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The Effect of Buerger Allen Exercise Towards Physical Health Performance of Peripheral Neuropathy Patients

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ABSTRACT

Introduction: Peripheral neuropathy is a common microvascular complication in Diabetes Mellitus patients, with symptoms of tingling, numbness, pain in the feet, and disabilities in daily activities. Buerger Allen Exercise to stimulate the development of collateral circulation in the feet. The purpose of the study was to explain the effect of Buerger Allen's Exercise on the physical health performance of diabetic neuropathy patients.

Methods: The research design used an experimental one-group pre-test post-test design. Purposive sampling technique with inclusion criteria: male and female DM patients, with a long history of diabetes> 5 years, undergoing treatment at the health center / other health services. Samples were taken in Krembangan Surabaya City with as many as 24 respondents. The independent variable was the Buerger Allen Exercise. The dependent variables were the physical health performance of diabetic neuropathy patients (peripheral oxygen saturation (StO2), Ankle-Brachial Index (ABI on the foot), and physical activity ability). The instruments used were an observation sheet for measurements of StO2, ABI, and physical ability. The research data were analyzed using the Paired t-test statistical test with a significance level of $p < 0.05$.

Results: There are significant results Buerger Allen Exercise of Ankle-Brachial Index ($p=0.0085$) and physical activity ability ($p=0.031$), and no significant result of peripheral oxygen saturation ($p=0.075$).

Conclusion: There is an effect of the Buerger Allen Exercise on the Ankle-Brachial Index and physical activity ability of diabetic neuropathy patients. Further research needs to examine Buerger's exercise toward blood glucose levels and control factors that are related.

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1. INTRODUCTION

Diabetes mellitus (DM) patients often experience acute and chronic complications due to uncontrolled blood glucose levels. Chronic complications in DM patients can occur over a long period of time, after an average length of DM illness of >5 years (Qomariah et al., 2019). Based on the PERKENI consensus, chronic complications in DM patients are divided into two, namely microvascular and macrovascular. Macrovascular complications are DM complications that occur in large vascular organs such as: heart, lungs, kidneys and others. Microvascular complications of DM patients that are often experienced are neuropathy. Signs and symptoms of neuropathy include: tingling, numbness in the skin, hot or prickly skin, cramps, easy fatigue (Alpert, 2019). Neuropathy occurs in the lower extremities on one leg or both, so that patients experience disability and physical limitations in daily activities. Therefore, physical exercise is needed that can improve the physical performance of DM neuropathy patients.

Buerger Allen Exercise (BAE) was first recognized by Black & Matassarin-Jacobs in 1997. BAE is done to improve circulation in the feet and soles of the feet (Ababneh et al., 2020; Saputra et al., 2020). Buerger Allen Exercise was a combination of changes in body position/ posture including: foot elevation 450-900 , low positioned feet, and supine sleep and increased blood flow in the ankle muscles, namely dorsiflexion and plantarflexion (Chen, M., Lin, B., Su, C., Lin, Y., Chen, M., Shen, J., & Chang, 2017).

The increase in the number of Diabetes Mellitus patients is increasing from year to year, which has an impact on increasing the prevalence of long-term complications of DM patients. Based on data from The Foundation for Peripheral Neuropathy, it is estimated that currently 60-70% of diabetes mellitus patients worldwide experience diabetic neuropathy (Weiswasser et al., 2003). RISKESDAS data in 2018 showed that the prevalence of Diabetes Mellitus based on doctor's diagnosis in the age group ≥15 years was 2%, with the 55-64 age group being the highest age group reaching 6.3%. A descriptive study on patients with type 2 diabetes mellitus in Indonesia on 1785 respondents found the prevalence of diabetic neuropathy was 63.5%. A study in Surabaya assessed the medical records of 302 patients with type 2 diabetes mellitus and found the prevalence of diabetic neuropathy to be 58.6% (Badan Litbangkes, 2018).

