

Screening for High-Risk People with Diabetes Ulcers in the City of Pontianak

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Abstract

Diabetes mellitus is a health problem that can cause disorders or abnormalities in the feet, namely disorders of the nerves (neuropathy) and blood vessels. Peripheral arterial disease is a circulation problem where the arteries are narrowing, resulting in reduced blood flow to the legs. Severe PAD is a significant factor in lower extremity amputation, especially in people with diabetes, then PAD in people with diabetes can be seen with ischemic or gangrene injuries. People with diabetes have decreased blood circulation, especially in the lower extremities, due to changes in the function of the endothelial layer due to a long hyperglycemic status. The difference is a decrease in nitric oxide production. Another problem is decreased sensation in the feet because people with diabetes have a risk for neuropathy. This neuropathy causes people with diabetes to get injured easily because the area on the feet is not felt when traumatized, making infection easier. Preventive action taken from the start is one of the best actions. Preventive measures in people with diabetes who experience circulation disorders and neuropathic problems can be done in several ways, including using tools and gymnastics. The device used is Veinoplus arterial or electrical muscle stimulation; the exercise in question is foot exercise. The working principle of this tool can increase blood circulation in the lower extremities by increasing the production of nitric oxide; nitric oxide is an essential component in preventing atherosclerosis which is one of the causes of blockage in blood vessels and can lead to injury and amputation. Therefore, improving circulation through specific interventions is needed to prevent these complications. Electrical muscle stimulation has been researched and proven to increase circulation and enhance sensation in people with diabetes. Therefore, this activity is expected to prevent complications in people with diabetes. The objectives of this activity include identifying risk factors for circulation disorders and neuropathy in people with diabetes, increasing public understanding of complications that can occur in people with diabetes, and increasing the community's ability to prevent complications. At the same time, the output that can be generated from this activity is an increase in the knowledge of people with diabetes on preventing wound complications.

Keywords: electrical muscle stimulation; diabetes mellitus complication; neuropathy; peripheral arterial disease

INTRODUCTION

Diabetes mellitus is a health problem that can cause various complications, both microcirculation, and macrocirculation. Disorders or abnormalities in the feet of people with diabetes include diseases of the nerves and blood vessels. The decrease in circulation in people with diabetes is due to abnormalities in the function of the endothelial layer.

In total, it is estimated that there will be an increase in the number of people with diabetes mellitus (DM) in the 2010-2030 range, which is 54%, an annual growth of 2.2%, about twice the annual growth of the total adult population in the world. The prevalence of people with diabetes aged 20-79 in ten countries with the highest increase, including India at 50.8 million, China at 43.2 million, the United States at 26.8 million, Russia at 9.6 million, Brazil at 7.6 million, Germany 7.5 million, Pakistan 7.1 million, Japan 7.1 million, Indonesia 7.0 million and Mexico 6.8 million (Shaw, Sicree, & Zimmet, 2010). Indonesia is predicted to be in sixth place in 2045, with 28.6 million sufferers (IDF, 2021). The prevalence of DM in Indonesia is 2.1% of the total existing chronic diseases, and West Kalimantan is 1%, with the twentieth rank nationally (National Institute for Health Research and Development, 2013).

There are several complications in people with diabetes, which are divided into two, namely microvascular (nephropathy, retinopathy, and neuropathy) and macrovascular (cardiovascular disease, cerebrovascular disease, peripheral arterial disease) (American Diabetes Association, 2011). A quarter of all people with diabetes mellitus will have a risk of developing a diabetic foot ulcer (Mutluoglu, et al. 2012). The average incidence in the UK is 5.1% - 7.4%, in the Netherlands 2.1% - 2.2%, and in the United States 5.8% (Winkley, 2012).

PAD is a circulation problem where the arteries are narrowing, resulting in reduced blood flow to the legs (Suriadi, 2007; Chadwick, Edmonds, McCardle, & Armstrong, 2013). Severe PAD is a significant factor in lower extremity amputation, especially in people with diabetes, then PAD in people with diabetes can be seen with ischemic or gangrenous wounds (Clark, 2003).

People with diabetes have decreased blood circulation, especially in the lower extremities, due to changes in the function of the endothelial layer due to a long hyperglycaemic status. The difference is a decrease in nitric oxide (NO) production. If there is a decrease in circulation, if not treated early, it can result in wounds that take a long time to heal and can lead to amputation.

