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The Effect of Active Assistive Range of Motion to Blood Pressure Decrease of Type II Diabetes Mellitus Patient

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Article Info

Abstract

The application of physical exercise that meets Frequency, Intensities, Time, Type can be applied to control the increase in blood sugar levels and reduce blood pressure. This research is a quantitative study with a pre-experiment design using a one group pretest-posttest model. The purpose of this research is to determine the effectiveness of providing Active Assistive Range of Motion actions in the form of isotonic movements where contractions of the muscles shorten with the movements of each joint in accordance with the range of motion which is normal but the tension in the muscles remains constant during the contraction to decrease blood pressure in people with type II diabetes mellitus. This research was carried out in 2019. The population of this study were people with type II diabetes mellitus who participated in chronic disease management program activities at the Baturetno Health Center as many as 52 people. The research sample of 25 people was taken by purposive sampling technique. The results showed a decrease in systolic and diastolic blood pressure in the range of 0-15 mmHg with an average decrease of 8.6 mmHg for systolic blood pressure and 6.64 mmHg for diastolic blood pressure. Statistical test with Wilcoxon obtained Asymp value. Sig. (2-tailed) of 0,000 with a confidence level of 95% so that it can be concluded that there is a significant difference between the blood pressure of patients with type II DM before and after the Active Assistive Range of Motion treatment at Baturetno Health Center.

Introduction

Mortality due to non-communicable diseases increased 15% globally between 2010 and 2020 (Budiman, Sihombing, & Pradina, 2017). Indonesia has entered the epidemic of type II Diabetes Mellitus (Purwanti, Jirna, & Arjani, 2016). Diabetes mellitus is a non-communicable disease that can be triggered due to lifestyle changes that are affected by urbanization, modernization and globalization (Isroin, 2019). Diabetes mellitus type II is a condition when blood sugar levels in the body are uncontrolled because of impaired sensitivity of pancreatic β cells to produce the hormone insulin (Lemone, Priscilla., Karen M. Burke, 2015). Insulin plays a role in regulating blood sugar levels, hyperglycemia

occurs when excessive glucose intake and insulin are unable to balance blood sugar levels. Aging and unhealthy lifestyles increase the prevalence of type II DM. Indonesia ranks 7th with the number of DM patients of 8.5 million (Winta, Setiyorini, & Wulandari, 2018) and it is estimated that in 2040 there are around 642 million adults who suffer from DM (Hu, 2019). People suffering from DM are at risk of developing cardiovascular disorders such as stroke and myocardial infarction and causing death due to blood pressure problems (Wang et al., 2019).

Long-term diabetes has a severe impact on the cardiovascular system. Microvascular complications occur due to thickening of the basement membrane of small vessels. The cause

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of thickening is directly related to high glucose levels in the blood. Microvascular thickening causes ischemia and decreased oxygen and nutrient delivery to tissues. Chronic hypoxia directly damages and destroys cells. In the macrovascular system in the endothelial lining of the arteries due to hyperglycemia the permeability of endothelial cells increases so that molecules containing fat enter the arteries. Damage to endothelial cells will trigger an inflammatory reaction so that platelets, macrophages and fibrous tissue eventually settle. Thickening of the arterial wall causes hypertension which will further damage the endothelial lining of the arteries due to the endothelial cell tearing force (Bare, 2002).

