabia: A Review of the Recent Literature. *Curr Diabetes Rev.* 2016;12(4):359-68.
4. Al-Rowais NA. Glycemic control in diabetic patients in King Khalid University Hospital (KKUH) - Riyadh - Saudi Arabia. *Saudi Pharm J.* 2014;22(3):203-6.
5. Alramadan MJ, Magliano DJ, Almigbal TH, Batais MA, Afroz A, Alramadhan HJ. Glycaemic control for people with type 2 diabetes in Saudi Arabia - an urgent need for a review of management plan. *BMC Endocr Disord.* 2018;18(1):62.
6. Al Odhayani AA, Al Sayed Tayel S, Al-Madi F. Foot care practices of diabetic patients in Saudi Arabia. *Saudi J Biol Sci.* 2017;24(7):1667-71.
7. Abdulghani HM, AlRajeh AS, AlSalman BH, AlTurki LS, AlNajashi NS, Irshad M. Prevalence of diabetic comorbidities and knowledge and practices of foot care among diabetic patients: a cross-sectional study. *Diabetes Metab Syndr Obes.* 2018;11:417-25.
8. Al-Hariri MT, Al-Enazi AS, Alshammari DM, Bahamdan AS, Al-Khtani SM, Al-Abdulwahab AA. Descriptive study on the knowledge, attitudes, and practices regarding the diabetic foot. *J Taibah Univ Med Sci.* 2017;12(6):492-6.
9. Goweda R, Shatla M, Alzaidi A, Alzaidi A, Aldhawani B, Alharbi H. Assessment of knowledge and practices of diabetic patients regarding diabetic foot care, in Makkah, Saudi Arabia. *J Family Med Health Care.* 2017;3(1):17.
10. Zhang P, Lu J, Jing Y, Tang S, Zhu D, Bi Y. Global epidemiology of diabetic foot ulceration: a systematic review and meta-analysis (†). *Ann Med.* 2017;49(2):106-16.
11. Alwin Robert A, Al Dawish MA. Microvascular complications among patients with diabetes: An emerging health problem in Saudi Arabia. *Diab Vasc Dis Res.* 2019;16(3):227-35.
12. Sud M, Wang X, Austin PC, Lipscombe LL, Newton GE, Tu JV. Presentation blood glucose and death, hospitalization, and future diabetes risk in patients with acute heart failure syndromes. *Eur Heart J.* 2015;36(15):924-31.
13. Armstrong DG, Swerdlow MA, Armstrong AA, Conte MS, Padula WV, Bus SA. Five-year mortality and direct costs of care for people with diabetic foot complications are comparable to cancer. *J Foot Ankle Res.* 2020;13(1):16.
14. Jia L, Parker CN, Parker TJ, Kinnear EM, Derhy PH, Alvarado AM. Incidence and risk factors for developing infection in patients presenting with uninfected diabetic foot ulcers. *PloS one.* 2017;12(5):e0177916.
15. Hunt D. Diabetes: foot ulcers and amputations. *BMJ Clin Evid.* 2009;2009.

16. Setacci C, Benevento D, De Donato G, Viviani E, Bracale UM, Del Guercio L. Focusing on Diabetic Ulcers. *Transl Med UniSa*. 2020;21:7-9.
17. Almobarak AO, Awadalla H, Osman M, Ahmed MH. Prevalence of diabetic foot ulceration and associated risk factors: an old and still major public health problem in Khartoum, Sudan? *Ann Transl Med*. 2017;5(17):340.
18. Cardoso HC, Zara A, Rosa S, Rocha GA, Rocha JVC, de Araujo MCE. Risk Factors and Diagnosis of Diabetic Foot Ulceration in Users of the Brazilian Public Health System. *J Diabetes Res*. 2019;2019:5319892.
19. Jeyaraman K, Berhane T, Hamilton M, Chandra AP, Falhammar H. Mortality in patients with diabetic foot ulcer: a retrospective study of 513 cases from a single Centre in the Northern Territory of Australia. *BMC Endocr Disord*. 2019;19(1):1.
20. Bracale UM, Ammollo RP, Hussein EA, Hoballah JJ, Goeau-Brissonniere O, Taurino M. Managing Peripheral Artery Disease in Diabetic Patients: A Questionnaire Survey from Vascular Centers of the Mediterranean Federation for the Advancing of Vascular Surgery (MeFAVS). *Ann Vasc Surg*. 2020;64:239-45.
