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Correlation Between Lipid Profile and Kidney Function in Ambulatory Heart Failure Patient

Sidhi Laksono Purwowiyoto[1,2]*, Hengkie Frankie Lasanudin[1], Budhi Setianto[3], Steven Philip Surya[4], Wincent Candra Diwirya[5]

[1] Departement of Cardiology and Vascular, Pertamina Central Hospital, South Jakarta, Jakarta, Indonesia
[2] Departement of Cardiology and Vascular, Faculty of Medicine, Universitas Muhammadiyah Prof. Dr. Hamka, Tangerang, Indonesia
[3] Departement of Cardiology and Vascular, Faculty of Medicine, Universitas Indonesia, Depok, West Java, Indonesia
[4] Primaya Hospital, Tangerang, Banten, Indonesia
[5] Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Central Java, Indonesia

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*CORRESPONDENCE:
sidhilaksono@uhamka.ac.id

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Abstract: Heart failure contributes to a high number of hospitalizations. Currently, the number of outpatients is more dominant than hospitalized heart failure patients. Unfortunately, a study in the outpatient setting is still limited. This study aims to evaluate the correlation between lipid profile and kidney function in ambulatory heart failure patients. This study is a single-center cross-sectional study. Data were collected from August to September 2020. Data were extracted from 62 medical records of heart failure patients with ejection fraction <45%. Exclusion criteria were life-threatening comorbidity and patient with routine hemodialysis. Data were analyzed with Pearson or Spearman correlation test. Most of the heart failure patients in our outpatient clinic are elderly (>60 years old) and male (58%). The researchers found positive correlation of total cholesterol (r 0.39; p 0.001) and triglyceride (r 0.59; p 0.001) to serum creatinine. On the other hand, LDL and blood cholesterol ratio negatively correlated with serum creatinine, r - 0.31; p 0.016; and r - 0.46; p 0.001; respectively. All of this analysis was statistically significant. It concluded that lipid profiles were correlated with kidney function in heart failure patients.

Keywords: Lipid Profile; Heart Failure; Cardiorenal.

INTRODUCTION

Heart failure is a medical syndrome caused by alteration and structure of the heart, which contributes to less cardiac output and upraised intracardiac pressure at rest or during stress. The clinical syndrome includes orthopnea, lower limb swelling, and objective findings like prominent jugular venous pressure (JVP) and pulmonary congestion.[1] In developed countries, international studies ratify heart failure happen in 1-2% in the adult population, and it would trigger escalation up to a minimum of 10% amongst elderly.[2] In Asia-Pacific Region, including Indonesia, it is suggested a higher hospitalization rate than Western countries.[3,4]

Recent studies showed that hospitalized patients with cardiovascular disease have a greater risk of end-stage kidney disease/ ESKD than patients with no cardiovascular disease.[5] The bidirectional relation between the heart and kidney organ is known as a cardiorenal syndrome; however, it is not completely understood.[6] Long-term mortality outcome also confirms substantial difference of a number of the mortality heart failure patient with kidney dysfunction compared to heart failure patients with normal kidney function (estimated glomerular filtration rate/ eGFR <15; hazard ratio 2.96; 95% confidence interval, 2.53-3.47).[7]

A lipid profile study suggested a positive correlation between high-density lipoprotein (HDL) and eGFR (P<0.05) in hospitalized heart failure patients.[8] However, none of the studies focused on lipid profile and kidney function in outpatient with heart failure. The number of outpatients is more dominant than hospitalized heart failure patients. This study aims to determine the correlation between lipid profile and kidney function in ambulatory heart failure patients.

MATERIALS AND METHOD

This study was a single-center and cross-sectional study from Pertamina Central Hospital, Jakarta. Data were collected from August to September 2020. Data were extracted from 62 medical records of heart failure patients with left ventricular ejection fraction (LEVF) <45% in the outpatient cardiovascular clinic and low-class New York Heart Association (NYHA) class I-II. Class I is defined as no activity limitation, and class II is defined as a small decrease in exercise tolerance. The main exclusion criteria included significant life-threatening comorbidity and underwent routine hemodialysis. Data of total cholesterol, LDL, HDL, triglycerides, and creatinine were extracted from the patient's laboratory examination in the medical record. The study has passed an institutional ethical review.

This study used consecutive sampling. The independent variable included creatinine level, while total cholesterol, HDL, LDL, triglycerides, and blood cholesterol ratio were the dependent variables. The age of respondents was calculated from the year of birth based on the ID Card. Total cholesterol is the result of lipid metabolism through the esterification process by acetyl coenzyme A and acetyltransferase. It was examined from the respondent's venous blood sample using the GHOD-PAP method with a rayto autoanalyzer. Triglycerides are the reesterification result of long-chain fatty acids by acyl-CoA synthetase. It was examined using the GPO-PAP method with a rayto autoanalyzer. HDL is a plasma lipoprotein that consists of 52% protein and 48% fat acts as transport cholesterol from peripheral tissues to the liver. It was examined using the Immunoinhibition method with a rayto autoanalyzer. LDL is a plasma lipoprotein that consists of 22% protein and 48% fat acts as transport fat through the endogenous route. It was calculated directly by using the Friedewaid formula. All lipid profile data were measured in mg/dl. The blood cholesterol ratio was calculated by dividing total cholesterol by HDL level. Creatinine is the final product of muscle metabolism released from the muscles and excreted in the urine, while urea is the final product of a protein that amino acid has been transferred to the liver. Creatinine and urea data were measured in mg/dl.

