REVIEW

Journal of International Surgery and Clinical Medicine (*JISCM)* 2021, Volume 1, Number 1: 5-8
E-ISSN: 2807-7008

Published By :
Surgical Residency Program
Universitas Syiah Kuala

Handling of diabetic foot in Type 2 Diabetes Mellitus (T2DM) patients based on a vascular approach: a literature review

Niko Azhari Hidayat[1*], Abed Nego Okthara Sebayang[2]

[1]Faculty of Advanced Technology and Multidisciplinary, Universitas Airlangga Hospital, Surabaya, Indonesia
[2]Setio Husodo Hospital, Kisaran, Indonesia

*Corresponding to:
Niko Azhari Hidayat;
Faculty of Advanced Technology and Multidisciplinary, Universitas Airlangga Hospital, Surabaya, Indonesia;
niko-a-h@fk.unair.ac.id

Received: 2021-05-09
Accepted: 2021-06-10
Published: 2021-06-17

ABSTRACT

Diabetes mellitus (DM) is a metabolic disease characterized by hyperglycemia that occurs due to insulin disorders, insulin action, or a combination of both. Based on data from the 2014 IDF, Indonesia ranks 5th in the world of patients with DM. Diabetic foot is one of the chronic complications of DM that is often encountered. Early vascular assessment in the legs of a diabetic patient is recommended to reduce mortality and morbidity. The vascular examination begins with a capillary refilling examination, palpation of the lower extremity arteries, and a further ankle-brachial index assessment. The vascular approach aims to assess the vascularization of the diabetic foot is still good or has experienced occlusion or obstruction due to inadequate blood vessels. Diabetic foot care is based on the classification recommended by the International Working Group On Diabetic Foot. Management of diabetic foot involves a variety of multidisciplinary, one of them with a vascular approach. The vascular approach also aims to determine the appropriate therapy for the diabetic foot. This study aims to provide better understanding

Keywords: Diabetic foot, diabetes mellitus, microvascular, macrovascular, vascular.
Cite This Article: Hidayat, N.A., Sebayang, A.N.O. 2021. Handling of diabetic foot in Type 2 Diabetes Mellitus (T2DM) patients based on a vascular approach: a literature review. *Journal of International Surgery and Clinical Medicine* 1(1): 5-8. DOI : 10.51559/jiscm.v1i1.5

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disease characterized by hyperglycemia that occurs due to insulin disorders, insulin action, or a combination of both.[1] DM is a condition in which blood sugar levels are higher than usual because the body cannot excrete and use enough insulin hormone. Among the classifications of diabetes mellitus, type 2 diabetes mellitus (T2DM) is the most common type of diabetes mellitus and often causes complications.[1,2]

DM Type 2 covers over 90% of all diabetes populations. The prevalence of T2DM in whites ranges from 3-6% in the adult population. The International Diabetes Federation (IDF) announced in 2011 that 336 million people worldwide have T2DM, and the disease is associated with 4.6 million deaths annually, or one death every seven seconds.[2]

The World Health Organization (WHO) predicts an increase in people with DM in Indonesia from 8.4 million in 2000 to around 21.3 million in 2030. IDF predicts an increase in people with DM in Indonesia from 9.1 million in 2014 to 14.1 million by 2035.[3]

Based on data from the IDF in 2014, Indonesia is ranked 5th in the world with 7.6 million people with DM. An epidemiological study conducted until 2005 stated that the prevalence of diabetes mellitus in Jakarta in 1982 was 1.6%, in 1992, it was 5.7%, and in 2005 it was 12.8%. In 2005 in Padang, the prevalence of T2DM was found to be 5.12%.[2,4]

The increasing prevalence of diabetes mellitus in developing countries is due to increased prosperity rates in the countries concerned. The increase in per capita income and lifestyle changes, especially in big cities, have led to an increase in the incidence of degenerative diseases, one of which is diabetes mellitus. Diabetes mellitus is a health problem that has an impact on productivity and can reduce human resources.[2,4]

