

The Effect of Walking Exercise on the Decreased Risk of Peripheral Artery Disease (PAD) based on the Value of Ankle Brachial Index (ABI) in Type 2 Diabetes Mellitus Patients in Lerep Village, West Ungaran Subdistrict

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Abstract

Diabetes Mellitus will cause complication factor in arterial blood vessels, such as atherosclerosis and arteriosclerosis. Atherosclerosis that occurs can cause Peripheral Artery Disease (PAD). One way to prevent the occurrence of PAD is by doing a physical activity such as a walking exercise, where while doing a walking exercise, it can increase the production of Nitric Oxide plasma so it can improve PAD by increasing the value of Ankle Brachial Index (ABI). The purpose of this study was to analyze the effect of the walking exercise to decrease the risk of PAD in patients with type 2 diabetes in Lerep Village, West Ungaran District. Research design used Quasi experiment, with pretest- posttest nonequivalent control group design. The population was clients of diabetes type II in Lerep Village, West Ungaran subdistrict. Samples of this research were 32 respondents divided into control and intervention groups. The sampling method used purposive sampling while data collecting tool used a stethoscope. Data analysis used Mann Whitney U-test. Based on the research, it was found that there was a difference of risk level of PAD before and after the research in intervention group with p value $0,002 < \alpha 0,05$. There was no difference in PAD risk level in the control group with p value $0,269 < \alpha 0,05$. There was an effect of walking exercise on the risk of PAD in patients of Diabetes Mellitus type 2 with p value $0,000001 < \alpha 0,05$. Diabetes Mellitus is one of the factors that affect blood flow because the increase of viscosity factor due to hyperglykemia. The increased blood viscosity can cause impaired blood flow throughout the body and causes a decrease in perfusion to body tissues. The heaviest decrease in perfusion is in the distal or leg area if this condition persists can cause complications such as PAD and in DM it can cause gangrene injury. Gangren wounds occur due to a decrease in perfusion so the tissue does not get nutrients and lacks oxygen and neuropathy. The conclusions of the study showed that there was an influence on the walking exercise towards increasing the value of ABI which had an effect on reducing the risk of PAD. Suggestion : Based on this research, walking exercise can be used as non pharmacologic therapy and be applied correctly to reduce the risk of PAD in Diabetes Mellitus type 2.

Keywords : Diabetes Mellitus type 2, Peripheral Artery Disease, Walking exercise

Introduction

Diabetes Mellitus (DM) is a chronic hyperglycemia syndrome due to relative deficiency of insulin, resistance or both (Soegondo, 2009). According to the International of Diabetic Federation (2010) estimates, there were 382 million people living with diabetes in the world in 2013. By 2035 that number is expected to increase to 592 million people. The incidence of DM according to Riskesdas (2013) data increased from 1.1% in 2007 to 2.1% in 2013 from a total population of 250 million.

Diabetes Mellitus will cause complications in arteries, such as atherosclerosis and arteriosclerosis (Black, 2014). Atherosclerosis that occurs can cause Peripheral Artery Disease (PAD). PAD is one of the complications that occur in patients with type 2 diabetes mellitus,

more than half of the nontraumatic lower limb amputation is associated with diabetes complications such as sensory and autonomic neuropathy, peripheral vascular disease, increased risk and rate of infection and poor healing (Black, 2014).

Diabetes Mellitus can cause increased blood viscosity or blood viscosity, this can affect the process of blood flow, where blood flow to the distal or peripheral parts has decreased due to viscosity in high blood vessels (Smeltzer & Bare, 2013). Anaerobic metabolism in cells will try to meet basic needs, but the removal process in the form of lactic acid and pyruvic acid will form fast so it causes a toxic state and is excreted very slowly (Black & Jane, 2014).

Stenosis is a condition of narrowed blood vessels and is progressive. The physiological influence of this stenosis causes Peripheral

Artery Disease (PAD) (Black & Jane, 2014). Peripheral Artery Disease (PAD) is a disease in which the disruption or blockage of blood flow from or to organ tissues. The blockage is caused by plaque that forms in the arteries that carry blood to all tissue of the body. This plaque consists of fat, calcium, fibrous tissue, and other substances in the blood. Peripheral Artery Disease (PAD) can be detected by measuring the Ankle Brachial Index (ABI), ABI which measures the ratio of systolic pressure in the arm with systolic pressure in the lower leg (Nussbaumerova et al, 2011).

Management of Diabetes Mellitus can be done with pharmacological and non-pharmacological therapy. One way to prevent the occurrence of Peripheral Artery Disease (PAD) in people with type 2 Diabetes Mellitus is to do physical activities such as walking exercise. Walking exercise is a very simple physical activity and can be done by all people. During the exercise the energy demand will increase and this is met from the breakdown of glycogen and the unloading of triglycerides, free fatty acids from adipose tissue and the release of glucose from the liver, increasing the elasticity of blood vessels (Tjokoprawiro et al, 2014).