All data were processed with SPSS for Windows 24th version. Gender is categorical data, presented with frequency and percentage, while age, total cholesterol, LDL, HDL, triglycerides, blood cholesterol ratio, urea, and creatine are numerical data. Numerical data with normal distribution were presented in mean and standard deviation, while non-parametric data were presented in the median. Continuous data with normal homogenous distribution were tested with Pearson for correlation test and spearman for non-parametric data.

RESULTS

Table 1 shows baseline parameters of the participant (age, total cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglyceride, kidney function (creatinine levels), and gender). Most of the heart failure patients in our outpatient clinic are elderly (>60 years old) and male patients (58%). The median urea and creatinine level is still within normal value; 43 mg/dL and 1.1mg/dL, respectively. However, our study's highest value was dramatically high; 157 mg/dL and 7.8mg/dL, respectively. None of the patients has routine hemodialysis. The median value of LDL of our 62 patients was 137.2mg/dL, more than normal value (normal value < 130mg/dL). Unfortunately, the blood cholesterol ratio (total cholesterol/ HDL) was mostly in the high-risk group with a median of 4.7 (high-risk group >4.2) and a maximum ratio value up to 22.08.

Table 1. Value of Age, Gender, Lipid Profile, and Kidney Function

Parameters	Value (Level)
Age (year)	69.1±10.20
Gender	
Male (%)	36 (58)
Female (%)	26 (42)
Lipid Profile	
Total Cholesterol (mg/dL)	192.6±48.27
LDL (mg/dL)	137.26±43.5
HDL (mg/dL)	40, 12 - 96
Triglyceride (mg/dL)	125, 35 - 651
Blood Cholesterol Ratio (Total/HDL)	4.7, 1.96 – 22.08
Kidney Function	
Urea (mg/dL)	43, 15 - 157
Creatinine (mg/dL)	1.1, 0.5 – 7.8

The total cholesterol and triglyceride level had positive correlation with creatinine value, (r 0.399, p < 0.01 and r 0.59, p < 0.01 respectively). On the other hand, HDL had the opposite direction with serum creatinine value (r - 0.31, p 0.016). Surprisingly, the blood cholesterol ratio negatively correlated with a significant p-value with creatinine (r -0.46 and p < 0.01) (Table 2).

Table 2. Correlation between Creatinine Level with Age, Total Cholesterol, HDL, LDL, and Triglyceride

Parameters	Correlation value (r)	*p*-value
Age (year)	0.22	0.077
Total Cholesterol (mg/dL)	0.39	0.001***
HDL (mg/dL)	-0.31	0.016***
LDL (mg/dL)	0.95	0.461
Triglyceride (mg/dL)	0.593	0.001***
Blood Cholesterol Ratio	-0.464	0.001***

Note= *** : correlate significantly

DISCUSSION

Cardiorenal syndrome reveals how close the relation between heart and kidney disease is. A strong link between kidney function and incidence of heart failure has been established by a previous study from The Atherosclerosis Risk in Communication (ARIC). This study also discovered that a significant reduction in kidney function could increase the incidence of heart failure up to three-fold higher than individuals with normal kidney function.[9] Oppositely, heart failure could worsen renal function either.[10,11]

One of the major risk factors of heart failure is age, especially in the aging population (more than 65 years old).[12] In the aging process, the vascular system produces excessive oxidative stress molecules, reduces nitric oxide bioavailability, and increases inflammatory cytokines.[13] Another contribution in aging cardiac cells is fibrosis. Mitochondrial dysfunction and alteration of the cardiac regenerative cell may contribute to heart failure and be decelerated by exercise.[12,14] Furthermore, more than half of the heart failure patients are women. However, the incidence remains high in male than female patients. More excitingly, the de novo incidence of heart failure in women is likely to happen in older age than men.[15] In our study, HDL also has a negatively moderate correlation with serum creatinine. It indicated that increasing HDL levels could preserve kidney function. On the other hand, higher total cholesterol and triglyceride concentration correlates with reduced kidney function.

Furthermore, a study by Duru *et al.* (2009) and Baumgarten & Gehr (2011) used estimated glomerular filtration rate (eGFR) to define kidney function, but eGFR might be less sensitive for detecting alteration of kidney function and more suitable for classifying the severity level.[16,17] In this study, the researchers used serum creatinine as screening tools to detect renal insufficiency rather than eGFR. A study form large registry concluded that HDL correlated with eGFR (17 mg of HDL was related to an 0.8% higher eGFR with 95% CI, 0.4-1.3%, p-value < 0.001) and, in the same time, it lowered risk for eGFR <60ml/min/1.73m^2 (OR 0.85; 95% CI, 0.77-0.93; p <0.001).[18] Another study with more hospitalized heart failure patients demonstrated HDL had a positive correlation with better kidney function, and LDL negatively correlated with kidney function.[8]

Nontraditional risk factors (such as inflammation, etc.) and traditional risk factors (hypertension, hypercholesterolemia, and diabetes mellitus) have a pivotal role in renal dysfunction and cardiovascular diseases.[19] However, the "reverse epidemiology phenomenon" is common in kidney disease patients with routine hemodialysis treatment. In this study, the researchers found that high total cholesterol correlated with kidney function significantly. In an epidemiological study, HDL has a vital role in reverse cholesterol transport inversely correlated with atherogenic triglycerides.[20] However, the result of this study concerning blood cholesterol ratio was conflicting with the previous study. The blood cholesterol ratio inversely correlates with serum creatinine.[21] Unfortunately, study about blood cholesterol ratio and kidney function is still limited.

CONCLUSION

There was a correlation between lipid profile and kidney function in ambulatory heart failure patients. The researchers emphasize conducting a further study about kidney function and lipid profile in outpatient heart failure clinics.

CONFLICT OF INTEREST

The authors declare that no conflict of interest.

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