Health Gate
Volume 2 Number 3 July 2024 ISSN 2986-1098
Homepage: https://healthgate.ppnikotablitar.com

DOI: http://dx.doi.org/10.70111/hg2301
Submitted : March, 29 2024
Reviewed: April, 15 2024
Accepted : July, 1 2024

Maintaining Stabilization of Blood Sugar Levels in Diabetes Mellitus Patients with Foot Exercises: Case Report

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ABSTRACT

The chronic hyperglycemia of Diabetes is associated with long-term damage, dysfunction, and failure of different organs. Physical activity is one of the factors that affect glycemic management. This case study aims to maintain the stability of blood sugar levels in DM patients by applying leg exercises. The design of this research is a case report with a nursing process approach carried out on Diabetes Mellitus patients with nursing problems of unstable blood sugar levels. Nursing care was carried out for seven days at the Muhammadiyah Ponorogo General Hospital. The intervention implemented is foot exercises. The case study results are presented in the form of nursing documentation. The case study results showed that the patient's blood sugar levels tended to be stable starting on the second day of the intervention.

An increase in whole-body insulin sensitivity mostly explains exercise-induced glycemic control. The long-term advantages of frequent exercise on glycemic control appear to be related to the cumulative effect of transitory gains in insulin sensitivity and glycemic control after each bout of exercise, rather than structural changes in insulin sensitivity.

Keywords: blood sugar level; Diabetes mellitus; foot exercise

Background

A class of metabolic disorders known as Diabetes mellitus (DM) is typified by increased blood glucose levels brought on by either a restriction in insulin secretion or an incapacity to use insulin (1). Maintaining glucose control is essential to patient care and is still the major therapeutic goal in preventing organ damage and other Diabetes-related issues (2). 462 million people were suffering from Diabetes Mellitus in 2017 and this number is predicted to increase to 643 million in 2045 (3). Indonesia is ranked fifth with a prevalence of 8.6% of type 2 Diabetes Mellitus cases from the total population in Indonesia (4). Of this number, East Java Province ranks fifth with the highest prevalence of Diabetes Mellitus compared to other provinces in Indonesia (5). Data from the Ponorogo District Health Service in 2020 recorded 15,397 cases of Diabetes mellitus. Muhammadiyah Ponorogo General Hospital had 95 cases in January-March 2023.

Sedentary lifestyles are a major risk factor for DM and its consequences. Physical activity has been proposed as a significant nonpharmacological treatment strategy for DM. Exercise is crucial for the management of all forms of Diabetes and may help avoid insulin resistance, a health issue associated with the disease. Nowadays, a lot of individuals know that leading a sedentary lifestyle contributes to Diabetes (6). Regular physical activity, such as exercise, is one aspect of well-being that effectively treats and prevents Diabetes mellitus.

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Among the advantages of regular exercise for Diabetes mellitus patients include reduced blood glucose, enhanced insulin sensitivity, and prevention. Changes in lifestyle, such as frequent exercise, are recommended by preventative medicine to lower the risk of getting certain disorders [(7)]. Therefore, enhancing cardio-metabolic risk factors with sustained exercise modalities can lead to better health outcomes. Without causing the fibres to get bigger, exercise can change how each one reacts to insulin. Cardiovascular risk factors and glycemic control are known to be managed by exercise. Additionally, it improves the metabolic profile of DM patients. Exercise raises the levels of GLUT4 in the muscles, hexokinase, glycogen synthase, and skeletal muscle capitalization and blood flow. At least 150 minutes a week of moderate-intensity physical activity or 90 minutes a week of vigorous aerobic exercise divided over at least three days a week and no more than two days without physical activity are recommended by the American Diabetes Association (ADA) [(8)]. Resistance exercise has been demonstrated to promote a muscle fibre type shift and hypertrophy response in working muscles, which increases the body's use of glucose. Resistance training lowers the risk of cardiovascular disease, increases flexibility and body composition, and strengthens and sustains muscles. Increased total muscle mass, an increase in the number of insulin receptors in muscle cells, and an increase in the number of glucose transporter (GLUT) proteins are some potential underlying mechanisms for the beneficial effects of resistance strength training [(9)]. Foot exercises are one of the simple exercises that can be done by DM patients who are being treated. In healthy populations, these advantages include better blood lipid profiles, bone mineral density, and glucose control.

