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The Relationship between LDL/ HDL Ratio and Coronary Lesion Severity Measured by Syntax Score in Patients with Non-Elevation Acute Myocardial Infarction at Hajj Adam Malik General Hospital, Medan

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ABSTRACT

Introduction: Coronary artery disease (CAD), results from reduced myocardial perfusion leading to angina, myocardial infarction (MI), and/or heart failure. It accounts for one third to one half of cardiovascular cases. A higher SYNTAX score indicates a more complex condition and poorer prognosis in patients undergoing coronary revascularization especially with PCI. This study aims to determine how the LDL/HDL ratio relates to the complexity of coronary lesions (Syntax Score) in coronary heart disease based on characteristics.

Methods: The type of this study was observational analytic retrospective with a cross sectional design. The study was conducted using secondary data through medical record data of patients diagnosed with NSTEMI.

Results: The subjects were 60 people with an average age of 58,1±8,629. It was found that the mean value of the LDL/HDL ratio was 3,95±3,837, in patients with an LDL/HDL ratio ≥ 2.517 it was found that there were 40 sample(66.7%) of whom had a lesion severity level of Syntax score ≥23 ,27 samples (45%), and in patients with an LDL/HDL ratio < 2.517, 20 samples (33.3%) were found to have a lesion severity level of Syntax score ≥ 23 with 4 samples (6.7%).

Conclusion: There is a relationship between the LDL/HDL ratio and the severity of CAD based on the Syntax score with LDL/HDL ratio values being higher in patients with moderate-severe CAD than in patients with mild CAD.

Keywords

Myocardial infarction, LDL/HDL ratio, SYNTAX score, CAD

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INTRODUCTION

Cardiovascular disease is the number one cause of death in the world.[1] Data from the Global Burden of Cardiovascular Disease and Risk Collaboration released in December 2022 revealed that Coronary Artery Disease (CAD) is the leading cause of death from cardiovascular causes, namely 9.44 million people in 2021 and a disability rate of 185 million people.[2] Indonesia's own data is quite in line with the prevalence in the global population, namely the ratio of deaths from CAD is almost close to 150 per 100,000 population.[2] Riskesdas data in 2018 shows the prevalence of people with CAD in North Sumatra is around 1.3% of the total population.[3] Coronary heart disease has a high prevalence and incidence, and is associated with one of the highest mortality rates in the world. CAD is an atherosclerotic disease, which is inflammatory in nature, manifesting as stable angina, unstable angina, myocardial infarction, or sudden cardiac death. Serum lipid profile is a major risk factor and predictor of CAD and cardiovascular disease (CVD). Dyslipidemia refers to abnormal levels of serum lipids. (triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), low-

density lipoprotein cholesterol (LDL-C), and total cholesterol (TC). Clinical trials to date report high LDL-C, TG, TC and low HDL-C are associated with CVD.[4]

Patients having a heart attack if the coronary arteries are involved, that part of the heart muscle may die and the situation becomes life-threatening. So immediate medical attention is required. The prognosis of the disease depends on many factors, some of which are modifiable while others are not. The patient's age, gender, family history and genetics, ethnicity, dietary and smoking habits, medication compliance, healthcare availability and economic status, and the number of arteries involved are some of the factors. Comorbid conditions including diabetes mellitus, hypertension, dyslipidemia, and chronic kidney disease also have a role in the overall outcome.[5] One of the most important scoring systems that has been designed to date is the SYNTAX score. The SYNTAX score is a tool to help cardiologists, interventionists and surgeons to assess the complexity of coronary artery lesions. A higher SYNTAX score indicates a more complex condition as well as a worse prognosis in patients undergoing coronary revascularization especially with PCI.[6]

Sun et al's study showed an increase in LDL HDL ratio >2.517 led to an increase in the degree of coronary artery stenosis and increased the severity of coronary lesions.[7] Zhang's study revealed a high LDL/HDL ratio was an independent factor for AMI significantly when LDL/HDL >2.595.[8] Therefore, the author would like to examine how the LDL/HDL ratio relates to coronary lesion complexity assessed by Syntax Score.