Diabetes Mellitus type II is caused by 2 things namely insulin resistance and decreased ability of pancreatic cells to secrete insulin in response to glucose load. In insulin resistance an increase in glucose production and a decrease in glucose use resulting in hyperglycemia (Lemone, Priscilla., Karen M. Burke, 2015). Diabetes which is characterized by hyperglycemia is one of the risk factors for hypertension (Tanto, C & Hustrini, 2014). Hypertension is a common complication disease in patients with type II Diabetes Mellitus and is a risk factor for cardiovascular, cerebrovascular and renal disease problems. Blood pressure instability is still a major cause of death in patients with type II Diabetes mellitus (Liu, Pong, Gallo, Darekar, & Terra, 2019) (Wang et al., 2019). High blood pressure affects two out of three people with diabetes mellitus (American Diabetes Association, 2017). One of the factors that affect the control of blood sugar levels is physical activity (Winta et al., 2018). Physical exercise is one of the pillars of the management of patients with DM, some studies say physical exercise can also reduce blood pressure (Ilyas, 2013). Regular physical exercise can improve the quality of blood vessels and improve all metabolic aspects, including increasing insulin sensitivity and improving glucose tolerance, FITT (Frequency, Intensities, Time, Type) are things to consider when giving physical exercise to patients with type II DM (Ilyas, 2013). The application of physical exercise that meets the FITT can also be applied to reduce the increase in blood sugar levels and reduce blood pressure such as Active Assistive Range of Motion (AAROM) which is part of the Range of Motion (ROM) which is in the form of isotonic movements in which muscle contractions shorten with each movement - each joint corresponds to a normal range of motion but the tension in the muscles remains constant during contraction. The need for glucose will also increase if the muscles contract due to arising of work and require energy (Guyton, A.C. dan Hall, 2008).

Based on data at the Baturetno Health Center, Hypertension and Non Insulin Diabetes Mellitus is the highest disease in the list of 10 major diseases. Population distribution based on sex, obtained data on the number of female population more than the male population with a ratio of 99.96% (Dinas Kesehatan Kabupaten Wonogiri, 2018). Preliminary study conducted at the Baturetno Health Center I obtained data from people with type II DM as many as 80 people, who participated in the chronic disease management program (prolanis) as many as 52 people.

Method

This research is quantitative. The design was pre-experimental using a one-group pretest-posttest design model. This research was conducted at the Baturetno Community Health Center for two weeks, from 8 to 20 April 2019. The population was all type II DM patients who participated in chronic disease management (prolanis) in the work area of the Community Health Center. The research sample taken as many as 25 people who meet the inclusion and exclusion criteria in accordance with the objectives of the study. The sampling technique was purposive sampling. In collecting data, the patient's blood pressure is measured before and after AAROM is given. The instrument used is a digital sphygmomanometer with the Omron brand. Samples that met the inclusion and exclusion criteria were given AAROM 8 times with a duration of 30 minutes for each action. Each respondent was given an explanation of the procedures and objectives of the study before action was taken. As a sign of being a research respondent, the sample signed an agreement to become a respondent. After the data was collected, the normality test data before and after AAROM was given using the Shapiro

Wilk test because the number of samples was less than 50 people. Test analysis of differences in blood pressure before and after AAROM was used statistical tests using Wilcoxon, p value <0.05

Reasult and Discussion

In Table 1 explaining the distribution of respondents by gender, it was found that most of the respondents were female, namely 21 respondents or 84% and the rest were male respondents, namely 4 people or 16%.

Based on the age, most respondents aged 56-65 years with 11 people or 44%, next were respondents aged 46-55 years totaling 9 people or 36%, followed by respondents with ages 35-45 years totaling 3 people or 12% and finally

respondents aged over 65 years as many as 2 people or 8%.

Characteristics of respondents based on employment, obtained data that most respondents who worked were 15 people or 60% and respondents who did not work were 10 people or 40%.

Characteristics of respondents based on Body Mass Index (BMI) resulted that highest number were respondents with moderate obesity namely 13 people or 52% then respondents with light obesity as many as 8 people or 32% and the lowest were respondents with overweight as many as 4 people or 16%.

Respondents characteristics based on fasting blood sugar (FBS) were categorized into

Table 1. Respondent's Characteristics Basen on Gender, Age, Employment, Body Mass Index and Fasting Blood Sugar

Characteristics	n	f	%
Gender			
Male		4	16
Female		21	84
Total	25		100
Age			
35 – 45 years		3	12
46 – 55 years		9	36
56– 65 years		11	44
>65 years		2	8
Total	25		100
Employment			
Work		15	60
Not work		10	40
Total	25		100
Body Mass Index			
Light Overweight		8	32
Moderate Overweight		13	52
Overweight		4	16
Total	25		100
FBS test result [*]			
< 100 mg/dl		6	24
100 - 125 mg/dl		7	28
> 125 mg/dl		12	48
Total	25		100

(*FBS : Fasting Blood Sugar
Source : primary data

Table 2. Normality Test of Systolic Blood Pressure before and after AAROM

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Pretest of systolic	.187	25	.024	.959	25	.400
Posttest of systolic	.116	25	.200[*]	.965	25	.523