Diabetes mellitus often causes macrovascular and microvascular complications. Macrovascular complications are mainly due to insulin resistance, whereas microvascular complications are more due to chronic hyperglycemia. This vascular damage begins with endothelial dysfunction due to oxidative stress and glycosylation that leads to the formation of advanced glycation end products (AGEs).[1,3] When AGEs bind into AGEs receptors, it activates the NF-κB as a inflammatory signaling factors. The persistence inflammation could leads to the impairment of vascular (angiopathy) and nerve (neuropathy). Those mechanisms induce diabetic food.[5,6]

Diabetic foot is one of the most common chronic complications of T2DM. Diabetic foot is a disease of the feet of

diabetics characterized by sensory, motor, autonomic and / or leg vascular disorders. Diabetic ulcers are one of the main causes of diabetics being hospitalized. Ulcers, infections and gangrene are serious complications and require a lot of money and take longer treatment.[2]

Amputation is a serious consequence of foot ulcers in diabetic patients. As many as 14.3% will die within a year after amputation, and as much as 37% will die three years after amputation. Early detection and adequate treatment will reduce the incidence of amputation. this study aims to explain the treatment of diabetic foot in T2DM patients based on a vascular approach.

MATERIAL AND METHODS

The literature review conducted by searching various sourches, whether in the conventional sources such as books, archives, magazines, articles printed or documents that were relevant to the problem being studied or from electronic source such as journals from several database. All relevant articles were synthesized to strengthen the arguments and provide the evidence. We found eleven journals related to the topic. The analysis technique used was content analysis intended to describe a message or a certain text in detail. The design of this analysis was not intended to test a particular hypothesis or test the relationship between variables.

RESULTS

This article noted that the vascular assessment of the lower extremities should be carefully assessed. The vascular examination begins with capillary refilling, palpation of the lower extremity arteries, and further assessment of the *Ankle Brachial Index* (ABI). If the medical history and physical examination reveal ischemia in the legs or if the ulcer does not heal, then a blood pressure check is performed on the fingertips. If the fingertip blood pressure is less than 40 mmHg, or *transcutaneous oxygen tension* (TcPO2) with a value less than 30 mmHg because arterial perfusion disturbances will cause impaired wound healing. Furthermore, the vascular evaluation will not only reach the ABI examination but will also carry out other supporting tests such as *Segmental Pressure Pulse Volume* (SPPV), *Skin Perfusion Pressure* (SPP), *Transcutaneous oxygen tension* (TcPO2), Doppler ultrasonography, and vascular imaging.[7]

DISCUSSION

Glycosylation process between the blood glucose with endothelial cells lead the formation of AGEs and culminating in diabetic food.[1,3,5] Thus, early detection of foot abnormalities with DMT2, especially in patients at high risk, is beneficial in determining early intervention and reducing the potential for hospitalization or amputation. Early detection includes identification of a history of foot complaints and a physical examination. A detailed history includes a history of previous ulcers, history of amputation, history of trauma, and the underlying disease and smoking habits. Infection. More than half of foot ulcers will become infected and require hospitalization, and 20% of lower limb infections will end in amputation. Initial vascular assessment of the ankles of diabetic patients is highly recommended to reduce mortality and morbidity.[2,3]

The vascular assessment of the lower extremities should be carefully assessed. The vascular examination begins with capillary refilling, palpation of the lower extremity arteries, and further assessment of the Ankle Brachial Index (ABI). If the medical history and physical examination reveal ischemia in the legs or if the ulcer does not heal, then a blood pressure check is performed on the fingertips. If the fingertip blood pressure is less than 40 mmHg, or TcPO2 with a value less than 30 mmHg because arterial perfusion disorders will cause impaired wound healing.[1,4]