A walking exercise can reduce blood sugar levels in Diabetes Mellitus patients due to an increase in the body's fuel needs by active muscles. Walking exercise in person associated with an increase in the speed of muscle glucose recovery (how much muscle takes glucose from the bloodstream) and increases the production of Nitrit Oxide plasma (Black, 2014). If Nitrit Oxide levels increase then the prophylactic role of atherosclerosis will run optimally and the end result will improve narrowing due to atherosclerosis (Black, 2014) thereby reducing the risk of Peripheral Artery Disease (PAD). Based on this description, researchers are interested in examining the effect of physical exercise (walking) on reducing the risk of

peripheral Artery Disease (PAD) based on the value of the Ankle Brachial Index (ABI) in patients with type 2 Diabetes Mellitus in Lerep Village, Ungaran Barat District, Semarang Regency.

This study aims to determine the effect of physical exercise (walking exercise) on reducing the risk of Peripheral Artery Disease (PAD) based on the value of the Ankle Brachial Index (ABI) in patients with type 2 Diabetes Mellitus in Lerep Village, West Ungaran Subdistrict. The benefits of this research are that it can help reduce the risk of Peripheral Artery Disease (PAD) and get information about the importance of physical exercise for Diabetes Mellitus patient.

Methods

This study used a Quasi experiment design, with a nonequivalent control group design approach. This research was conducted on 11 to 13 July 2017. The sample in this study were 32 type 2 diabetics with 16 intervention group and 16 control group and using purposive sampling technique. The instrument was used a stethoscope and spynomanometer to measure ABI to determine the level of risk of PAD. The statistical test was used the Wilcoxon test and the Mann Whitney U test.

Results

1. An Ankle Brachial Index (ABI) as indicator Peripheral Artery Disease (PAD) risk level before and after walking exercise on the intervention and control group.

Table 1

Frequency distribution of Ankle Brachial Index (ABI) as indicator Peripheral Artery Disease (PAD) risk level before and after walking exercise in the intervention and control group

The results of the study based on table 1 can be known that before the treatment of walking exercise, most respondents in intervention group with a risk of Peripheral Artery Disease (PAD) at the level of ischemia are 9 people (56.2%) and none at the level of no risk, whereas after being

Risk of PAD	Intervention				Control			
	Before		After		Before		After	
	f	%	f	%	f	%	f	%
No Risk	0	0	4	25	0	0	0	0
Calcification	7	43,8	10	62,5	7	43.8	6	37.5
Ischemia	9	56,2	2	12,5	9	56.2	10	62.5
Jumlah	16	100	16	100	16	100	16	100

treated with walking exercise, most respondents with a Peripheral Artery Disease (PAD) risk at the level of calcification were 10 respondents (62.5%) and not at risk as many as 4 people (25%). In control group, we can be seen that before the study, most respondents with a risk of Peripheral Artery Disease (PAD) at the level of ischemia that is 9 people (56.2%) and none at the level of no risk, and after the study, most respondents with Peripheral risk Artery Disease (PAD) at the level of ischemia is 10 respondents (62.5%) and none at the level of no risk.

- Effect of walking exercise on reducing the risk of Peripheral Artery Disease (PAD) based on the value of the Ankle Brachial Index (ABI)

Table 2.

Effect of walking exercise on reducing the risk of Peripheral Artery Disease (PAD) based on Ankle Brachial Index (ABI) value in type 2 Diabetes Mellitus patients in Lerep Village, Ungaran Barat District, Semarang Regency (n = 16)

Risk of PAD	n	Median	Min	Max	p-value
Control	16	0.86	0.79	0.94	0.0001
Intervention	16	0.96	0.85	1.00	

The results of the study based on table 5, it can be seen that the median is 0.86 with a minimum value of 0.79 and a maximum value of 0.94 in the pretest, and in the posttest the median value increases to 0.96 with a minimum value of 0.85 and a maximum value of 1.00.

Based on the Mann Whitney test, a p-value is $0.0001 < \alpha (0.05)$, it can be concluded that there was an effect of walking exercise to reducing the risk of Peripheral Artery Disease (PAD) based on the value of the Ankle Brachial Index (ABI) in patients with type of Diabetes Mellitus type 2 in Lerep Village, Ungaran Barat District, Semarang Regency.

Discussion

- Ankle Brachial Index (ABI) as indicator Peripheral Artery Disease (PAD) risk level before and after walking exercise in the intervention and control group

The results of the study based on table 1 can be known that before the treatment of walking exercise, most respondents with a risk of Peripheral Artery Disease (PAD) at the level of ischemia are 9 people (56.2%) and none at the level of no risk, whereas after given walking exercise treatment, most respondents with the risk of Peripheral Artery Disease (PAD) at the level of calcification is 10 respondents (62.5%) and no risk as much as 4 people (25%).