The most important pathogenic factor in the occurrence of peripheral neuropathy, especially in the feet and soles of the feet in DM patients is because the peripheral blood vessels are damaged due to hypoxia due to thickening of the capillary basement membrane which results in decreased Nitric Oxide (NO) synthesis. In addition, insulin deficiency causes a decrease in glucose uptake into intra-cells so that to fulfill intra-cell glucose there is an increase in protein catabolism and lipolysis. Glycosylation of nerve cell proteins causes demyelination of nerve cells (Fikri, Muhammad. Nurdian, 2019). Metabolic disorders of lipid complexes which are components of peripheral nerves cause disturbances in the structure and function of nerve cell myelin in conducting impulses. These metabolic and vascular abnormalities result in impaired nerve impulse transmission in the lower extremities, namely the feet and soles of the feet, which is often referred to as peripheral neuropathy in DM patients. Management of diabetic neuropathy patients with pharmacological therapy has not provided optimal results. Proper management pain in diabetic neuropathy patients with the aim of preventing further complications such as: foot ulcers and even necrosis / tissue death in the foot. Pain due to neuropathy can hinder physical activity, quality of life, and work productivity (Herman et al., 2017).

There have been many studies on BAE in DM neuropathy patients with results showing that BAE can improve ankle-brachial index (ABI) and other measurements such as peripheral oxygen saturation (Lin et al., 2020). However, there is not much literature that discusses the effectiveness of BAE on the physical performance of diabetic neuropathy patients. Patients' physical performance is measured using the ankle-brachial index, peripheral oxygen saturation and physical activity ability. The purpose of this study was to explain the effect of Buerger Allen's Exercise on the physical health performance (ankle-brachial index, peripheral oxygen saturation, and physical activity ability) of peripheral neuropathy diabetic patients.

2. METHODS

Study Design

This research is a type of experimental research. There is an intervention or treatment on the research subject, using a one group pre-test and post-test design approach.

Population, Samples, and Sampling

The target population in this study were diabetic neuropathy patients who had undergone a previous examination at a puskesmas/hospital in the Krembangan area of Surabaya City. The research sample was obtained as many as 24 people using purposive sampling technique. The inclusion criteria of this study were 1) male and female DM patients aged >40 years, 2) a long history of DM >5 years, 3) undergoing routine treatment at the puskesmas/other health services. The exclusion criteria for this study were DM patients with comorbid diseases other than neuropathy and DM patients with emergency conditions. The independent variable is the Buerger Allen Exercise intervention. The dependent variable is the physical health performance of diabetic neuropathy patients measured by peripheral oxygen saturation (StO2), Ankle-Brachial Index (ABI in the foot), physical activity ability.

Instruments

This research instrument uses booklets and observation sheets measuring peripheral oxygen saturation, Ancle Brachial Index, and physical activity ability. Booklet Buerger Allen Exercise Improves Physical Health Performance modified from Mellisha (2016) which contains a check list of exercise implementation by patients according to the research target (Mellisha, M. S. E. S., & Sc, 2016). Measurement of peripheral oxygen saturation (StO2) with a calibrated oximeter on the patient's toes (Tri Indriawati, 2020). Measurement of Ancle- Brachial Index (ABI) with a calibrated sphygmomanometer and stethoscope. ABI is the ratio of the highest systolic (right foot or left foot) on the dorsalis pedis artery to the highest systolic (right hand or left hand) on the brachial artery. Physical activity ability is based on the time it takes respondents to complete the physical ability test activity, namely the patient sits in a chair, then stands up and walks 6 meters and returns to the starting point.

Procedure

The research has obtained permission and research recommendations by the Surabaya city government in accordance with letter number 070/3334/S/RPM/436.7.15/2022 The first stage was pre-test measurement of StO2, ABI, and physical activity ability of diabetic neuropathy patients. Then the researcher gave an explanation to the patient and family about Buerger Allen Exercise which included the purpose, how to implement and provide a booklet and checklist that must be filled in after doing the exercise according to instructions for 4 weeks. The substance of Buerger Allen Exercise was: 1) Patient supination position then raise the lower extremity to 450-900 and maintain this position for 3 minutes until the skin turns pale (the skin on the legs is slightly pale white), 2) Patient sit with legs and soles hang on the side of the bed for a while until the lower extremities are reddish (make sure and take care that there is no pressure on the back of the knee). Maintain this position for 10 minutes. While in this position, move your feet to the right, left, up and down; 3) The final position is supination and place your feet on a flat for 10 minutes. Buerger Allen Exercise can be done with a frequency of 3 times (at 8 am, 12 noon and 4 pm) and 3 times every week. Duration of Buerger Allen Exercise was 23 minutes each session. Total frequency of Buerger Allen Exercise was 36 times exercise. After 1 week of the intervention, post-test observations of StO2, ABI, and physical activity ability of peripheral neuropathy patients were conducted.