The American Diabetes Association (ADA) recommends ABI as a test for the vascular evaluation of the legs of people with DMT2.[7] ABI examination can assess the level of obstruction in the lower limb arteries. ABI is the ratio of systolic blood pressure measured in the dorsalis pedis or tibial posterior ankle artery, compared to systolic blood pressure in the brachial artery measured in the patient's arm in the supine position. Diagnostic interpretation indicates that a low ABI ratio is associated with a high risk of vascular abnormalities (Table 1). ABI has a weakness in the interpretation of results in certain circumstances. ABI values greater than 1.2 can be secondary to vascular calcinosis, and ABI can be falsely negative in diabetic patients with aortoiliac stenosis.[7]

Table 1. Vascular Evaluation Interpretation based on ABI[7]

Resting ABI	*Severity*
0,91-1,30	*Normal*
0,70-0,90	*Mild Obstruction*
0,40- 0,69	*Moderate Obstruction*
<0,40	*Severe obstruction*

The vascular evaluation does not end with the ABI assessment. Furthermore, other supporting examinations will be carried out, such as SPPV, SPP, TcPO2, doppler ultrasonography, and vascular imaging.[7] The selection of these investigations is based on patient needs, ABI values, and medical personnel skills.

The SPPV is performed on patients with normal ABI values but clinically suspected of having peripheral vascular disease.[4,7] This examination is carried out on the principle that vascular obstruction occurs proximal to where the blood pressure drops. A tensimeter is placed on the thigh, calf, and ankle in sequence, and the blood pressure is recorded for lesion location finding. From the blood pressure records obtained at the three examination sites, it can be assessed for the presence of vascular lesions, the severity, and the primary location of vascular abnormalities.[2,7,8]

The SPP is a laser doppler assessment that uses a tensimeter on the ankle. This examination can assess the presence of impaired perfusion in the lower extremities. This examination is an assessment of the cutaneous capillary circulation. It is more sensitive than other techniques for detecting lower limb peripheral artery abnormalities.[7,8]

The TcPO2 is a test assessing oxygen pressure in two areas associated with ulcers. This examination is recommended to be a diagnostic tool to assess the chance of a wound healing process.[3,7,8] This examination is recommended as a

screening tool in populations at high risk for vascular disorders. TcPO2 is usually used in diabetic patients with critical limb ischemia.[7,9]

Doppler ultrasonography is a simple examination that is currently a prevalent, easy, inexpensive, and reliable tool in assessing the degree of arterial stenosis, obstruction to the state of blood flow after revascularization.[7,9] The location of arterial stenosis can be identified by placing a serial probe. Doppler along the extremities.[2,7,10]

Vascular imaging studies have an important role in diabetic ulcers. If the ABI examination results are within normal limits, but on clinical examination, symptoms, and signs of peripheral artery disease are found, other tests are needed, namely vascular imaging tests including CT-angiography (CTA), magnetic resonance angiography (MRA), and digital subtraction angiography (DSA). This examination is for diagnosis and can assess the severity and location of the lesion. Currently, percutaneous transluminal angioplasty (PCTA) is the gold standard in determining the narrowing of blood vessels.[9,10]

In addition to the above examinations, an ulcer assessment also needs to be carried out to determine the type of therapy to be carried out whether medical use is sufficient or an amputation procedure should be performed. This ulcer assessment is based on a specific classification. There are various classifications of diabetic foot, namely the classification by Edmonds of King's College Hospital London, Liverpool classification, Wagner classification (Table 2), Texas classification, and the one that is more widely used is the one recommended by the International Working Group on Diabetic due to disorders determination are more dominant, namely vascular. , infection and neuropathy so that the direction of management in treatment can be well focused.[10,11]

Table 2. Classification of Wagner[7]

Grade	Lession
0	No open lesions; only deformity or cellulitis
1	*Superficial ulcer*
2	Deep ulcers down to the tendon or joint capsule
3	Deep ulcer with abscess, osteomyelitis, or joint sepsis
4	Local gangrene in the forefoot and heel
5	Gangrene in all legs

Apart from the Wagner classification, a classification that is also often used is the Edmonds classification. Based on the Edmonds classification, the diabetic foot is classified into six degrees.[3,7,8]

Based on the above classification, treatment and surgery can be determined as follows (Figure 1):[7,9,10]

1. Degree 0
   Local treatment is not required. Management focuses on administering anti-hyperglycemic drugs or administering insulin
2. Degree 1 until 4
   Medical management and minor surgery
3. Degree 5 and 6
   Minor surgery is performed. If it fails, major surgery can be performed with an amputation above the knee or below the knee.