Preventive action taken from the start is one of the best actions. Preventive measures in people with diabetes who experience circulation disorders can be done in several ways, including using tools and gymnastics. The device used is Veinoplus arterial or electrical muscle stimulation (EMS) then the exercise in question is foot exercise.

The principle of EMS and foot exercises that can increase blood circulation in the lower extremities is by increasing the production of nitric oxide (NO); nitric oxide is an essential component in preventing atherosclerosis which is one of the causes of blockage in blood vessels and can lead to injury and amputation. Therefore, improving circulation through specific interventions is needed to prevent these complications.

Electrical muscle stimulation with leg exercises has been researched and proven to increase circulation in people with diabetes with circulation disorders. Therefore, this activity is expected to prevent complications in people with diabetes. The results of interviews with several people with diabetes who experienced wounds related to DM, foot care, and diet at the Kitamura Clinic. People with diabetes stated they had yet to receive accurate, precise, and adequate information during the pandemic. The patient said he still needed information about DM, how to prevent or treat feet, and the proper diet.

Based on the data obtained, the city of Pontianak has the second rank of DM sufferers in West Kalimantan, with a total of 2.1% (Risk National Institute for Health Research and Development, 2018). This indicates that the number of people with diabetes is quite large. Accordingly, wound complications or risks also increase. Based on the information obtained, there has never been a screening for complications of neuropathy and circulation disorders carried out by the partner health centre, namely the Alianyang Health Centre.

The solution offered in the current situation is to provide education about the risk factors for impaired sensation and circulation and the prevention of wound complications. In addition, at the time of the activity, screening was carried out for people with diabetes, then for those at risk, EMS therapy was carried out to increase circulation in the feet of the people with diabetes.

METHOD

Activities carried out at this stage are to manage permits to carry out activities from the Faculty of Medicine, to identify people with diabetes at the Alianyang Health Centre, Pontianak, to equalize the perception of PKM members to be able to take turns providing education to people with diabetes (there were two educational sessions in one day of activity) and to make an appropriate time contract with the Puskesmas to provide education and screening for complications of neuropathy and circulation disorders.

This evaluation was carried out at the end of the meeting session regarding achieving the objectives of the health education provided. After that, the screening for blood glucose and ankle brachial index as well as the monofilament test were carried out. Based on the ABI test,

people with diabetes were having electrical muscle stimulation therapy. In Figure 1, we can see the steps of the activities.