METHODS

The type of research used in this study was a retrospective design. The study was conducted using secondary data through medical record data of patients diagnosed with NSTEMI. This study was conducted at the Integrated Heart Center of Haji Adam Malik Medan from the period of February 2022 to sample February 2023 The research sample was all patients diagnosed with NSTEMI at the Integrated Heart Center of Haji Adam Malik General Hospital from the period of May 2022 to the sample met with inclusion criteria such as: patients diagnosed with NSTEMI and willing to undergo coronary angiography procedures during treatment at H. Adam Malik General Hospital. The exclusion criteria for this study were patients who were not willing to undergo the study, patients with a history of previous heart attack and underwent Percutaneous Coronary Intervention, patients who had undergone Coronary Artery Bypass Surgery (CABS), patients with malignancy, hepatic disease, with blood disorders and infection (sepsis), patients with kidney function abnormalities and patients with incomplete medical data.

Before starting data collection, this research proposal will be submitted to the Ethics Committee of the Faculty of Medicine, University of North Sumatra. After being declared ethical, a license will be submitted to the Research and Development Agency of the Haji Adam Malik Central General Hospital Medan.Data collection was carried out using secondary data, namely all patient medical record files diagnosed with NON-ST Elevation acute myocardial infarction patients obtained from records in the medical records section. The medical records listed the variables to be studied in accordance with the specific objectives of this study. Medical records were collected and recorded and tabulated with the types of variables to be studied. Data from the results of laboratory examinations and medical records obtained will then be assessed for validity based on the inclusion and exclusion criteria of the study. The data will then be categorized according to the predetermined categories.

For serum preparation, blood specimens must be centrifuged at a temperature of no more than 20ºC at a minimum of 1500 rpm for 10 minutes. Whole blood samples should not be frozen during processing. For plasma preparation, after thorough mixing of the blood sample with EDTA, the blood sample should be refrigerated. Within 3 hours (and preferably within 1 hour), the tubes should be centrifuged at 4ºC in a refrigerated centrifuge at 1500 rpm for 30 minutes. If a refrigerated centrifuge is not available within 3 hours of collection, samples may be centrifuged at room temperature within 1 hour of collection, and plasma stored at 4ºC.

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RESULTS

Table 1 Characteristics of Research Subjects

Parameter	SYNTAX Score (n=60)		Total	P value
	≥23 (n=31)	<23 (n=29)		
Age, year	59.78±1.352	54.20±0.832	58.1±8.629	0.027
Gender (%)				0.311
Male	21 (35)	23 (38.3)	44 (73.3)	
Female	10 (16.7)	6 (10)	16 (26.7)	
DM				0.040
Yes	21 (35)	12 (20)	33 (55)	
No	10 (16.7)	17 (28,3)	27 (45)	
Smoking				0.297
Yes	14 (23.3)	17 (28,3)	31 (51,7)	
No	17 (28.3)	12 (20)	29 (48)	
Hb	13.06±2.275	13.196±1.9	13.126±2.088	0.803
Leukocyte	9210 (5940-18720)	10150 (5150-21770)	9885 (5150-21770)	0.501
Trombocyte	266548.39±69903.66	252655.17±54554.21	259833.33±62818.05	0.393
Ureum	26 (9-195)	32 (12-158)	28 (9-195)	0.560
Creatinine	0.9 (0.5-4.23)	0.9 (0.55-6.22)	0.9 (0.5-6.22)	0.700
Natrium	134.68±6.199	135.14±4.65	134.9±5.464	0.745
Potassium	4.012±0.596	3.962±0.575	3.988±0.582	0.738
Klorida	103 (89-110)	105 (94-110)	103 (89-110)	0.122
Fasting Glucose	135 (70-415)	108 (58-216)	119.5 (58-415)	0.005
Ad Random Glucose	156 (53-375)	113 (75-463)	137 (53-463)	0.085
2hPP Glucose	187 (99-339)	157 (78-347)	156.5 (77-473)	0.206
HbA1C	7.3 (5.4-10.7)	6.3 (5.3-10)	7 (5.3-10.7)	0.009
HDL	35.1±11.356	36.1±8.837	35.58±10.144	0.702
LDL	132.39±29.127	100.97±33.250	117.2±34.739	<0.001
Trigliceride	159 (78-262)	122 (75-259)	147 (75-262)	0.085
Total Cholestrol	184 (124-328)	164 (86-268)	169,5 (86-328)	0.178
Troponin I	4.15 (0.7-15)	2.59 (0.19-15)	2.8 (0.07-15)	0.407
GRACE Score	110.71±28.4	100.1±24.3	105.58±26.819	0.125
SYNTAX score	29.774±4.76	15.70±6.966	22.975±9.21	
LDL/HDL ratio	4.95±5.07	2.88±1.08	3.95±3.837	0.034