In addition, some special measures are also needed in handling diabetic foot, such as:

1. The incision in the abscess and broad cellulitis
2. Excision of first and 2nd-degree diabetic feet
3. Debridement/necrotomy in diabetic foot degrees 2,3 and 4
4. Mutilation in 5-degree diabetic foot
5. Amputation in grade 5 and 6 diabetic feet

Management of DM Type 2 patients with diabetic foot is almost the same as managing diabetic patients without complications which aims to improve the patient's quality of life. Management objectives include short-term and long-term management goals. Short-term management goals are eliminating

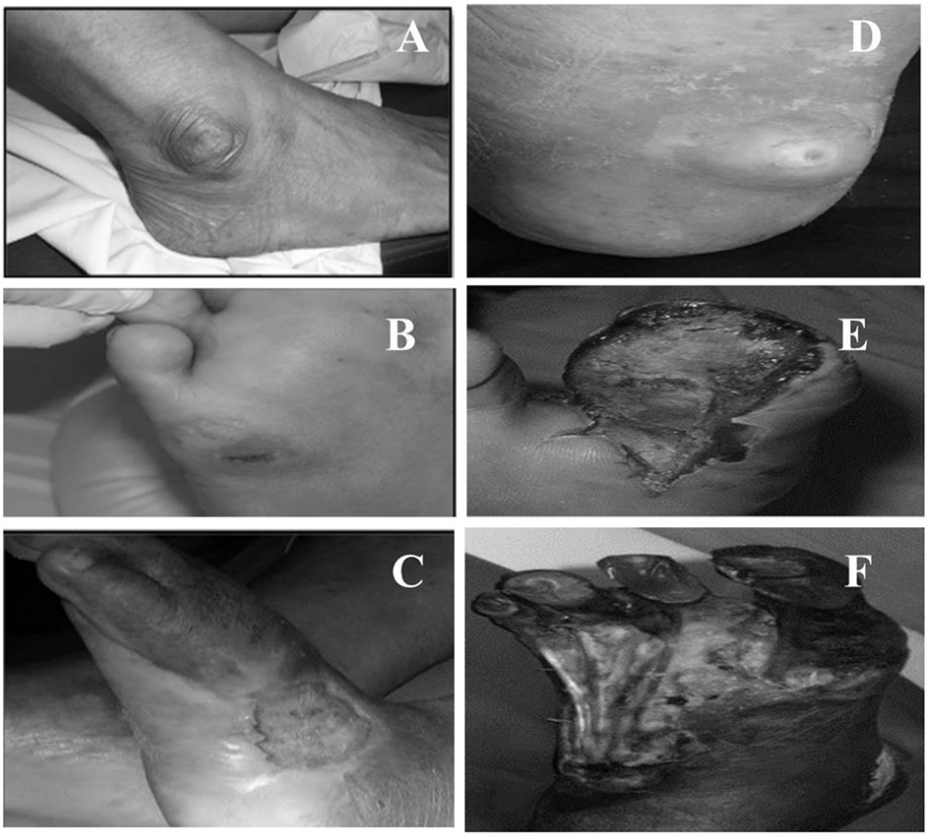

Figure 1. Classification of diabetic foot. (A) Normal foot, (B) High risk of worsening DMT2, (C) Legs with open score, (D) Foot with lesions accompanied by tissue necrosis, (E) Feet infection, (F) Unsaved leg.[7]

complaints and signs of diabetes, maintaining a sense of comfort, and achieving targets for blood glucose control.[3,8]

