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NEUROVASCULAR TREATMENT IN IMPROVING PERIPHERAL PERFUSION IN DIABETES MELLITUS PATIENTS

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ABSTRACT
Diabetes Mellitus (DM) is a long-term metabolic disorder caused by insulin function insufficiency, with many etiologies characterized by hyperglycemia accompanied by problems with carbohydrate, lipid, and protein metabolism. More than 90% of DM patients experience neuropathy complications and 50% experience peripheral neuropathy. DM patients with peripheral neuropathy experience decreased peripheral nerve perfusion so that neurovascular care is needed. Objective: This study was conducted to provide an overview of neurovascular care in improving peripheral perfusion in DM patients. Method: This study used a descriptive case study design using the nursing process. This study focuses on improving peripheral perfusion in DM patients with Neurovascular Care interventions to 2 respondens. The intervention carried out on two respondents according to the evidence base was foot exercises with diaball, foot spa, and ROM for 3 x 8 hours. The research instrument used is The Michigan Neuropathy Screening Instrument (MNSI) in assessing the complications of peripheral neuropathy which focuses on data on decreased peripheral perfusion and monofilaments to measure foot sensitivity. Results: Nursing activities start from assessing the patient's circulation needs and continue to data analysis. The data analyzed showed that >80% of the major and minor data listed in the guidelines for raising nursing diagnoses, namely the Indonesia Nursing Diagnose Standards (SDKI). From the data obtained, the diagnosis that can be raised is that peripheral perfusion nursing is ineffective with peripheral perfusion nursing outcomes with increased expectations. On the last day of the nursing evaluation, there was an increase in peripheral perfusion from a decreasing level to a moderate level in the respondents. Conclusions: Neurovascular Treatment can be applied to improve peripheral perfusion in DM patients.

Keywords: diabetes mellitus; ineffective peripheral perfusion; neurovascular treatment

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INTRODUCTION

Diabetes Mellitus (DM) is a long-term metabolic disorder caused by insulin function insufficiency, with many etiologies characterized by high blood sugar levels accompanied by problems with carbohydrate, lipid and protein metabolism (WHO, 2022). DM is an endemic disease in Asia, even in Indonesia. Currently, DM does not only occur among the elderly but also occurs in young people. DM is considered the beginning of other diseases because it causes hypertension, heart disease, stroke, kidney failure, and blindness (Rahman et al,. 2021). The most common complication in DM patients and can be life-threatening is peripheral vascular disease of the lower extremities, namely changes in the peripheral nervous system or peripheral neuropathy (somatic neuropathy) (IDF, 2021). More than 90% of DM patients experience neuropathy complications. (Rahman et al, 2021). Neuropathy that often occurs in DM patients is a triad of neuropathy, namely peripheral/sensory neuropathy, motor neuropathy and autonomic neuropathy (ADA, 2022). Peripheral neuropathy is the most common complication with an incidence of 50% of global neuropathy cases (Lehmann et al., 2020). Peripheral neuropathy is a condition due to damage to the peripheral nerves or

peripheral nerves. Symptoms that arise from complications of peripheral neuropathy are such as weakness, numbness in the feet and hands, pain in the feet and decreased sensitivity of the feet which causes the risk of diabetic foot problems which are characterized by decreased sensitivity of the feet (Rahman et al., 2021).

When oxidative stress increases, peripheral perfusion becomes ineffective. This leads to increased advanced glycosylated end products (AGEs), polyol accumulation, decreased nitric oxide (NO), impaired endothelial function, impaired Na/K ATP ace activity, and homocysteinemia (Scioli et al., 2020). As a result, peripheral neuropathy occurs. In hyperglycemia, glucose and proteins produce glycosylated proteins, which can be damaged by free radicals and fats. As a result, AGEs appear, which cause problems in the nervous system. In addition, decreased NO activity leads to decreased blood flow to peripheral nerves (Meiti, 2020). DM patients with peripheral neuropathy are often diagnosed with ineffective peripheral perfusion nursing.According to PPNI, (2018) one of the nursing interventions that can be given to improve peripheral perfusion is neurovascular care. Neurovascular care is identifying and treating patients who experience impaired sensation and circulation in the extremities. Interventions that can be done are monitoring peripheral circulation, elevation of the extremities, moving the extremities regularly, and passive/active range of motion exercises. Based on research conducted by Rother et al., (2020) in 94 clients who were given a 65 cm leg elevation intervention, swelling was slowly reduced and blood flow to the arteries was increased.