Methods

The research design is a case report with a nursing process approach which includes assessment, formulating nursing problems, developing interventions, carrying out implementation, and conducting evaluations. The patient who will be treated is a patient diagnosed with Diabetes Mellitus with the nursing problem of unstable blood sugar levels. The basis for patient selection uses major and minor data in the Indonesian Nursing Diagnosis Standards. The location where the case was taken was the Muhammadiyah Ponorogo Regional Hospital. Nursing care was carried out for seven days. All data is documented in the form of nursing documentation.

Results

A 41-year-old female patient was treated in the Ahmad Dahlan ward of the Muhammadiyah Ponorogo Hospital with complaints of weakness due to Diabetes Mellitus. When he came to the hospital, the patient experienced weakness, dizziness, blurred vision, slightly slurred speech, frequent urination, frequent thirst, drowsiness easily, and tingling in the legs. BP: 259/135 mmHg, N: 95x/minute, RR: 22x/minute, GDA: 645.4 mg/dl. The patient admitted that he had a history of hypertension 10 years ago and had experienced symptoms of a mild stroke but did not have regular health checks and only discovered he had Diabetes mellitus when he was hospitalized. The patient received pharmacological therapy in the form of 3 x 8IU insulin injections. Diagnostic examination revealed that the patient was suffering from hyponatremia and hyperglycemia. In carrying out nursing care, patients are given informed consent. The main nursing problem determined was the instability of blood sugar levels according to the Indonesian Nursing Diagnosis Standards (D.0027). Nursing interventions are prepared based on the Indonesian Nursing Intervention Standards with outcome criteria in the form of drowsiness, dizziness, fatigue/lethargy, dry mouth, and reduced thirst, improved blood glucose levels. Application of foot exercises is carried out after the assessment. These leg exercises are carried out using the standards of the Ministry of Health of the Republic of Indonesia.

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This application is an integrated nursing intervention that facilitates independent monitoring of blood sugar levels. The procedure includes; 1) Position the patient either standing, lying or sitting. Movements can include bending, twisting in and out, and lifting (Figure 1). 2) Put your heels on the floor, stretch the tips of the toes of both feet up then bend them back down like claws, do this 10 times (Figure 2). 3) Put your heels on the floor, then lift the soles of your feet. Then, the toes are placed on the floor with the heels of the feet lifted upwards. Repeat this method 10 times (Figure 3). 4) The heels of the feet are placed on the floor. The leg is lifted and a 360º rotation is made by moving the ankle 10 times (Figure 4). 5) Straighten your knees then bend them back down 10 times. Repeat this step for the other leg as in the previous exercise, but this time with both legs together (Figure 5). 6) If done in a lying position, lift both legs straight and maintain that position, then move the feet at the ankles, forward and backwards (figure 6). 7) Straighten one leg and lift it. Rotate the feet at the ankles, forward and backward. 8) Place a sheet of newspaper on the floor. Tear the paper into two parts. Shape the paper into a ball with two legs. Then, open the ball into a sheet as before using both feet (Figure 7).

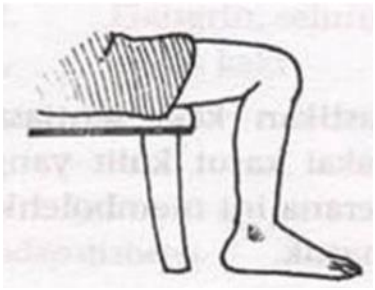

Figure 1. Foot position

Figure 2. Stretch the tips of the toes of both feet up then bend them back down like claws

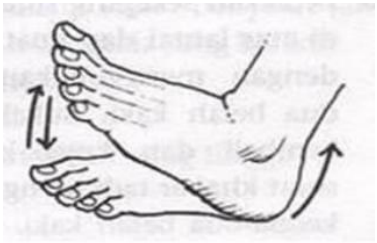

Figure 3. Toes are placed on the floor with the heels of the feet lifted upwards

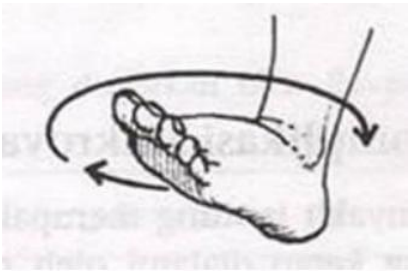

Figure 4. The leg is lifted and a 360º rotation

Figure 5. Straighten the knees then bend them back down

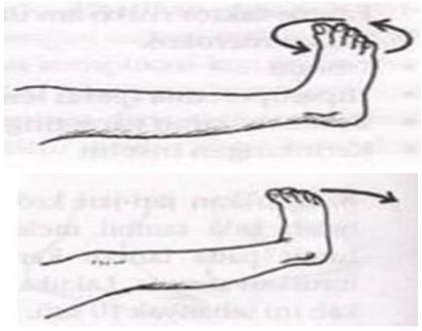

Figure 6. Move the feet at the ankles, forward and backwards

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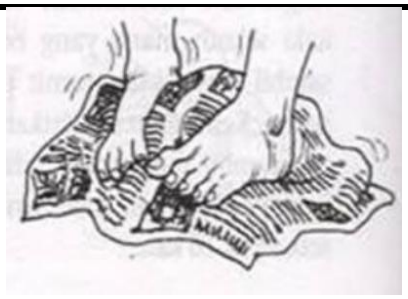

