

## A REVIEW OF THE DIABETIC FOOT IN THE MALAYSIAN PERSPECTIVE

Azwanis Abdul Hadi\*<sup>1</sup>, Mohd Aznan Md Aris<sup>1</sup>, Nurul Husna Azmi<sup>1</sup>, Hasheema E Nasreen<sup>2</sup>, Aminuddin Che Ahmad<sup>3</sup><sup>1</sup>Department of Family Medicine, International Islamic University Malaysia.<sup>2</sup>Department of Community Medicine, International Islamic University Malaysia.<sup>3</sup>Department of Orthopaedics, International Islamic University Malaysia.

\*Corresponding Author: Dr. Azwanis Abdul Hadi

Department of Family Medicine, International Islamic University Malaysia.

Article Received on 07/07/2019

Article Revised on 28/07/2019

Article Accepted on 18/08/2019

## ABSTRACT

One of the most common complication of diabetes is the development of foot ulcer which could lead to lower limb amputation and even death. Diabetic foot causes significant impact to the patient, community and country. Therefore, detection of a diabetic foot at risk of ulceration is essential to prevent these complications. This article will discuss regarding the diabetic foot, the factors associated with it and the variety of systems that are used for its classification, with some focus on the Malaysian perspective.

**KEY WORD:** Diabetic foot, diabetic foot at risk, diabetic foot classification, Malaysia.

## INTRODUCTION

Diabetes mellitus is a chronic disease that occurs as a result of reduced production of insulin (a hormone that regulates blood sugar or glucose in the body) from the pancreas or when the body cannot effectively use the insulin. It is also classified under one of the metabolic diseases and one of four priority of non-communicable disease that had given the biggest impact to the health, social and economic status worldwide. It is a common and potentially disabling chronic disease worldwide.<sup>[1]</sup>

According to the latest update from WHO (2016), an estimated 422 million people globally were living with diabetes in 2014, compared to 108 million in 1980. The global prevalence of diabetes also showed double increment since 1980 from 4.7% to 8.5% in the adult population.<sup>[1]</sup> These reflect an increase in associative factors such as sedentary lifestyle or being overweight or obese.

Malaysia is one of the 22 countries and territories of the IDF (International Diabetes Federation) Western Pacific Region. There were over 3 million cases of diabetes in Malaysia in 2017 with prevalence of diabetes in adults of 16.9%.<sup>[2]</sup>

According to the Malaysian National Health and Morbidity Survey (NHMS) 2015, the overall prevalence of diabetes mellitus (known and undiagnosed) among adults of 18 years and above was 17.5%. There was an overall increasing trend in the 18-19 years age group and among the 70-74 years age group.<sup>[3]</sup>

The annual incidence of foot ulcer in the general population was 2.2-5.9% and the prevalence was lower (1.7%-3.3%) in younger patients with either type 1 or type 2 diabetes and higher (5-10%) in older individuals with mainly type 2 diabetes. This is due to non-healing ulcer, where the recurrent rate is high.<sup>[4]</sup>

People with diabetes are more susceptible to foot problems, often because of peripheral neuropathy and poor circulation which are two complications of the disease. Peripheral neuropathy causes a loss of sensation in the feet, reducing the ability to feel pain or pressure in their feet that predisposed to the development of corn, calluses, cuts and blisters. Minor foot injuries can lead to an ulcer. Poor circulation diminishes the body's ability to heal, making it difficult to resist infection and heal injuries or wounds. This is a common complication associated with diabetes and can lead to chronic foot ulcer, which is a leading cause of amputation. Amputation is considered when the healing potential is poor or a serious infection becomes widespread, threatening the patient's life.<sup>[5]</sup>

Establishing the National Diabetes Registry is part of the diabetes intervention program in Malaysia. This is an initiative from the Ministry of Health Malaysia to further strengthen non-communicable disease surveillance in Malaysia specifically for monitoring the quality of care received by diabetic patients attending the MOH health care facility.<sup>[7]</sup>

## IMPACT OF DIABETIC FOOT PROBLEM TO INDIVIDUAL, FAMILY AND COUNTRY

Diabetic foot disease which is the leading cause of non-traumatic amputations of the lower limb is increasing locally and globally hence a major health care and socioeconomic burden.