In addition to leg elevation, moving the extremities can increase peripheral perfusion. When the legs move, the endothelium of the blood vessels is activated to secrete or release nitric oxide. NO will cause soluble guanylate cylase (SGC), which produces more cyclic GMP synthesis than guanosine triphosphate (GTP). As a result, the blood vessels will relax. When smooth muscle cells relax, blood flow to the periphery of the legs becomes more efficient (Laurindo et al., 2018). Leg exercises, Buerger-Allen exercises (BAE), range of motion exercises on the lower extremities, and foot spas are exercises to move the extremities that can be done by DM sufferers. Based on the above phenomenon, increased peripheral perfusion in DM patients is essential to prevent complications and weakness of their lower extremity muscles. Therefore, the researchers conducted a case study on DM patients with ineffective peripheral perfusion problems that aimed to describe nursing care with neurovascular care interventions in patients with diabetes mellitus.

METHOD

This case study uses a type of qualitative research with a descriptive case study that uses a nursing care process approach, namely review, enforcing nursing diagnoses, preparing nursing plans, implementation, and evaluation of nursing. The respondents in this case study were 2 respondents who met the inclusion criteria of the study, namely patients who were medically diagnosed with DM by the doctor in charge of the patient, had a history of DM, were in the age range of 45-75 years, were willing to be respondents, and had complaints of cramps, tingling, numbness, and pain in the lower extremities. In the application of nursing care, an assessment was carried out on the respondents, starting from demographics, current and past health history, as well as a physical assessment that focused on the circulatory system. The instrument used was the Michigan Neuropathy Screening Instrument (MNSI) by Carmichael et al., (2021), and in assessing the sensitivity of the foot using a monofilament tool. After the data is collected, it is analyzed into major data and minor data, which later, if sufficient >80%, can be established in accordance with the Indonesia Nursing Diagnostic Standards (SDKI) by PPNI, (2018) If the diagnosis has been established, the expected

outcomes can be determined in accordance with the Indonesia Nursing Outcomes Standards (SLKI) and nursing interventions can be determined in accordance with the Indonesia Nursing Intervention Standards (SIKI). The implementation of nursing is carried out for 3 x 8 hours. Nursing evaluation is raised based on expectations from planned nursing outcomes.

RESULTS

Assessment

Based on the results of the assessment conducted by researchers on January 22, 2024, it was found that Mrs. Z, aged 64 years, complained of pain in both lower extremities, numbness, cramps, tingling, and heat in the soles of her feet. Mrs. Z has been suffering from DM for the past 5 years. When the circulation needs assessment was carried out, Mrs. Z's leg sensation decreased with the sensitivity of the right leg 8/10 and the left leg 8/10, capillary refill time (CRT) >3 seconds, pale skin, and cold extremities. When a diagnostic examination was carried out, the GDS examination results were high with a value of 312 mg/dl. The results of the assessment of Mrs. T, aged 57 years, showed that Mrs. T complained of pain in both lower extremities, numbness, cramps, tingling, and heat in the soles of her feet. Mrs. T said that she had been suffering from DM for the past 6 years and had been hospitalized for DM. When the circulation needs examination was carried out, Mrs. Z's leg sensation was T decreased with right leg sensitivity 6/10, left leg sensitivity 8/10, CRT >3 seconds, pale skin, and cold extremities. GDS examination results 220 mg/dl.

Nursing Diagnose

Based on the results of the assessment and continued data analysis, the nursing diagnosis that was established was ineffective peripheral perfusion related to hyperglycemia.