Long-term management aims to prevent and inhibit the progression of macrovascular and microvascular complications and diabetic neuropathy. The ultimate goal of managing T2DM is to reduce morbidity and mortality. To achieve these goals, it is necessary to manage diabetes earlier and faster so that fasting blood glucose levels, blood glucose after meals, blood glucose variability, HbA1c, blood pressure, body weight and lipid profile can be controlled.[8]

Management of DM Type 2 with diabetic foot focuses on multidisciplinary. Multidisciplinary cooperation is needed. Starting from mechanical control with insulin administration, neuropathic control with the administration of vasodilators (antiplatelet and cilostazol), vascular control is carried out by vascular assessment, mechanical-pressure control in collaboration with vascular surgeons and medical rehabilitation, wound control by administering antibiotics and cleaning the wound regularly. adequate.[8,11]

CONCLUSION

Diabetic foot is one of the complications that occur in patients with diabetes mellitus. Handling of diabetic foot involves various multidisciplinary measures, one of which is a vascular approach. The vascular attachment aims to assess the vascularization of the diabetic foot is still good or has experienced occlusion or obstruction due to inadequate blood vessels. The vascular approach also aims to determine the appropriate therapy for the diabetic foot. Proper and adequate handling will reduce morbidity and mortality in DM patients with diabetic foot.

DISCLOSURE

Funding
No funding.

Conflict of Interest
There is no conflict of interest of this study.

Author Contributions
All of the authors contribute in this article preparation.

Ethical Statement
Not applicable

ACKNOWLEDGEMENT

The authors would like to thanks to all parties that helps in the process of making and preparing the manuscript for publication.

REFERENCES

1. Fan W. Epidemiology in diabetes mellitus and cardiovascular disease. Cardiovasc Endocrinol. 2017;6(1):8–16.
2. Cho NH, Shaw JE, Karuranga S, Huang Y, da Rocha Fernandes JD, Ohlrogge AW, et al. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. Diabetes Res Clin Pract. 2018;138:271–81. Available from: http://dx.doi.org/10.1016/j.diabres.2018.02.023
3. American Diabetes Association. Diagnosis and Classification of Diabetes Mellitus. Diabetes Care. 2011;34(SUPPL.1):562–9.
4. Bandeira S de M, da Fonseca LJS, Guedes G da S, Rabelo LA, Goulart MOF, Vasconcelos SML. Oxidative stress as an underlying contributor in the development of chronic complications in diabetes mellitus. Int J Mol Sci. 2013;14(2):3265–84.
5. Huijberts MSP, Schaper NC, Schalkwijk CG. Advanced glycation end products and diabetic foot disease. Diabetes Metab Res Rev. 2008;24 Suppl 1:S19-24.
6. Lep M. Chapter V : Diabetic Foot. 2011;42:60–74.
7. Davies MJ, D'Alessio DA, Fradkin J, Kernan WN, Mathieu C, Mingrone G, et al. Management of hyperglycaemia in type 2 diabetes, 2018. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). Diabetologia. 2018;61(12):2461–98.
8. Paneni F. 2013 ESC/EASD guidelines on the management of diabetes and cardiovascular disease: Established knowledge and evidence gaps. Diabetes Vasc Dis Res. 2014;11(1):5–10.
9. Beckman JA, Creager MA. Vascular complications of diabetes. Circ Res. 2016;118(11):1771–85.
10. Einarson TR, Acs A, Ludwig C, Panton UH. Prevalence of cardiovascular disease in type 2 diabetes: A systematic literature review of scientific evidence from across the world in 2007-2017. Cardiovasc Diabetol. 2018;17(1):1–19.
11. Ramachandran A, Snehalatha C, Ma RCW. Diabetes in South-East Asia: An update. Diabetes Res Clin Pract. 2014;103(2):231–7.