In this research, there was an increase of 3.7% or 1 respondents in control group who went from ischemia to calcification, and as many as 15 respondents remained at the same level of PAD risk. This is caused by sufferers of Diabetes Mellitus in the group control was not given any form of intervention. Resulting in the risk of PAD is stagnant. The 1 respondent who experienced decrease the risk of PAD from calcification to ischemia is related to smoking. Early adult smokers at risk of PAD caused by substances contained in cigarettes, i.e. nicotine and carbon monoxide (CO). Nicotine and carbon monoxide will damage endothelium of the arteries, decreased blood elasticity and increased blood pressure (Depkes, 2007).

The indicator of the risk of PAD occurrence is by looking at the value ABI. ABI is one of the

non-invasive, simple and inexpensive tests can be used to diagnose PAD objectively. ABI is a supporting examination recommended by AHA as the main diagnostic tool for PAD. ABI is ratio of systolic blood pressure to ankles systolic blood pressure in the arm. Normal ABI values are 1.00-1.40 and if the ABI value of 0.91-0.99 includes calcification, a value of 0.4-0.90 means ischemia, whereas if the ABI value <0.40 means severe ischemia (Dieter, 2009).

The indicator of PAD involves the decline in ABI values. . From a series of patient examinations carried out at vascular laboratory, the value of ABI has decreased by an average of 0.06 each 4.6 years. The ABI level can also be used to predict events involving the lower extremities where systolic blood pressure below or equal to 50 mmHg is often associated with numbers high amputation (Dieter, 2009).

In this study there were 9 (56.2%) respondents who experienced ischemia in both intervention and control group. Ischemia is a restriction in blood supply to tissues, causing a shortage of oxygen that is needed for cellular metabolism. Ischemia is generally caused by problems with blood vessels, with resultant damage to or dysfunction of tissue. Ischemia comprises not only insufficiency of oxygen, but also reduced availability of nutrients and inadequate removal of metabolic wastes. Ischemia can be partial (poor perfusion) or total. The low tissue perfusion is the caused of PAD.

Type 2 diabetes or insulin-dependent diabetes mellitus (NIDDM), caused by a decrease in the sensitivity of the target tissue to the target metabolic effect of insulin, a decrease in sensitivity to insulin is often referred to as insulin resistance (Guyton & Hall, 2007). The effect of insulin resistance which can cause plaque. Macrovascular complications of decreased sensitivity to insulin cause the walls of blood vessels to thicken, sclerosis, and become occlusion by plaque attached to the walls of blood vessels that cause blockage of blood vessel flow, one of which causes peripheral vascular disease or Peripheral Artery Disease (PAD).

Peripheral Artery Disease (PAD) are all diseases that occur in non-acute coronary syndromes after exiting the heart and aorta, so that vessels that can be the location of PAD are vessels in all four extremities, and clinically PAD is a disorder in the arteries that aggravates the extremity below (Dieter, 2009). Peripheral Artery Disease (PAD) is a condition characterized by narrowing of the peripheral arteries due to the process of atherosclerosis and generally occurs in the arteries in the legs (Chesbro et al, 2011).

Peripheral Artery Disease (PAD) risk occurs in the condition of Diabetes Mellitus with an increase in chronic blood sugar which causes the accumulation of glycoprotein in the cell wall, thus causing plaque in the endothelium causing endothelial dysfunction (Black, 2014). In individuals with type 2 DM, endothelial dysfunction appears to be based on decreased bioavailability of Nitrite Oxide (NO). Increased production of superoxide radicals not only causes an increase in NO inactivation, but also increases the synthesis of prostanoids which function as vasoconstrictors in the presence of hydrogen peroxide (H₂O₂) and hydroxyl radicals.

2. Effect of walking exercise on reducing the risk of Peripheral Artery Disease (PAD) based on the value of the Ankle Brachial Index (ABI)

The results of the study based on table 2 can be seen that the median is 0.86 with a minimum value of 0.79 and a maximum value of 0.94 in the pretest, and in the posttest the median value increases to 0.96 with a minimum value of 0.85 and a maximum value of 1, 00. An indicator of the risk of PAD occurrence is by looking at the value of ABI.

Based on the Mann Whitney test, a p-value of $0.0001 < \alpha (0.05)$, it can be concluded that there is an effect of physical exercise (walking) on reducing the risk of Peripheral Artery Disease (PAD) based on the value of the Ankle Brachial Index (ABI) in patients with Diabetes Mellitus type 2 in Lerep Village, Ungaran Barat District, Semarang Regency. The results of this study indicate the influence of a walking exercise to an

increase in the value of ABI which has an effect on reducing the risk of PAD.