There is one local study which estimated the cost for acute diabetic foot infection treatment is around USD 11 000 per year and USD 60 per patient per year (adjusted to USD 1 = RM3.23, based on Bank Negara Malaysia on Ringgit Foreign Exchange Rate; dated November 2013) during the 12 months study period. From the study, they have found that half of the expenditure (50.29%) is from the administration of antibiotics. While surgical procedure contributed the smallest percentage of the cost which is nine per cent. They concluded that these may be due to religious and community factor as in Terengganu, many patients view amputation as taboo. Wound dressing plays a significant role in the treatment of diabetic foot infection and cost approximately 18% of the total expenditure. While admissions and baseline investigations, together with the cost for wound dressing contributed to the rest 22.73% the total expenditure.<sup>[7]</sup>

As mentioned earlier, most studies only focused at direct causes such as the cost of the healthcare system. Indeed indirect causes such as loss of productivity and the individual patient's cost is far more important as it is immeasurable and might affect the patient's life as well as the country's productivity.<sup>[8]</sup> Chronic foot ulcers and/ amputation have a major effect on an individual's physical and psychosocial functioning and quality of life. One study showed that about 77% of individuals over 75 years of age undergoing amputation were unable to return to their own homes after surgery, and required additional financial support and social services.<sup>[9]</sup>

## ASSOCIATED RISK FACTORS FOR DEVELOPMENT OF FOOT PROBLEM IN DIABETES

Diabetic foot complications are the most common cause of non-traumatic lower extremity amputations in the industrialized world. Several studies showed 10 – 15 fold higher lower limb amputation risk in patients with diabetes in comparison with the general population.<sup>[10]</sup>

Among patients with diabetes, approximately 15% will develop foot ulcer at some time in their lifetime and of these, 14% to 24% will subsequently require a lower limb amputation.<sup>[10]</sup>

There are many risk factors identified for ulcer development, which are peripheral sensory neuropathy, vascular disease, limited joint mobility, abnormal foot pressures, minor trauma, history of ulceration or amputation, impaired vision, structural foot deformity, uncontrolled hyperglycemia, duration of diabetes, chronic renal disease and old age. However, the most common single factor to lower limb amputations among

diabetics is peripheral sensory neuropathy leading to foot ulcer.<sup>[11,12]</sup> Peripheral neuropathy as a consequence of long-lasting diabetes is a cause of 50-70% of non-traumatic lower limb amputation.<sup>[13]</sup> Clinical studies have consistently identified measures of peripheral neuropathy as predicting diabetic foot ulceration.<sup>[12]</sup>

Studies have shown that significant associated factors for peripheral neuropathy among newly diagnosed T2DM were age and presence of retinopathy. The risk for neuropathy increased with age and for every 1-year increase in age, there will be 1.11 times odds of having neuropathy compared to non-neuropathy. Those who had retinopathy were 5.51 times at odds of having neuropathy compared to those without retinopathy.<sup>[14]</sup>

Infection and ischemia is a significant risk factor for amputation although not for ulceration.<sup>[12]</sup> Chronic hyperglycemia can contribute to foot ulceration, delay normal wound healing, and is associated with foot amputations. A history of previous amputation is the best predictor for subsequent amputations.<sup>[15,16]</sup>

According to a study done in Kuala Langat in 2009, the result showed the associated risk factors for the development of diabetic foot ulcer were the number visits for check-ups and medical co-morbidity such as renal impairment, will shorten the time to develop diabetic foot complication.<sup>[4]</sup>

Based on a few studies smoking status was also related to the development of ulcer.<sup>[17]</sup> Smokers tend to develop ulcers earlier than non-smokers. The mean ulcer-free survival for smokers was 95 months, whereas mean survival for non-smokers was 101 months.<sup>[4]</sup>

## DIABETIC FOOT AT RISK

Nather et al. (2018) defined 'Foot at risk as the foot with the potential to ulcerate'. This is because a high percentage of diabetic foot ulcers will lead to lower limb amputation. Furthermore, he identifies foot at risk by four key features: Loss of protective sensation (peripheral neuropathy), one or both distal pulses not palpable (peripheral arterial disease), the presence of foot deformity or callosity and inability to reach a foot or visual impairment. Peripheral neuropathy has been shown to be the most common risk factor and was present in 78% of foot ulceration cases.