Figure 7. Shape the paper into a ball with two legs

During the implementation of the intervention, blood sugar levels were monitored before and after foot exercises for 6 days. Measurements were taken one hour after the intervention was carried out. The intervention is carried out once a day. The results of monitoring blood sugar levels can be seen in Table 1 below:

Table 1. Monitoring blood sugar levels

Day	Blood sugar levels (gr/dl)		Number of changes (gr/dl)	Average (gr/dl)
	Before	After		
1	411	412	increase 1	18
2	315	312	decrease 3	
3	268	276	increase 8	
4	277	245	decrease 32	
5	256	223	decrease 44	
6	241	221	decrease 20	

The results in the table show that blood sugar levels began to decline on the second day. After that, it tends to be stable until the sixth day. The average change in patient blood sugar levels was 18 gr/dl.

Discussion

Diabetes mellitus patients run the risk of serious consequences. Foot ulcers are one such issue that has been linked to higher rates of morbidity, death, and medical expenses [(10)]. Patients with Diabetes mellitus are at a significant risk for both decreased physical mobility and amputation. There isn't much data available right now about the recommended physical activity regimens for these individuals, who run the risk of developing foot ulcers. This patient received nursing care for seven days, with six days of foot exercises. The patient's blood pressure tends to be elevated from the beginning of the examination; hence this exercise is done once a day. During the evaluation, there were also extremely high blood sugar levels.

Preventing complications and giving diabetic patients a high quality of life are the main objectives of Diabetes care. An increasing body of research has demonstrated the therapeutic benefits of physical activity [(7)]. Exercise, in particular, has been shown to have a beneficial effect on diabetics over time, acting as a protective factor by favourably modifying body composition and glycaemic management [(2)]. Cells utilize glucose both aerobically and anaerobically to produce energy. Transmembrane proteins called glucose transporters, or GLUTs, are responsible for moving glucose across cell membranes. Insulin facilitates glucose entrance into the skeletal and adipose tissues, which in turn enhances glucose consumption.
This has been proposed to be accomplished by increasing the total rate of glucose flux into a

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cell via insulin-induced GLUT4 translocation from intracellular compartments to the cell membrane [(9)]. Through glucose absorption into peripheral tissue, postprandial high blood glucose levels are swiftly reduced to prevent hyperglycemia and associated pathophysiological implications. Insulin-dependent glucose transporter type 4 (GLUT4), a member of the GLUT family that is mainly expressed in adipocytes and muscle cells, is the main mediator of this process. Basic structural elements, such as 12 transmembrane segments, ATP and glucose binding sites, and N and C termini found in the cell's cytoplasm, are shared by all 14 transmembrane GLUT proteins [(2)].

The process of cellular absorption of glucose in muscle and fat cells, which lowers blood glucose levels, depends on insulin-induced GLUT4 translocation [(11)]. All age groups, including those classified as asymptomatic/healthy, prediabetic/MetS, and those with DM, clearly benefit from PA and exercise. However the results are not clear-cut, and even within trials, not all markers of glycaemic control and insulin sensitivity show benefits [(6)]. These changes also affect body composition because they arise from the cellular remodelling of skeletal muscle, which raises basal metabolism and oxidative capacity [(12)].The foot exercise improves persons with Diabetes mellitus's body composition and glycemic management. According to previous theories, foot exercise results in physiological changes that enhance the stabilization of plasma glucose and support the management of chronic hyperglycemia.

Conclusions and Recommendations

Diabetes patients can better control their blood glucose levels by exercising. Healthcare professionals and their patients should be made aware of the importance of physical activity in blood glucose control. Numerous writers assert that blood glucose monitoring plays a critical role in glycemic control for individuals with long-term conditions.

Acknowledgement

The author would like to thank the patients, families and all multidisciplinary staff at Muhammadiyah Ponorogo General Hospital who participated in the case study which consisted of nurses, doctors, physiotherapists and clinical nutritionists.

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