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Table 3. Normality Test of Diastolic Blood Pressure before and after AAROM

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Pretest of diastolic	.148	25	.161	.972	25	.708
Postest of diastolic	.143	25	.198	.944	25	.187

a. Lilliefors Significance Correction

Table 4 Average blood pressure values before and after the Active Assistive Range of Motion (AAROM) for Type II Diabetes Mellitus Patients in Baturetno Health Center

Blood Pressure	Average before AAROM (mmHg)	Average after AAROM (mmHg)	Average Blood Pressure Decrease (mmHg)
Systolic	148.16	139.56	8.6
Diastolic	86.72	80.08	6.64

Source : Primary Data

three groups: respondents with FBS levels less than 100 mg / dl, respondents with FBS levels between 100 - 125 mg / dl and respondents with FBS levels more than 125 mg / dl. The results as shown in table 4.1 are most number of respondents have FBS levels of more than 125 mg / dl namely 12 people or 48%, then respondents with FBS levels between 100 - 125 mg / dl namely 7 people or 28% and finally are respondents with levels of FBS less than 100 mg / dl namely 6 respondents or as much as 24%.
Normality Test

The results of normality test with Saphiro Wilk are shown in table 2 and table 3 with the results of the sig pretest value for systolic blood pressure is 0.400 and the sig value. the posttest is 0.523, while for the value of sig. diastolic blood pressure pretest of 0.708 and sig. posttest diastolic blood pressure of 0.187. Because the value of sig. greater than 0.05, it can be concluded that the data are normally distributed.

The results showed a decrease in blood pressure in respondents. Table 4 obtained data before given AAROM (Pre Test) the mean value of the respondent's systolic pressure was 148.16 mmHg and diastolic pressure 86.72 mmHg. After being given AAROM (Post Test) obtained the average value of the respondent's systolic pressure was 148.16 mmHg and the diastolic pressure was 86.72 mmHg. to 139.56 and a diastolic pressure of 80.08 mmHg. The mean decrease in systolic pressure is 8.6 mmHg and a diastolic pressure of 6.64 mmHg. Statistical test results with Wilcoxon show Asymp.Sig. (2-tailed) obtained a value of p 0,000 with a confidence level of 95%.
Respondents Characteristics

Characteristics of respondents based on gender obtained 84% were female respondents. The incidence of type 2 DM in women is more than men because of the role of sex steroid hormones, in this case the hormone estrogen (Nabila, Widyastuti, & Murbawani, 2018).

Gender is closely related to the incidence of type 2 diabetes in the Cengkareng sub-district health center (Styorogo, 2012). Women have a greater risk of developing type 2 diabetes than men, related to pregnancy where pregnancy is a risk factor for developing diabetes mellitus (Nabila et al., 2018).

Characteristics of respondents by age showed that most of respondents aged 56 - 65 years. This is because at the age of 40 years and over, more at risk of developing DM (Arellano-Campos et al., 2019). The lack of pancreatic beta cells in producing insulin due to glucose intolerance and the aging process (Trisnawati, Shara K, 2013). Decreased body function in metabolizing glucose occurs at the age of ≥45 years. Where people who are more than 45 years old have a risk of suffering from type 2 diabetes eight times higher compared to people who are not yet 45 years old (Kekenusa, 2013). Increased age puts a person at risk for an increased incidence of diabetes mellitus, people who have aged 55 years and over, most likely suffer from diabetes mellitus because at that age physiologically decreased body function or decreased secretion resulting in less than optimal body in controlling glucose (Iroth, Kandou, & Malonda, 2013).

Characteristics of respondents based on employment indicated 60% of respondents work. Blood glucose levels are related to physical activity (Anani, 2012). The occurrence of diabetes mellitus can be caused due to poor control of sugar levels (Purwanti, O.S. Yetti, K. Herawati, T. Sudaryanto, 2016). High intensity activity decreases blood sugar less than moderate intensity, this is due to an increase in the amount of catecholamine and growth hormone which is greater at heavy intensity, can increase blood sugar (Winta et al., 2018).