Exercise is extremely important in diabetes management because of its effects on lowering blood glucose and reducing cardiovascular risk factors. Exercise lowers blood glucose levels by increasing the uptake of glucose by body muscles and by improving insulin utilization. It also improves circulation and muscle tone. Exercise also alters blood lipid concentrations, increasing levels of highdensity lipoproteins and decreasing total cholesterol and triglyceride levels. This is especially important for people with diabetes because of their increased risk of cardiovascular disease (Smelzer & Bare, 2012).

The walking exercise that is the same as foot massage that is giving pressure and movement on feet affect increase endorphin secretion which functions to reduce pain, vasodilation of blood vessels so that there is a decrease in blood pressure especially systolic brachialis which is directly related to ABI values (Laksmi, Agung, Mertha, & Widianah, 2006). This is in line with research conducted by Wahyuni (2016), which states that the value of ABI can be increased by doing foot gymnastics for 30 minutes and based on his research, a p value of 0.005 means that there is an effect of foot massage on increasing the ABI value.

A walking exercise makes the body relaxed and blood circulation. Smooth blood circulation due to movement, stimulates blood delivering more oxygen and nutrients to the body's cells, besides helping to carry more toxins to be excreted (Natalia et al., 2012). The effect of relaxing walking is directly related to an increase in the speed of muscle glucose recovery and to increase the production of Nitrit Oxide plasma (Black, 2014). Increased NO helps in deep collateral arteries compensate for being able to meet the oxygen demand of the vessels blocked arteries, so that it can help improve perfusion and blood circulation in the limbs of type 2 DM patients which have an effect on reduced risk of PAD.

PAD patients have resistance to the walking exercises and lower levels of physical activity compared to groups of patients without

PAD. This is evidenced by several studies that show that a low ABI value is associated with greater functional impairment and decreased physical exercise capacity than a population with a high ABI value. Indicators of decreased perfusion to the limb area can be measured through ABI. ABI is the ratio of systolic blood pressure measured in the foot area and measured in the brachial artery and used for foot blood circulation is the flow of blood pumped by the heart throughout the body, one of which is the foot which is influenced by three factors, namely viscosity (blood thickness), blood vessel length and diameter of blood vessels.

Diabetes mellitus is one of the factors that influence blood pressure due to blood viscosity cause sugar buildup. Blood viscosity results in impaired blood flow throughout the body and causes a decrease in perfusion to body tissues. The most severe decrease in perfusion is in the distal area or legs if this condition lasts a long time can cause complications such as PAD and in DM is can cause gangrene injuries. Gangrenous sores appear due to decreased perfusion so that the tissue does not get nutrients and lack of oxygen and neuropathy. In DM patients the thing that is feared is the presence of gangrene wounds that are difficult to cure (Agustianingsih, 2013).

These macrovascular complications of DM can be prevented by physical exercise in the form of walking exercise. A walking exercise is a way appropriate to increased circulation, especially to the leg area. Walking exercise is a form of exercise that meets the foot area continuous, rhythmical, interval, progressive and endurance criteria every prisoner movement must be carried out. Sports or physical exercises It is recommended for DM patients who are aerobic which means it requires oxygen and can help blood circulation, strengthen small muscles feet, prevent foot deformities that can increase the potential for diabetic sores on legs, increasing the production of insulin used in glucose transport to cells so that it helps reduce glucose in blood (Dewi, Sumarni, & Sundari, 2012).

The results of this study indicate the influence of the road relaxed towards an increase in the value of ABI which has an effect on reducing risk PAD. casual walks make the body relaxes and blood circulation. Blood circulation which is smooth due to being moved, stimulates the blood delivering oxygen and more nutrition to the body's cells, besides that it helps carry more toxins to be excreted (Natalia et al., 2012). Influence

Relaxed walking is directly related to increased speed recovery of muscle glucose and increase plasma NO production. If NO levels increase, the role of prophylaxis atherosclerosis will run optimally and the end result will be repair narrowing due to atherosclerosis so can reduce the risk of PAD (Black, 2014).

Conclusions

The conclusion is there was an effect of walking exercises to reducing the risk of Peripheral Artery Disease (PAD) based on the Ankle Brachial Index (ABI) value in Diabetes Mellitus type 2 patients in Lerep Village, Ungaran Barat District, Semarang Regency with a p-value of $0.0001 < \alpha (0.05)$. Suggestions that can be given based on this study, it is expected that people with Diabetes Mellitus do physical exercise (walking) as a non-pharmacological therapy and be applied properly to reduce the risk of PAD in patients with type 2 DM to prevent the occurrence of severe ischemia that indicates gangrene and indications of lower limb amputation .

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