21. Perez-Panero AJ, Ruiz-Munoz M, Cuesta-Vargas AI, Gonzalez-Sanchez M. Prevention, assessment, diagnosis and management of diabetic foot based on clinical practice guidelines: A systematic review. *Medicine (Baltimore)*. 2019;98(35):e16877.
22. Wu L, Norman G, Dumville JC, O'Meara S, Bell-Syer SE. Dressings for treating foot ulcers in people with diabetes: an overview of systematic reviews. *Cochrane Database Syst Rev*. 2015(7):CD010471.
23. Penny HL. DFU offloading: we know what works, why don't we do it? *J Wound Care*. 2019;28(Sup5):S3.
24. Daza Asurmendi P, Etxeberria Agirre A, Ezkurra Agirre P. Guía de Práctica clínica sobre diabetes tipo 2. *Guia Salud*. 2008.
25. Edwards J, Stapley S. Debridement of diabetic foot ulcers. *Cochrane Database Syst Rev*. 2010(1): CD003556.
26. Elraiyah T, Domecq JP, Prutsky G, Tsapas A, Nabhan M, Frykberg RG. A systematic review and meta-analysis of debridement methods for chronic diabetic foot ulcers. *J Vasc Surg*. 2016;63(2 Suppl):37S-45S e1-2.
27. Liu S, He CZ, Cai YT, Xing QP, Guo YZ, Chen ZL. Evaluation of negative-pressure wound therapy for patients with diabetic foot ulcers: systematic review and meta-analysis. *Ther Clin Risk Manag*. 2017;13:533-44.
28. Oyibo SO, Jude EB, Tarawneh I, Nguyen HC, Harkless LB, Boulton AJ. A comparison of two diabetic foot ulcer classification systems: the Wagner and the University of Texas wound classification systems. *Diabetes Care*. 2001;24(1):84-8.
29. Schaper NC. Diabetic foot ulcer classification system for research purposes: a progress report on criteria for including patients in research studies. *Diabetes/Metab Res Rev*. 2004;20 Suppl 1:S90-5.
30. Dubský M, Jirkovská A, Bem R, Fejfarová V, Skibová J, Schaper NC. Risk factors for recurrence of diabetic foot ulcers: prospective follow-up analysis in the Eurodiale subgroup. *Int Wound J*. 2013;10(5):555-61.
31. Kee KK, Nair HKR, Yuen NP. Risk factor analysis on the healing time and infection rate of diabetic foot ulcers in a referral wound care clinic. *J Wound Care*. 2019;28(Sup1): S4-s13.
32. Perreault L, Pan Q, Mather KJ, Watson KE, Hamman RF, Kahn SE. Effect of regression from prediabetes to normal glucose regulation on long-term reduction in diabetes risk: results from the Diabetes Prevention Program Outcomes Study. *Lancet*. 2012;379(9833):2243-51.
33. Hicks CW, Canner JK, Mathioudakis N, Lippincott C, Sherman RL, Abularrage CJ. Incidence and Risk Factors Associated With Ulcer Recurrence Among Patients With Diabetic Foot Ulcers Treated in a Multidisciplinary Setting. *J Surg Res*. 2020;246:243-50.
34. Musuuza J, Sutherland BL, Kurter S, Balasubramanian P, Bartels CM, Brennan MB. A systematic review of multidisciplinary teams to reduce major amputations for patients with diabetic foot ulcers. *J Vasc Surg*. 2019;71(4):1433-46.
35. Barshes NR, Sigireddi M, Wrobel JS, Mahankali A, Robbins JM, Koungias P. The system of care for the diabetic foot: objectives, outcomes, and opportunities. *Diabet Foot Ankle*. 2013;4(1):21847.
36. Tian X, Liang XM, Song GM, Zhao Y, Yang XL. Maggot debridement therapy for the treatment of diabetic foot ulcers: a meta-analysis. *J Wound Care*. 2013;22(9):462-9.
37. Prompers L, Schaper N, Apelqvist J, Edmonds M, Jude E, Mauricio D, et al. Prediction of outcome in individuals with diabetic foot ulcers: focus on the differences between individuals with and without peripheral arterial disease. The EURODIALE Study. *Diabetologia*. 2008;51(5):747-55.

38. Astbury J BC, Barnes S. Type 1 diabetes in adults National clinical guideline for diagnosis and management in primary and secondary care. 2004. Available from: <https://www.nice.org.uk/guidance/cg15>.