Data Analysis

The results of the study are presented in the form of frequency tables according to the classification of peripheral oxygen saturation data, ABI, and physical activity ability. Normal peripheral oxygen saturation value ≥95%. ABI results >1.4 indicate no blockage of blood vessels, ABI >1.0 indicates normal values, ABI <0.9 indicates lower extremity arterial disease, ABI <0.5 indicates severe ischemia (Vowden & Vowden, 2018). The results of physical activity ability if the time required is 20 seconds or less indicates total independence, if the time is 21- 40 seconds indicates independent, if the time is 41 seconds or more indicates dependent (Rahmawati & Qomariyah, 2019). The analysis of the study used SPSS software with the statistical test of Paired t-test to compare pre-test data with post-test peripheral oxygen saturation, ABI, and physical activity ability.

Ethical Clearance

This research has passed ethical consideration from the Research Department of STIKES Adi Husada with ethical number of 761/PPM/Etik/STIKES-AH/XII/2022. Researchers made an agreement contract with respondents and filled out informed consent according to the research ethics of anonymity, confidentiality, and beneficience.

3. RESULTS

Table 1. Demographic Data Characteristics of Patients with Peripheral Neuropathy Patients at Krembangan, Surabaya from December 2022 to January 2023

Characteristics of Respindents	f	%
Age		
40-49 Years	3	12.5
50-59 Years	5	20.8
60-69 Years	14	58.4
>70 Years	2	8.3
Gender	**n**	**%**
Man	2	8.3
Woman	22	91.7
Education	**n**	**%**
Elementary school	1	4.2
Junior High School	8	33.3
Senior High School	15	62.5
Occupataion	**n**	**%**
Private employees	6	25
Housewife	18	75
History of Diabetes Mellitus	**n**	**%**
6 Years	9	37.5
7 Years	10	41.7
8 Years	2	8.3
9 Years	2	8.3
>10 Years	1	4.2

Table 2. Results of Ancle-Brachial Index

Ancle-Brachial Index	Before		After	
	f	%	f	%
Normal	16	66.7	22	91.7
Arterial disease lower extremity	8	33.3	2	8.3
Total	24	100	24	100
Paired t-test p= 0.0085				

Table 3. Results of Peripheral Oxygen Saturation

StO2	Before		After	
	f	%	f	%
Normal	24	100	24	100
Total	24	100	24	100
Paired t-test p= 0.075				

Table 4. Results of Physical Activity Ability

Physical Activity Ability	Before		After	
	f	%	f	%
Totally Independent	22	91.7	24	100
Independen	2	8.3	0	0
Total	24	100	24	100
Paired t-test p= 0.031				

The results of research conducted for 2 months in December 2022 to January 2023 obtained demographic data can be seen in table 1 shows that almost all peripheral neuropathy patients are female (91.7%), with ages mostly in 60-69 years (58.4%), with education mostly senior high school (62.5%),

most patients were housewife (75%), and history of diabetes mellitus was mostly for 7 years (41.7%).

Table 2 shows that before Buerger Allen Exercise there were 8 patients who had arterial-disease lower extremity (33.3%) and 16 patients with normal Ancle- Brachial Index (66.7%). After doing Buerger Allen Exercise there are still 2 patients who experienced lower extremity arterial disease (8.3%) and almost all patients with normal ABI results (91.7%). The statistical test results show that there is an effect of Buerger Allen Exercise on the Ancle-Brachial Index of peripheral neuropathy patients ($p=0.0085 \leq 0.05$).

Table 3 shows the statistical test results that there is no effect of Buerger Allen Exercise on peripheral oxygen saturation of peripheral neuropathy diabetic patients ($p=0.075 \geq 0.05$). The results of peripheral oxygen saturation of peripheral neuropathy patients before and after BAE show the same results, normally StO2 >95% with results of patients varying from 96%, 97%, and 98%.

Table 4 shows the results of statistical tests that there is an effect of Buerger Allen Exercise on the physical activity abilities of peripheral neuropathy diabetic patients ($p=0.031 \leq 0.05$). Before Buerger Allen Exercise there were 2 patients with independent ability level (8.3%), after Buerger Allen Exercise action all peripheral neuropathy patients showed totally independent results (100%).