Table 2 Analysis of LDL/HDL ratio on coronary lesion severity

LDL/HDL ratio	SYNTAX Score		Total	P value	Sensitivity	Specificity
	≥23 (n=31)	<23 (n=29)				
≥ 2.517	27 (45%)	13 (21.7%)	40 (66.7%)	0.01	87.1%	55.2%
< 2.517	4 (6.7%)	16 (26.7%)	20 (33.3%)			

This study analyzed the LDL/HDL ratio on the severity of coronary lesions based on the SYNTAX score. The LDL/HDL ratio was divided into two groups with a cut-off value of 2.517. The group with SYNTAX score ≥23 was dominated by subjects with LDL/HDL ratio ≥ 2.517 as many as 27 people (45%). Based on statistical analysis, there was a significant relationship between the LDL/HDL ratio and the severity

of coronary lesions based on the SYNTAX score with a p value of 0.01. At a cut-off value of 2.517, a sensitivity of 87.1% and specificity of 55.2% were obtained.

Multivariate analysis used to determine which factors were predictors of coronary lesion severity in IMA-NEST patients is presented in table 3. The assessed factors of age, diabetes mellitus, Apo B, LDL, HbA1C, GDP, and LDL/HDL ratio were included in the logistic regression analysis of coronary lesion severity assessed by SYNTAX score. The analysis showed that LDL/HDL ratio was a statistically significant predictor of coronary lesion severity in IMA-NEST.

Table 3 Multivariate analysis of risk factors for coronary lesion severity in patients with IMA-NEST

Variable	Coefisien	p Value	OR	CI 95% (min-max)	
Age	-0,099	0,029	0,905	0,828	0,990
Fasting glucose	-0,011	0,109	0,989	0,975	1,003
LDL/HDL ratio	2,778	0,001	16,082	2,974	86,982
Constant	8,819				