Characteristics of respondents based on Body Mass Index (BMI) showed that 52% of respondents had moderate overweight status. Increased up-take of cells to free lipid acids and lipid oxidation can be caused by the presence of high free lipid deposits that will ultimately inhibit the use of glucose in the muscles. Lipid tissue is an active endocrine one that can release adipose cytokines. It has a proinflammatory effect and can disrupt the insulin signaling pathway which can then end in a state of insulin resistance. This situation causes an increase in blood glucose levels in a person (Fadilah A, Putri Y, Decroli E, 2015). Research conducted by Jin Ook Chung et.al in 2012 showed that there was a significant relation between BMI and the occurrence of insulin resistance that caused an increase in fasting blood sugar levels, p values <0.05 (Chung, J.O., Cho D.H., Chung D.J., 2012). The greater the value of body mass index, the greater the value of fasting blood sugar. The greater the value of body mass index means that the patient leads to obesity (Nguyen N.T., Nguyen X.T., Lane J., Wang P., 2011).

Characteristics of respondents based on fasting blood sugar (FBS) results obtained 48% of respondents have FBS levels> 125 mg / dl. High blood sugar levels in the body pathologically play a role in increasing the concentration of glycoprotein, which is a trigger or risk factor for some vascular diseases (Purwanti et al., 2016). Measurement of fasting FBS level is used to test the effectiveness of medicine or the effect of foods that give different results in people who have been diagnosed as diabetics. The Perkeni Consensus states that FBS in DM patients is said to be controlled if the FBS value is 80-126 mg / dL. In this research, the result obtained was respondents' FBS levels in the uncontrolled category.

The effect of Active Assistive Range of Motion(AAROM) to DM type II patient Blood Pressure Decrease

The average systolic blood pressure of the patient before being given AAROM was 148.16 mmHg and the diastolic blood pressure was 86.72 mmHg. The mean systolic blood pressure of the patient after being given AAROM was 139.56 mmHg and the average diastolic blood pressure was 80.08 mmHg. Decrease in systolic and diastolic blood pressure was in the range of 0-15 mmHg with an average decrease of 8.6 mmHg for systolic and 6.64 mmHg for diastolic blood pressure before and after AAROM was given for type 2 DM patients joining prolanis activities at the Baturetno Puskesmas. The mechanism that regulates constriction and relaxation of blood vessels is located in the vasomotor center, in the medulla in the brain. From the center of this vasomotor begins a sympathetic nerve pathway that goes down to the spinal cord and out of

the spinal cord column into the sympathetic ganglia in the thorax and abdomen. Vasomotor central stimulation is delivered in the form of impulses that move downward through the pathways of the sympathetic nervous system to the sympathetic ganglia. At this point, preganglionic neurons release acetylcholine which stimulates post ganglion fibers into blood vessels by releasing norepineprin which results in blood vessel constriction (Bare, 2002). In a state of relaxation, suppression of sympathetic nerve activity will inhibit the secretion of epineprin and norepineprin which can cause vasoconstriction of blood vessels where individuals with hypertension are very sensitive to norepineprin (Bare, 2002)

Arterial pressure is determined by factors pushing blood from the heart (cardiac ouput) and resistance to blood flow through peripheral blood vessels. Stimulation of the sympathetic nerves increases the thrust by the heart and total peripheral resistance, which usually causes an increase in arterial pressure (Guyton, A.C. dan Hall, 2008). Another major blood pressure regulation is total peripheral resistance which is affected by arteriolar diameter and blood viscosity. Arteriola diameter depends on metabolic control that adjusts blood flow to the requirements. By providing vasoconstrictive effects, the sympathetic nerves will affect the diameter of the ateriola. In addition there are substances that can affect the diameter of arterioles, namely vasopressin and angiotensin II in regulating fluid and electrolyte balance by the mechanism of rennin-angiotensin-aldosterone (Guyton, A.C. dan Hall, 2008)

One of the physiological stimuli involving all body systems, including the muscular system, nervous system, and metabolic system of hormones is physical exercise (Mosavat, M., Mohamed, M. & Mirsanjari, 2013). Physical activity causes an increase in cortisol both in physical activity with maximum and submaximal doses (Sugiharto, 2012). In the beginning of physical exercise involves skeletal muscle which is affected by the central command of the motor to the spinal cord through the pyramid by activating the sympathoadrenal system. The collateral motor center of the command pathway activates the central autonomic nervous system in the hypothalamus. The hypothalamic hypophysis adrenal axis (HPA) plays a role in the mechanism of metabolic response. Hypothalamus α- and β-adrenoreceptors play an important role in controlling the increased concentration of epinephrine and norepinephrine in the blood (Siti Baitul Mukarromah, Hardhono Susanto, 2016).