4. DISCUSSION

Effect of Buerger Allen Exercise on Ankle-Brachial Index of Peripheral Neuropathy Patients

Diabetic neuropathy is a condition of peripheral nerve dysfunction caused by DM disease rather than other diseases. Some literature explains that Diabetic Neuropathy is a condition of nerve damage to the feet due to metabolic disorders of blood glucose levels / excessive blood glucose levels which often occur in patients with Diabetes Mellitus (Faiqotunnuriyah & Widya Hary Cahyati, 2021). Signs and symptoms of patients with diabetic neuropathy include: patients complain of burning in the feet, tingling, pain in the feet, experiencing sensations in the feet such as stabbing and numbness (numbness), and some people complain of a sense of instability in walking (Barra, 2022).

In patients with diabetes mellitus who experience ineffective peripheral tissue perfusion, if peripheral blood resistance and cardiac output increase, there will be an increase in blood pressure as well. Ankle brachial index (ABI) is said to be normal when the blood pressure of the feet proportional to brachial blood pressure. A normal ABI is an indicator that blood flow to the periphery including the feet is effective.This study compares systolic blood pressure that can be measured at the ankle artery (dorsalis pedis/ posterior tibia) and the brachial artery. ABI is also called ankle arm index, ankle brachial blood pressure index, ankle arm ratio or Winsor index (Santosa & Rusmono, 2016). This study result similar with previous study that Buerger Allen Exercise make ABI of diabetes mellitus patients to be normal. Ankle movement may be increased muscle strength and ankle joint can increase spasm of the small muscles of the calf veins, cause the pump to rise back into the vein heart. A contraction occurs in a small area muscular diabetes can increase the amount of oxygenated blood and nutrients in the circulation of foot (Trisnawati et al., 2020).

Effect of Buerger Allen Exercise on Peripheral Oxygen Saturation in Peripheral Neuropathy Patients

There is no significant effect of Buerger Allen Exercise on peripheral oxygen saturation (StO2) on feet because result of some patients before and after Buerger Allen Exercise showed an increase in peripheral oxygen saturation but only increases 1-2% and some of patients is settle down, range from 96%-98% but still within normal limits. Most of the oxygen saturation is a health benchmark to measure the amount of oxygen levels in the bloodstream. The normal value of oxygen saturation ≥95% is said to be abnormal when ≤95%(Tri Indriawati, 2020). If excess O2 in the body can poison (called oxygen poisoning), if the oxygen pressure is higher than 1 bar (normal pressure) or if this oxygen level is higher than 21%.

This study measures the amount of oxygen present in the peripheral blood vessels of the lower extremities by using an oximeter on the toes. This instrument based on another study shows that an oximeter on toes is non-invasively assess peripheral tissue actual blood flow throughout the foot to detect ischemic areas, same result use of real angiosome of StO2 foot mapping. The angiosome is a model of five or six distinct three-dimensional blocks of tissue fed by three main source arteries and their branches to the foot and ankle (Kagaya et al., 2014)

Effect of Buerger Allen Exercise on Physical Activity Ability of Peripheral Neuropathy Patients

Physical inactivity is an independent risk factor for chronic diseases, and overall is estimated to cause mortality globally (Fadul & Afonso, 2018). Research based on the measurement of body movements by the body's muscles and support systems that require energy expenditure. In Buerger Exercise, utilizing the force of gravity applied by the smooth muscles of the blood vessels and vascular system at different positions. Gravity helps emptying and filling the space in the blood vessels alternately, ultimately improving vascular blood transportation. Buerger Exercise is proven to increase ABI values higher due to the combined exercise of muscle pump (dorsiflexion and plantarflexion) and changes in gravity (45° foot elevation, foot drop, supine sleep) (Sari et al., 2019). Buerger Exercise increases vascularization and blood supply and flow thereby improving peripheral perfusion and reducing pain in the lower extremities. If DM patients have wounds

on the feet, it can help the wound healing process (Supriyadi, 2019)

CONCLUSION

Buerger Allen Exercise as an independent nursing intervention affects changes in Ankle-Brachial Index and physical activity ability of peripheral neuropathy patients. Peripheral oxygen saturation in peripheral neuropathy patients with long-standing diabetes mellitus still shows normal results.

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