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Correlation of Hba1c, Triglyceride, HDL with the Degree of Stenosis in Coronary Heart Patients with Type 2 Diabetes Mellitus

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Abstract

Background: Coronary Heart Disease (CHD) is a disease caused by the narrowing of the coronary artery wall as a result of the atherosclerosis process. Atherosclerosis plays an important role from the beginning of plaque formation until plaque rupture which causes blood clots. Diabetes mellitus and dyslipidemia are one of the major risk factors for CHD. In patients with type 2 Diabetes Mellitus, there was an altered lipid profile which led to endothelial damage that caused the formation of atherosclerosis. HDL cholesterol labeled as good cholesterol was decreased due to uncontrolled LDL cholesterol labeled as bad cholesterol. LDL cholesterol synthesis process was disrupted then causing plaque formation in the arteries which causes CHD.

Aim: The aim of this study was to analysis correlation between HbA1c levels, triglyceride levels, HDL levels and the degree of stenosis in coronary heart disease sufferers with type 2 diabetes mellitus.

Method: This study was an observational cross-sectional analytical study with total of 51 patients with CHD who underwent cardiac catheterization at Telogorejo Hospital. Semarang. The correlation test in this study using the Spearman test with $p < 0.05$ is considered significant.

Results: Results of this study show that there is no significant correlation between HbA1C levels and triglyceride levels ($p = 0.793$), and Hba1C with the degree of stenosis was ($p = 0.685$) but, there was significant correlation between HDL cholesterol level with the degree of stenosis ($p = 0.015$).

Conclusion: It was concluded that there was no significant correlation between the correlation of HbA1c levels and triglyceride levels with the degree of stenosis and there was a moderately negative significant correlation between HDL levels and the degree of stenosis.

Keywords: HbA1c, HDL, Triglyceride, Coronary Heart Disease, Diabetes Mellitus Type 2

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INTRODUCTION

Coronary Heart Disease (CHD) is an abnormal condition caused by unbalanced myocardial oxygen demand and blood flow. CHD is caused by the narrowing of the coronary artery walls as a result of the atherosclerosis process. This condition becoming a major cause of death in both developed and developing countries^{1,2}. Mortality number based on World Health Organization (WHO) data show that around 17.5 million people die because of cardiovascular disease and 7.4 million. Based on the results of Basic Health Research (RISKESDAS) in 2018 the prevalence of heart disease based on doctor's diagnosis in Indonesia reached 1.5% with the prevalence in Central Java Province reaching 1.6%⁴.

Diabetes mellitus is an important risk factor for CHD. The risk of coronary heart disease can occur three to four times in diabetes mellitus patients compared to non-diabetes mellitus⁵. Type 2 diabetes mellitus is a metabolic disease caused by insulin resistance and diffusion of pancreatic beta cells⁶. Diabetes mellitus condition increases risk of coronary heart disease. High blood sugar level called hyperglycemia increased blood viscosity that increases the workload of the heart and also increase fat plaque formation which stick in the walls of blood vessels, resulting in narrowing of the blood vessels.

Hemoglobin A1c (HbA1c) is a parameter for controlling blood glucose. HbA1c is a long-term examination parameter of 2-3 months and is the gold standard of glycemic control⁶. In patients with type 2 DM, the lipid profile is often found to have increased triglycerides which damage endothelial function, causing the formation of atherosclerosis and a decrease in HDL cholesterol caused by uncontrolled LDL level. The process of removing LDL cholesterol in the body is hampered, causing plaque formation in the arteries which causes CHD. The degree of stenosis is a determinant of the severity of stenosis due to CHD which is caused by the buildup of atherosclerotic plaque. This can be done with coronary angiography (CAG) which is an examination carried out to observe blood vessels in heart which is the gold standard for detecting the degree of stenosis in the coronary arteries⁷.

Based on the background above, there are more and more cases of CHD patients with diabetes mellitus in Indonesia and several studies are still contradictory, so researchers are interested in examining the correlation

between HbA1c levels, triglyceride levels, HDL levels and the degree of stenosis in coronary heart patients with type 2 diabetes mellitus.

METHOD

This research is an observational study with cross sectional design that conducted in November-December 2023 at the Clinical Pathology Laboratory at Telogorejo Hospital and the cardiac catheterization Laboratory (Cath Lab) at Telogorejo Hospital, Semarang. Inclusion criteria were male or female patients aged 35-75 years and willing to be part of this study. The total number of respondents in this study was 51 people with a sampling technique using consecutive sampling. Data were analyzed using SPSS for normality test using the Kolmogorov Smirnov test, and percent for categorical data. The data was analyzed using normal data correlation, followed by a correlation test using the Pearson test and for abnormal data, a correlation test was carried out using the Spearman test. The p-value was significant if <0.05.

The research was carried out in accordance with approval from the research ethics committee of Telogorejo Hospital Semarang. Ethical Clearance No. 33903/TU.710/KEPK/K/2023.