Nursing Planning

The preparation of nursing care planning refers to two important standards in nursing practice in Indonesia: Indonesian Nursing Intervention Standards (SIKI) and Indonesian Nursing Outcome Standards (SLKI). The nursing action plan is carried out for 3 x 8 hours. The SIKI used is Neurovascular Care with nursing activities carried out are identifying signs of neurovascular disorders such as measuring extremity temperature, checking foot sensation, checking foot sensitivity, and signs of decreased peripheral perfusion. Then non-pharmacological actions are carried out according to evidence based, namely leg elevation, moving the feet routinely with foot exercises, BAE, foot spa, and doing ROM either actively or passively.The SLKI used is peripheral perfusion. The expected outcome is an increase in peripheral perfusion according to the following criteria: higher peripheral pulse rate, better wound healing, better sensation, paler skin color, peripheral edema, extremity pain, paresthesia, muscle weakness, muscle cramps, lower necrosis, better capillary refill, acral, better skin turgor, and better ankle brachial index.

Nursing Implementation

The implementation was carried out for 3 days, from January 22, 2024 to January 24, 2024. In the nursing diagnosis of ineffective peripheral perfusion related to hyperglycemia, the planned interventions were not all carried out on both patients because of considering the condition and state of the patient in the inpatient room who was still in the recovery period, also because actions such as checking for signs of compartment syndrome were not carried out because the patient clearly did not have compartment syndrome. The author only carried out several interventions, namely identifying signs of neurovascular disorders such as measuring extremity temperature, checking foot sensation, checking foot sensitivity, and signs of decreased peripheral perfusion, and in accordance with the development of evidence-based,

namely elevating the feet as high as 65°, leg exercises with diaballs, foot spa, and ROM. At the time of implementation, the patient and family were able to follow the actions well for 3 x 8 hours, and the patient and family felt enthusiastic about learning.

Nursing Evaluation

After the implementation on the first day, the results were obtained; Mrs. Z said that the tingling and numbness in both soles of the feet had not decreased, Mrs. Z said that the pain in both feet had not decreased, capillary refill had not improved, CRT > 3 seconds, cold acrals had not improved, pale skin had not decreased, ABI <0.90, had not improved, and foot sensation had not increased. So from the findings it was concluded that peripheral perfusion had not increased and the intervention was continued the next day. On the third day of implementation, the results found were Mrs. Z said that the tingling and numbness in both soles of the feet had slightly decreased from yesterday, Mrs. Z said that the pain in both feet had decreased quite a bit, capillary refill was moderate, CRT = 3 seconds, acrals felt cold moderately, pale skin color had decreased quite a bit, ABI <0.90, had not improved, and foot sensation had not increased still at the same foot sensitivity, so the conclusion on the third day was that peripheral perfusion was at a moderate level. The intervention on Mrs. Z was stopped because Mrs. Z was planned to be allowed to go home.

The results of the implementation on Mrs. T were Mrs. T said that the tingling and numbness in both soles of the feet had not decreased, Mrs. T said that the pain in both feet had not decreased, capillary refill had not improved, CRT > 3 seconds, acral felt cold, had not improved, pale skin color, had not decreased, ABI <0.90, had not improved, and sensation had not increased, so it can be concluded that peripheral perfusion had not increased and neurovascular care intervention was continued. On the third day, the results were obtained Mrs. T said that the tingling and numbness in both soles of the feet had slightly decreased from yesterday, Mrs. T said that the pain in both feet had decreased sufficiently, capillary refill was moderate, CRT = 3 seconds, acral felt cold moderately, pale skin color had decreased sufficiently, ABI <0.90, had not improved, Sensation was moderate with right foot sensitivity of 7/10 and left foot sensitivity of 8/10. So it can be concluded that peripheral perfusion is at a moderate level. The things that made it less than optimal were the same as what happened to Mrs. Z. The intervention on Mrs. T was stopped because Mrs. T was planned to go home.