## ASSESSMENT OF FOOT PROBLEM IN DIABETES PATIENT AND ITS CLASSIFICATION

Assessment of foot problem in Diabetic patient comprises of detailed history on diabetes duration and control, adherence to medication, current foot complaint, duration of a foot problem, severity and its effect on quality of life. Other associated co-morbidity such as nephropathy and retinopathy need to be addressed as it is sometimes could directly or indirectly lead to the onset of diabetic foot complication. Furthermore, identification of other risk factors such as smoking, awareness, and

practice towards diabetic foot care, or any pre-existing foot problem need to be addressed as well.

After detailed history has been taken, physical examination will be performed which include proper foot examination. Eventually, the foot status will be stratified according to the guidelines used in the country. In Malaysia, University of Texas classification is preferred to classify diabetic foot based on latest diabetic foot guideline.<sup>[16]</sup> The aim of foot assessment is to classify the

foot status into different categories or severity to further estimate the risk of developing diabetic foot problem and risk of amputation.

There are many diabetic foot classification systems such as the Wagner Ulcer Classification System, the University of Texas Diabetic Wound Classification and the King's College classification. Table 1 shows the comparison between the three classification systems.

**Table 1. Comparison of diabetic foot classification systems.**

Classification	Grades
The Wagner Ulcer Classification System	<p>The Wagner diabetic foot ulcer classification system assesses ulcer depth and the presence of osteomyelitis or gangrene by using the following grades:</p> <p>0 – No open foot lesions            1 – Presence of superficial ulcer, partial or full thickness            2 – Ulcer extends to ligaments, tendon, joint capsule or deep fascia without abscess or osteomyelitis.            3 – Presence of deep ulcer with abscess, osteomyelitis or joint sepsis            4- gangrene localised to the forefoot or heel            5-extensive gangrene.</p>
The University of Texas Diabetic Wound Classification	<p>The University of Texas system grades diabetic foot ulcers by depth and then stages them by the presence or absence of infection and ischemia:</p> <p>0 - Presence of pre-ulcer or post-ulcer epithelisation            1 - Superficial ulcer not penetrating tendon, bones or joint            2 - Ulcer penetrating through to tendon or capsule            3 - Ulcer penetrating to bone or joint</p> <p>Within each wound grade there are four stages:</p> <p>A - Non infected and non-ischaemic ulcer            B - Infection present            C - Ischaemia present            D - Both infection and ischaemia are present</p>
The King's College classification	<p>The Kings' College diabetic foot classification system describes the changes of the diabetic foot more generally.</p> <p>1 - No risk factors of neuropathy, ischemia, callus, deformity, or swelling.            2 - Risk factors for diabetic foot including ischemia, neuropathy, callus, deformity or swelling.            3 - Skin breakdown of the foot.            4 - The foot has developed infection.            5 - Necrosis of foot has supervened.            6 - The foot cannot be saved and will need a major amputation.</p>

All of the above classification systems included the major risk factors involved in causing a diabetic foot problem such as vasculopathy and neuropathy. Therefore all three are good classification systems that can be used as guidelines for the management of the diabetic foot.

The Wagner classification was the most widely used classification system. It is a simple system with 6 grades. It starts with a grade for normal foot with its subsequent grades focusing on ulcers with increasing depths. This

classification includes abscess, osteomyelitis and gangrene in its later grades, however it does not assess wound infection or ischemia.

The University of Texas (UoT) wound classification starts its first grading the foot with intact skin but with dermatological changes, followed by ulcers of increasing depth. It is a mixture of four stages and four grades with the inclusion of infection and ischaemia making this system a more thorough tool. Studies have shown that

the UoT mixture of grade and stage makes it a better predictor of outcome. This means increasing stage is associated with increased risk of amputation and prolonged ulcer healing time.<sup>[18]</sup> The drawback of this complex classification system is that it is not suitable to be used for daily practice in the primary care setting.