Based on the Wilcoxon test results obtained Asymp values. Sig. (2-tailed) of 0,000 so that the p value <0.05 with a confidence level of 95%, which means there is a difference in blood pressure before and after the AAROM is given both systolic and diastolic blood pressure. AAROM is an isotonic movement, which is a contraction of shortened muscle contractions with the movements of each joint in accordance with the normal range of motion, but the tension in the muscles remains constant during contractions. When muscles contracting there will be an increase in blood flow which causes more open capillary nets so that more insulin receptors are available and active (Ilyas, 2013). The same thing was expressed by (Sazli, 2012) stated that when muscles contracting, there will be an increase in glucose absorption in skeletal muscle through the translocation of glucose transporter proteins from the intracellular compartment to the cell surface.

When muscles contracting a glucose transposter translocation due to an increase in the amount of the plasma membrane Glucose Transporters 4 (GLUT4), this condition is the same as insulin which can also cause GLUT4 translocation in skeletal muscle. Muscle contractions will also activate intercelular signaling such as Protein Kinase C (PKC). PKC insoform can be divided into three namely conventional PKC (cPKC), PKC novel (nPKC), and atypical PKC (APKC). A subgroup of cPKC is known to be sensitive to porbol esters which can stimulate glucose transport in skeletal muscle. ATP will be hydrolyzed to form ADP when the muscles contract, then ADP helps the availability of ATP cells again by dividing phosphate clusters to other ADPs, forming ATP and AMP. The more AMP produced during contraction, the ratio of AMP to ATP increases which will then stimulate the activity of AMPK. AMPK that has been activated will phosphorylate aPKC which then stimulates

the phosphatase that acts on insulin receptor substrate 1 (IRS1). So AMPK can increase insulin sensitivity by suppressing inhibitory serine phosphorylation on IRS1 (Sazli, 2012).

Diabetes Mellitus type II is caused by the relative failure of pancreatic β cells and insulin resistance. Insulin resistance is a decrease in the ability of insulin to stimulate glucose uptake by peripheral tissues and to inhibit glucose production by the liver. B cells are unable to fully compensate for this insulin resistance, meaning that there is a relative deficiency of insulin. This inability can be seen from the reduction in insulin secretion in glucose stimulation, as well as in glucose stimulation along with other insulin stimulants. Pancreatic β cells undergo glucose desentization. Insulin resistance and hyperinsulinemia in people with DM are believed to increase peripheral vascular resistance and contractility of vascular smooth muscle through excessive response to norepineprin and angiotensin II. This condition causes an increase in blood pressure through physiological feedback mechanisms as well as the Renin-Angiotensin-Aldosterone system (Bare, 2002). The condition of hyperglycemia in DM patients also induces overexpression of fibronectin and collagen IV which triggers endothelial dysfunction and thickening of the glomerular basement membrane that affects hypertensive renal disease (Wang et al., 2006). The increase in insulin sensitivity will reduce blood glucose levels and prevent an increase in blood pressure due to complications of type II diabetes mellitus. In a cohort study, it was found that a decrease in blood pressure of about 5-10 mmHg can reduce the risk of death associated with type II Diabetes mellitus up to three times, reduce the incidence of complications in the form of stroke by up to 50% and reduce the risk of heart failure by up to three times compared to patients whose blood pressure is uncontrolled (Adler Al et al., 2000).

Conclusion

There was a significant difference between the blood pressure of patients with type II DM before and after being given AAROM with a value of p = 0.000 where there was a decrease in the average systolic and diastolic blood pressure. The average systolic blood pressure dropped by 8.6 mmHg and the diastolic blood pressure dropped by 6.64 mmHg on average by giving AAROM 8 times with a duration of one action for 30 minutes.

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