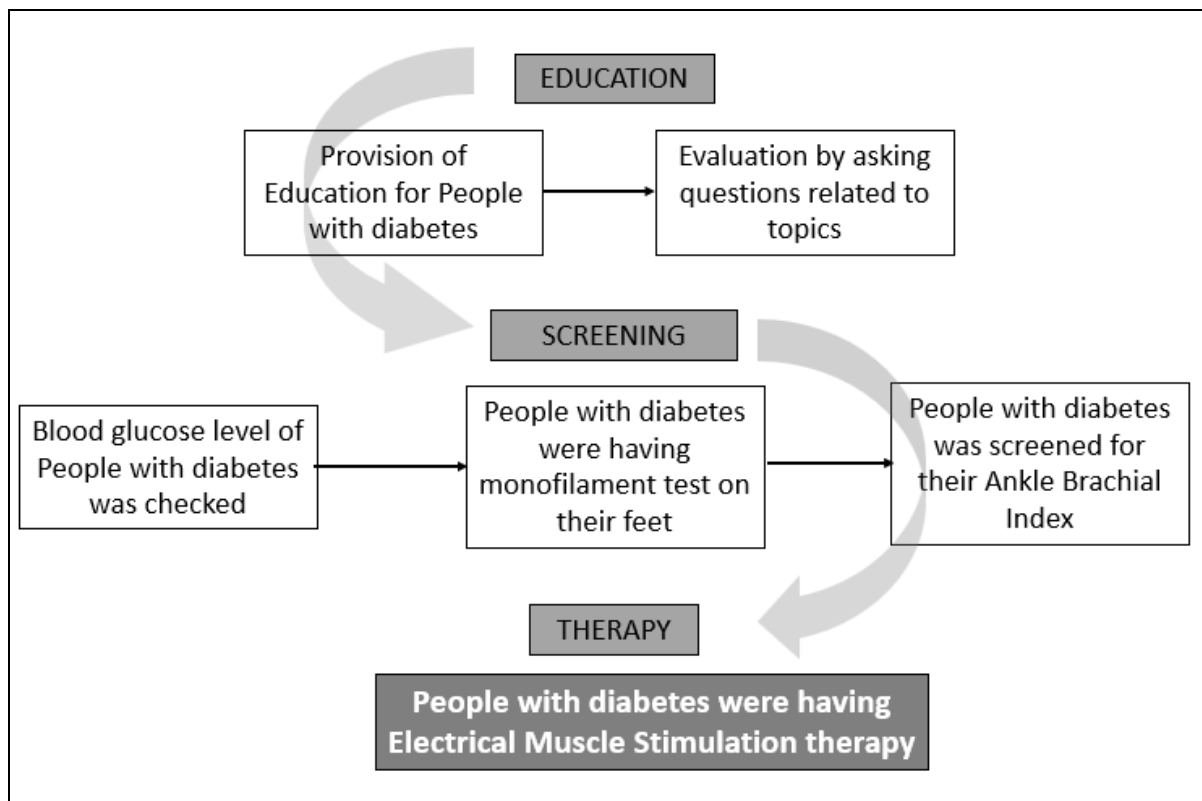


Figure 1. The steps of activities during community services for people with diabetes

RESULTS

A total of 32 participants took blood sugar tests. Among these 32 people, the youngest participant was 46 years old, while 82 were the most senior. The range of blood sugar values based on examination after exercise and diabetes education was between 83 mg/dL and 233 mg/dL. The following is a table of the results of the blood sugar examination (Table 1).

Table 1. Results of blood sugar examination (n=32)

Blood Glucose Level	Frequency (f)	Percentage (%)
< 100 mg/dL	11	34
100-200 mg/dL	19	59
≤ 200 mg/dL	2	6

A total of 28 participants received a monofilament examination, where there were 22 people obtained average values on this examination, and the rest had abnormal results on the monofilament examination (Table 2). Monofilament is an examination to detect abnormalities in the peripheral nerves, especially on the soles of the feet.

Table 2. Monofilament Examination Results (n=28)

Value	Frequency (f)	Percentage (%)
Normal	22	79
Abnormal	6	21

Twenty-eight participants received the ABI examination (Table 3). The lowest ABI value is 0.66, and the highest is 1.40. Of the 28 people, 12 received EMS therapy for 10 minutes each.

The results of the ABI examination after EMS therapy were carried out, where there was an average increase in the ABI value of 0.123.

Table 3. Results of Ankle Brachial Index (ABI) examination before EMS therapy (n=28)

ABI	Frequency (f)	Percentage (%)
1.00 – 1.40	17	61
Less than 1.00	11	39
More than 1.40	0	0

Participants who were given EMS therapy were willing and voluntary and had ABI values below normal. The lowest ABI value is 0.90, and the highest is 1.23, as shown in Table 4.

Table 4. Results of Ankle Brachial Index (ABI) examination before EMS therapy (n=12)

DISCUSSION

ABI	Frequency (f)	Percentage (%)
1.00 – 1.40	88	67
< 1.00	4	21
1.40	0	0

Hyperglycaemia can increase glucose metabolism through the sorbitol pathway. Increased sorbitol accumulation in nerve tissue will cause peripheral neuropathy in people with diabetes. Accumulation of sorbitol will trigger the formation of advanced glycosylation end products (AGEs), which causes a decrease in the ability of blood vessels to contract and relax, so that tissue perfusion in the distal part of the limbs is not good and is an excellent environment for the proliferation of pathogenic bacteria. In hyperglycemia conditions, blood viscosity becomes high, which results in slowed blood flow and reduced oxygen supply (Veranita et al., 2016).

The vascular examination is an essential part of people with diabetes and can be done using palpation, located on the pedal, namely the dorsal pedis and posterior tibia, but can also be examined using tools such as Doppler ultrasound, ankle brachial pressure index (ABPI), and Doppler waveform (Bryant & Nix, 2007).