DISCUSSION

Nursing evaluation of patients with ineffective peripheral perfusion related to hyperglycemia conducted on Mrs. Z and Mrs. T showed an increase in peripheral perfusion. During the implementation for 3 days in 1 work shift, initially peripheral perfusion was on a decreasing scale (1) increasing to a moderate scale (3). The less than optimal increase in peripheral perfusion could be due to many factors, in this study meetings with both clients were only conducted for 3 days in 1 work shift (8 hours) so that the implementation carried out was not optimal, because according to Dinata et al., (2022) interventions should be done 3 times a week for one month, done for 30-40 minutes. Based on the implementation, there are four actions according to evidence based that are carried out, namely 65 cm leg elevation, leg exercise with diaball, foot spa, and ROM. DM patients with ineffective peripheral perfusion often develop edema in the lower extremities. As many as 38% of 314 patients with diabetic foot wounds experienced edema (Wu, 2018). Edema occurs due to damage to the capillary blood vessels which causes fluid in the capillaries to leak into the surrounding tissues, making the legs swollen. In DM patients, circulation problems occur so that the wound is difficult or does not heal (Ielapi et al., 2022). This condition makes fluid can easily settle in the legs. To

reduce the degree of edema, elevation of the lower extremities can be performed. According to a study conducted by (Rother et al., 2020) on 94 patients who underwent a 65 cm high leg elevation intervention slowly decreased swelling and increased blood flow in the arteries.

To improve blood circulation in the legs, DM patients can do leg exercises (ICMR, 2018). Leg exercises can improve blood circulation, strengthen small leg muscles, and prevent foot deformities (Holmes & Hastings, 2021). Leg exercises can also increase leg muscle strength and help overcome limited joint movement (Verissimo et al., 2021). When doing leg exercises, glycogen can quickly be used as energy in the muscles and liver, especially at the beginning of diabetic leg exercise training (Ruben et al., 2018). Research conducted by Oktorina et al., (2022) with 20 people surveyed, foot sensitivity increased both before and after foot exercises, with a mean difference of 2.85. The results of additional analysis showed a p value of 0.002, indicating that there was a relationship between foot sensitivity before and after foot exercises using newspapers. The study conducted by Shazhabilla, (2023) foot exercise with diaball with 38 respondents, there was a significant increase in foot sensitivity after treatment with a p value of 0.0025 so it can be concluded that foot exercise with diaball has an effect on increasing foot sensitivity in DM patients..

Joint range of motion/ROM exercises, which are part of physical exercises performed by people with diabetes mellitus, help smooth blood circulation, allowing nutrients to enter cells, reducing cell damage, and improving vascular endothelial function, which helps prevent diabetic foot ulcers (Purnamawati et al., 2022). According to research conducted by Surianti et al., (2020) there is a significant difference in sensation values so that active ROM can be used as an exercise to increase peripheral perfusion in DM patients. In addition, ROM can increase muscle strength and tendon reflexes as well as ABI values and protective sensations (Yuliantini et al., 2023). Based on research conducted by du Plessis et al., (2023) it was found that the difference in the dependent variables during pre and post treatment was $p<0.05$ which means that the range of motion can increase the strength of the lower extremity muscles, increase the range of motion, and balance in patients with peripheral neuropathy. Foot spa can increase peripheral tissue perfusion, oxygen transport, and nutrients to the peripheral area in patients with peripheral neuropathy (Inda Mujisari et al., 2020). Spa can affect blood vessels to dilate and increase blood flow. When foot spa is done, blood flow will increase to other organs of the body (Sunarmi et al., 2022). Research by Wardani et al., (2019) Foot spa can reduce the rate of complications in DM, in line with research by Noor, (2021) Foot spa can improve blood circulation in DM patients.

CONCLUSION

Neurovascular care in patients can increase ineffective peripheral perfusion. The results of this study are expected to be used as a practical guide to carry out nursing actions based on evidence based on DM patients with decreased peripheral perfusion and can help provide comprehensive nursing care in accordance with the nursing code of ethics, especially for DM patients

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