Tools And Materials

1. The tools used in this research are POCT, GPO-PAP, CHOD-PAP, syringe, alcohol cotton, yellow tip and micropipette, spectrophotometer, centrifuge, test tube, micropipette (10 µl, 1000 µl), blue tip, yellow tip and tissue.
2. Whole blood of CHD patients with Type 2 DM and Serum of CHD patients with Type 2 DM.

Research Procedure

Blood sampling

The patient was sitting and as comfortable as possible, explaining to the respondent that blood would be drawn. Place the tourniquet at a distance of 3 cm from the elbow crease. Disinfect the veins. Then puncture with a 3 cc syringe at a 45o angle. When the blood has entered, release the fist and tourniquet. Take 3 cc of blood, remove the syringe then cover the stabbing site with plaster and put the blood into the EDTA vacuum tube and the vacuum tube with anticoagulant, then write down the respondent's identity.

HbA1c examination

POCT (Boronate affinity) tool, the working principle of the tool is influenced by variant hemoglobin and provides excellent precision and accuracy with a sensitivity of 82.9% and a specificity of 100%. The POCT tool is calibrated before carrying out the examination. Open the top of the tool to place the cartridge. Homogenize the reagent before adding the sample, then add 5 µl of the blood sample. Put the reagent containing blood into the cartridge and close the tool and the results will come out within 5 minutes.

Triglyceride and HDL examination

Make a blank solution by pipetting 1000 µl of R1 and put it in a test tube. Incubate for 10 minutes at 20 - 25°C. Make a standard solution by pipetting 1000 µl of R1 and 10 µl of standard reagent into a test tube. Homogenize and incubate for 10 minutes at 20 - 25°C. Make a standard solution by pipetting 1000 µl of R1 and 10 µl of serum sample into a test tube. Homogenize and incubate for 10 minutes at 20 - 25°C and read the sample after incubation with a spectrophotometer with a wavelength of 546 nm.

Check the Degree of Stenosis

Examination of the degree of stenosis was carried out by secondary data collection which was carried out by heart and blood vessel specialists.

RESULTS

Characteristics of research subjects

Based on the results of the analysis, the characteristics of the research subjects were shown in Table 1. Characteristics data show that the number of heart disease patients who underwent catheterization was 51 people, dominated by 40 male research subjects (78.4%) with the highest age of research subjects being 56-65 years were 19 (37.3%) with the youngest age being 41 years and the oldest being 74 years and the duration of diabetes mellitus > 5 years being 26 (51.0%). Subjects have risk factors for coronary heart disease (CHD) with type 2 diabetes mellitus.

Based on table 2 of the correlation test, it was found that there was no correlation between HbA1C levels and the degree of stenosis after statistical tests were carried out ($p=0.793$). There was no correlation between triglyceride levels and the degree of stenosis after statistical tests ($p=0.685$). There was a moderate negative correlation between HDL levels and the degree of stenosis after statistical tests were carried out ($p=0.015$; $r=-0.339$).

Table 1. Characteristic Respondent

Characteristic	N (%)	(Min-Max)	Mean±SD
Gender			
Male	40 (78,4%)		
Female	11 (21,6%)		
Age (Years)			
35-45	1 (2,0%)		
46-55	16 (31,4%)	41-74	7.726
56-65	19 (37,3%)		
66-75	15 (29,4%)		
Smoking			
Yes	0 (0%)		
No	51 (100%)		
Dyslipidemia			
Yes	4 (7,8%)		
No	47 (92,2%)		
Hipertensi			
Yes	2 (3,9%)		
No	49 (96,1%)		
Physical Activity			
Yes	51 (100%)		
No	0 (0%)		
Alcohol Consumption			
ya	0 (0%)		
Tidak	51 (100%)		
Smoking			
Ya	0 (0%)		
Tidak	51 (100%)		
Disease Duration		3-9	5.61±1.601
Diabetes mellitus			
< 5	23 (40.4%)		
>5	28 (49.1%)		
Dyslipidemia			
< 5	1 (1.8%)		
>5	3 (5.3%)		
Hipertensi			
<5	0 (0%)		
>5	2 (3.5%)		
HbA1c (%)		4.30-12.20	6.909±1.715
Triglyceride (mg/dL)		34.90-275.0	129.6±55.37
HDL (mg/dL)		16.00-66.50	40.44±11.91
LDL (mg/dL)		41.20-180.0	89.23±30.83
Total Cholesterol (mg/dL)		91.90-238.1	150.7±31.25
Degree of Stenosis (%)		30.0-99.0	67.41±20.58

Table 2. Correlation Test Variable

	Degree of Stenosis	
	p	r
HbA1C	0.793	-0.043
Triglycerides	0.685	-0.058
HDL	0.015*	-0.339

*Significant

DISCUSSION

Based on the characteristics of respondents in this study, male respondents were dominant compared to female respondents. Based on previous study, male patients having higher risk of CHD than women⁸. The majority of respondents were in the 56-65 year age group linier from previous study that higher risk of CHD in line with increasing age⁹. Respondents in this study had a risk factor for CHD, namely diabetes mellitus and hypertension. Respondents who did physical activity were 51 people (100%), physical activity carried out 3-4 times a week would prevent CHD disease and those who did not consume alcohol and did not smoke were 51 people (100%). A long duration of suffering from a history of diabetes mellitus, dyslipidemia and hypertension > 5 years can influence a disease^{10,11}.