The Kings College classification is the only classification among these three classifications that has a grade for normal foot and also a grade for the diabetic foot at risk. It describes the criteria to detect the diabetic foot at risk with more detail such as ischaemia, neuropathy, calluses, deformity and swelling; as compared with the university of Texas classification which only include dermatological changes. However, its description of ulcer and infection is broad and does not go in detail as compared with the other two classifications. Due to its simplicity, the Kings' College classification has the advantage of being easier to be administered by supporting health personnels in the primary care sector while the University of Texas classification more in depth details on the extent and severity of ulcers would be useful to the Orthopaedic surgeon in deciding the next step of surgical management. In Malaysia, the latest diabetic foot clinical practice guidelines uses the University of Texas classification.<sup>[16]</sup>

## CONCLUSION

Diabetic foot is a serious complication of diabetes that warrant early identification and timely prevention. Hence the importance of utilising a classification system. There are many factors associated with diabetic foot but majority of classification system identifies peripheral neuropathy and vasculopathy as the main factors to elicit. It is recommended to implement a routine clinic visit to assess patient's history with routine foot examination using a classification system in our regular practice.

## FUNDING

This study received funding from the International Islamic University Research Initiative Grant Scheme (RIGS17-046-0639).

## REFERENCES

1. World Health Organization. Global Report on Diabetes. Geneva; WHO Press: 2016.
2. International Diabetes Federation. Malaysia - International Diabetes Federation. 2017. Retrieved from <https://www.idf.org/membership/wp/malaysia#membership>
3. Institute for Public Health. National Health and Morbidity Survey 2015 (NHMS 2015), Non-Communicable Diseases, Risk Factors & Other Health Problems. Volume 2, Kuala Lumpur; Ministry of Health: 2015.
4. Faridah K, Azmi M. Retrospective Study of Predictors for Foot Ulceration among Diabetic Patients Attending Kuala Langat Health Centre from 1999 to 2008. *Journal of Community Health*, 2008; 15(2): 43–59.
5. Frykberg RG, Zgonis T, Armstrong DG, Driver VR, Giurini JM, Kravitz SR. Diabetic Foot Disorders, a clinical practice guidelines. American College of Foot and Ankle Surgeons, Volume 45, Number 5: 2006
6. Feisul MI, Azmi S. (Eds). National Diabetes Registry Report, Volume 1, 2009-2012. Kuala Lumpur; Ministry of Health Malaysia: 2013 Jul.
7. Lam AWC, Zaim MR, Helmy HH, Ramdhan IMA. Economic Impact of Managing Acute Diabetic Foot Infection in a Tertiary Hospital in Malaysia. *Mal Orth J*, 2014; 8(1): 46–9.
8. Alsalamah SM, Alshalan AM, Zaheer M, Alsalamah MS, Alqahtani HH. Socio-Economic impact on families with Diabetic Foot Ulcers and Amputations. *Ann. Pak. Inst. Med. Sci.*, 2015; 11(1): 21–5.
9. Hopkins RB, Burke N, Harlock J, Jegathisawaran J, Goeree R. Economic burden of illness associated with diabetic foot ulcers in Canada. *BMC Health Services Research*, 2015; 15(1): 13.
10. Jain AKC, Joshi S. Diabetic Foot Classifications : Review of Literature. *Med Sci*, 2013; 2(3): 715–21.
11. Alexiadou K, Doupis J. Management of diabetic foot ulcers. *Diabetes Ther*, 2012; 3(1): 4.
12. Amin N, Doupis J. Diabetic foot disease : From the evaluation of the “ foot at risk ” to the novel diabetic ulcer treatment modalities. *World J Dia*, 2016; 7(7): 153–164.
13. Nehring P, Mrozikiewicz-rakowska B, Krzy M, Sobczyk-kopcio A, Karnafel W. Diabetic foot risk factors in type 2 diabetes patients : a cross-sectional case control study, *Journal of Diabetes and Metabolic Disorder*, 2014; 13(1): 79.
14. Azura M, Adibah H, Juwita S. Risk Factor of Peripheral Neuropathy among Newly Diagnosed Type 2 Diabetic Patients in Primary Care Clinic, *International Journal of Collaborative Research on Internal Medicine & Public Health*, 2012; 4(11): 1858–67.
15. Van Damme H, Limet R. Amputation in Diabetic Patients. *Clin Podiatr Med Surg*, 2007; 24(3): 569–82.
16. Clinical Practice Guideline on Management of Diabetic Foot. Second edition, Putrajaya; Ministry of Health: 2018.
17. Al-Rubeaan K, Al Derwish M, Ouizi S, Youssef AM, Subhani S N, Ibrahim HM, Alamri BN. Diabetic Foot Complications and Their Risk Factors from a Large Retrospective Cohort Study. *PLOS ONE*, 2015a; 10(5): e0124446.
18. 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.