Ankle Brachial Index (ABI) is a tool that has been widely used to determine vascular status and accurately diagnose lower extremity circulation disorders. Indications for ABI examination include knowing the state of Lower extremity arterial disease (LEAD), especially in wounds, establishing a diagnosis of arterial disease in patients suspected of LEAD, intermittent claudication, age more than 70 years, age over 50 years who have a history of smoking and DM. The ABI measurement method is simple and proven efficient in diagnosing PAD and identifying the presence of heart disease in people with diabetes (Potier et al., 2011). The contraindications for using the ABI examination include severe pain in the lower extremities, deep vein thrombosis, and severe pain associated with wounds (WOCN, 2012).

The examination is carried out by measuring by looking for the systolic value in the brachial section and looking for the systolic value at the ankle, then dividing the systolic ankle value by the systolic brachial value. The results of the ABI examination were divided into several categories, including ABI values >1.0 (average), ABI 0.9 (LEAD), ABI 0.6 - 0.8 (Borderline perfusion), 0.5 (severe ischemia), <0.4 (critical ischemia, limb treated) (WOCN, 2012). Clinical suspicion based on symptoms and clinical findings, the ABI should be used as a first-line non-invasive test, and the ABI has a vital role in the diagnosis of PAD.

Prevention of risk is an action that is very necessary for patients with diabetes because patients with diabetes have a chance for various complications, and injuries are one of the high risks that can occur in diabetic patients. Preventive measures are carried out by detecting risks through ABI and monofilament examinations. The ankle-brachial index is included in one of the strategies to prevent diabetic foot ulcers, thus recommending that all people with diabetes must be examined with ABI (Lim & Thomas, 2017). Patients can experience injuries due to reduced sensation in the feet, then the wounds that occur will quickly become infected. Therefore, such

patients should be given preventive measures by routine assessment for peripheral vascular disease and neuropathy on their feet (Lim & Thomas, 2017).

Electrical Muscle Stimulation or Veinoplus arterial is a device made by Atram in Paris, France, in 2010. It is recommended for use when there is a decrease in blood flow to the lower limbs and is indicated to increase local blood circulation and reduce pain in the lower limbs. Feet, reduce leg swelling (oedema) and improve wound healing in the lower limbs (Veinoplus, 2012).

Veinoplus arterial received ISO 13485 certificate in 2012. In terms of safety, this tool already has safety standards, namely IEC 60601-1 bar for safety requirements on electrical health equipment, IEC 60601-1-2 standard on electromagnetic compatibility, and IEC standard 60601-2-10 for safety for nerve and muscle stimulators. Stimulation from this device carries a major amount of electricity. This number is below international safety standards, including American AAMI/ANSI standards (Veinoplus, 2012). In addition, stimulating muscle contraction is a method to increase leg blood flow and walking capacity in patients with pain due to PAD (Vajanto et al., 2009).

People with diabetes have decreased blood circulation caused by a long hyperglycaemic status. Prolonged hyperglycaemia causes some functions of the blood vessel lining to reduce, especially the endothelial layer. The endothelium is known to have several roles, including controlling arterial properties such as vascular tone, vascular permeability, angiogenesis, and response to inflammatory processes. The endothelium secretes important substances, namely vasoactive substances and growth factors. Substances that are important in regulating vascular vasodilation are nitric oxide. People with diabetes who experience extremity injuries experience a decrease in the amount of nitric oxide, resulting in delayed wound healing. Therefore, it is recommended to have regular screening for people with diabetes who have a low and high risk for peripheral arterial disease. In addition to health education, proper footwear is recommended, along with assessing their foot temperature (Bus et al., 2020).

The prevention of diabetes foot ulcer for people living with diabetes is crucial. People must have a screening for their blood glucose level and risk of diabetes foot ulcer (Suhanda et al., 2022). Besides, people with diabetes need to be educated about diabetes, including diabetes foot exercises (Suhanda et al., 2022). Providing health education about diabetes and its management may also increase the self-efficacy of people with diabetic foot ulcers (Ariani et al., 2022).

CONCLUSIONS AND RECOMMENDATIONS

People with diabetes have a risk for decreased circulation and nerves. Early examination is critical to identify risk factors that can occur. Patients who experience reduced circulation and decreased nerve sensitivity can be treated using EMS. The EMS has been shown to improve circulation in people with diabetes.

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APPENDIX



Figure 2. Provision of Education



Figure 3. Screening for Blood Glucose Level



Figure 4. ABI examination and Monofilament Test



Figure 5. EMS Therapy