Correlation between HbA1c and degree of stenosis

There was no significant correlation between HbA1c and the degree of stenosis. HbA1c levels in this study showed that 35 subjects (68.6%) had HbA1c levels <7 (68.6%) due to regular monitoring of glycemic control. HbA1c examination can have benefits for reducing glycemic levels in diabetes patients so that it can slow down the occurrence of the formation of atherosclerosis¹².

HbA1c levels were within normal limits due to several factors, namely the subject always did physical activity, did not consume alcohol and did not smoke. Apart from that, this study did not group drug consumption with diabetes medication which is an effort to control blood glucose levels to reduce HbA1c levels and can slow down the atherosclerosis process and certain diets such as complex carbohydrates, namely rice, bread, potatoes, cassava and sago. Low-fat proteins include fish, chicken, skim milk, tempeh, tofu and nuts. Fat is in limited quantities in foods that are prepared

by steaming or boiling and grilling. It is very likely that respondent in this study have drug consumption history¹³. However, in this study the degree of stenosis did not decrease. This is because intensive glucose reduction has nothing to do with a significant reduction in cardiovascular risk because each type and different dose of diabetes medication consumed has a different way of working and side effects¹⁴.

Correlation between triglycerides and the degree of stenosis

There is no significant correlation between triglycerides and the degree of stenosis. The triglyceride levels in this study showed that 45 people (88.2%) respondents in this study had triglyceride levels <150 mg/dl. Normal triglyceride levels were caused by several factors, namely the subject always did physical activity, the subject did not consume alcohol and did not smoke. Apart from that, this study did not group the consumption of statin drugs such as (lovastatin, atorvastatin, fluvastatin, pravastatin, simvastatin and rosuvastatin³. Healthy food consumption can be done to control dyslipidemia. Recommended foods include foods containing omega-3 fatty acids, such as avocado, whole wheat, fruits and vegetables that can reduce triglyceride levels¹⁵. The degree of stenosis did not decrease because it was found that it was already in a chronic process so that the degree of stenosis increased so that it could cause blockage or arteriosclerosis and it is possible that the subjects in this study had just been on diet, exercise and taking medication so that the level triglyceride is still within normal limits so it does not reduce the degree of stenosis

There are other factors that can cause the degree of stenosis to continue to increase, one of them was aging. Aging causes changes in the heart and blood vessels that increasing risk of CHD¹⁶. Most of respondents in this study were 56-65 years old which is categorized as elderly. Aging led to several changes in the heart muscle, namely hypertrophy and atrophy in old age which will cause the mortality rate in individuals to increase because the heart experiences physiological changes even without previous disease^{3,17}.

Correlation between HDL and degree of stenosis

There is a significant correlation between HDL and the degree of stenosis, there is a moderate negative correlation¹⁸. A decrease in HDL levels can also trigger the formation of plaque in the blood vessels because

the process of removing LDL cholesterol in the body is hampered, the amount of LDL is uncontrolled and the function of HDL does not work well to clean LDL cholesterol can cause plaque formation in the arteries and inhibit the oxygenation process in the blood. all body organs including the heart and brain, thereby increasing the risk of cardiovascular disease such as CHD¹⁹.

In this study, respondents had exercised, did not consume alcohol and smoke, dieted and also consumed drugs that can reduce the lipid profile so that in this study the triglyceride levels were normal and the HDL levels were low, possibly due to consuming statin drugs and buffered fibrates. reduces triglyceride and LDL levels but only has a small effect on increasing HDL cholesterol by 2-10%²⁰. In this study, normal triglyceride levels were found, low HDL levels <40 in 49 people (96.1%) and high degrees of stenosis in This subject is already in a chronic process so that the degree of stenosis has increased so that it can cause blockage or atherosclerosis and it is possible that the subject in this study has just undergone a process of diet, exercise and consumption of drugs so that it reduces triglyceride and LDL levels but does not increase HDL levels and reduces the degree of stenosis^{21,22}.

CONCLUSION

There is no significant correlation between HbA1c levels and the degree of stenosis in coronary heart patients with type 2 diabetes mellitus. There is no significant correlation between triglyceride levels and the degree of stenosis in coronary heart patients with type 2 diabetes mellitus. There is a moderate negative correlation between HDL levels and the degree of stenosis. in coronary heart disease sufferers with type 2 diabetes mellitus.

LIMITATION

The limitations of this study are that the research design used a cross-sectional study which only examined HbA1c, triglyceride and HDL levels with the degree of stenosis in CHD sufferers and did not look at the type and dose of medication, did not look at blood pressure and certain diets when taking blood from CHD patients. which might give different results.

The authors declare that all the procedures and experiments of this study respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008(5), as well as the national law. Informed consent was obtained from all the patients included in the study.

Conflicts of interest

There are no conflicts of interest regarding this article.

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