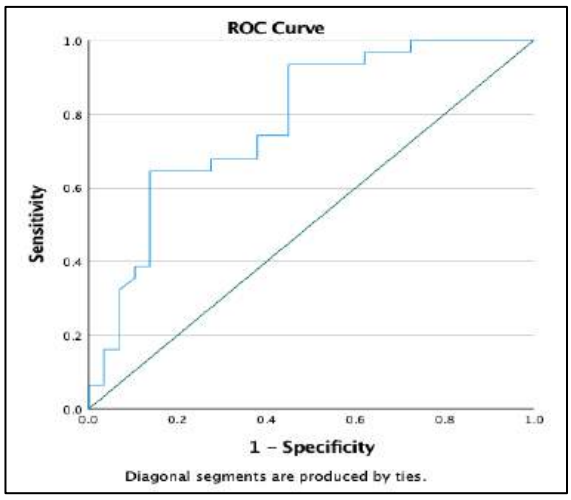

Figure 1. ROC curve of LDL/HDL ratio versus lesion severity

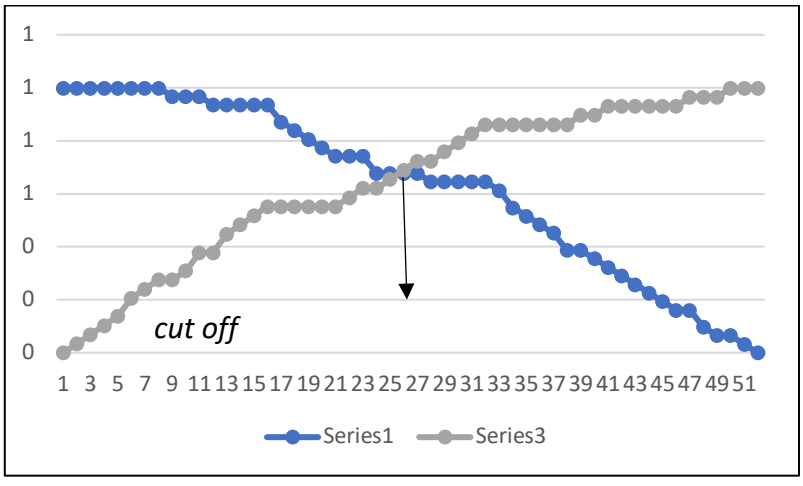

Figure 2 Graph of LDL/HDL ratio cut off in predicting coronary lesion severity

To determine the LDL/HDL ratio that can predict the severity of coronary lesions in patients with IMA-NEST, ROC analysis was performed, presented in Figure 1. The LDL/HDL ratio has a good relationship strength with an AUC of 0.780 and a statistically significant p value <0.001. LDL/HDL ratio has a sensitivity of 67.7% and a specificity of 69%.

Visualization to determine the optimal cut off point of LDL/HDL ratio against coronary lesion severity in patients with IMA-NEST is presented in Figure.2. The cut off point of LDL/HDL ratio to coronary lesion severity was obtained at 3.397. If a patient has an LDL/HDL ratio value of more than 3.397 then it is likely that the patient has more severe coronary lesions.

DISCUSSION

This study analyzed the relationship between LDL/HDL ratio and coronary lesion severity based on SYNTAX score. There was a higher mean LDL/HDL ratio in the SYNTAX score ⩾23 group (4.95 ± 5.07 vs 2.88 ± 1.08). With an LDL/HDL ratio cut-off value of 2.517, 45% of subjects with an LDL/HDL ratio ⩾ 2.517 had more severe coronary lesions. The results of this study showed a significant association between LDL/HDL ratio and coronary lesion severity (p=0.01). The study by Xu et al, mentioned that the group with LDL-C/HDL ratio >2.4 had a significantly higher mean SYNTAX score (13.81±8.87 vs 11.70±8.05, p<0.001). On correlation analysis, there was a significant positive correlation between LDL-C/HDL-C ratio and SYNTAX score, number of coronary artery lesions and number of target lesions (p<0.05). Zhang et al reported that the group with high LDL-C/HDL-C ratio (⩾2.33) had a significantly higher mean SYNTAX score compared to the low LDL-C/HDL-C ratio group (16±10 vs 12,97±9,22, p<0.001).[9,10]

Similar results were found in a study by Sun et al, in 1351 patients with myocardial ischemia, a higher LDL/HDL ratio was found in patients with coronary heart disease compared to controls (2.94±1.06 vs 2.36±0.78, p<0.05). LDL/HDL was significantly associated with the severity of coronary artery stenosis. The LDL/HDL ratio increased with increasing coronary artery stenosis and increasing Gensini score (p<0.01).[11] Huang et al reported the LDL-C/HDL-C ratio was positively correlated with the severity of coronary lesions based on the Gensini score (r=0.148, p=0.01).[12] Another study in the IMA-EST population found the LDL/HDL ratio had a significant correlation with the Gensini score.[7] The results of this study showed that the LDL/HDL ratio was a predictor of coronary lesion severity (p: 0.001; OR: 16.082 95%CI: 2.974-86.982). In bivariate analysis, LDL had a significant relationship with coronary lesion severity, but not in multivariate analysis. Meanwhile, LDL/HDL ratio was significantly associated with coronary lesion severity in both analyses. Therefore, LDL/HDL ratio was a better predictor of coronary lesion severity than LDL alone. Similar results were also found in a previous study. LDL/HDL combination was better than LDL or HDL alone in predicting the severity of coronary atherosclerotic lesions as an independent risk factor of coronary heart disease (p<0.001; OR: 0.473 95%CI 0.399-0.561).[11] Gao et al also revealed that LDL/HDL ratio had the best correlation with Gensini score after applying multiple linear regression analysis ($R2 = 0.423$, $\beta = 0.518$, $p < 0.05$).[13]

Based on ROC curve analysis, the LDL/HDL ratio values with sensitivity and specificity were 67.7% and 69%. The LDL/HDL ratio also showed a good ability to predict the severity of coronary lesions with an AUC value of 0.780 and $p < 0.001$. The cut-off value of LDL/HDL ratio was 2.517 with a sensitivity of 64.5% and specificity of 61.3% in predicting coronary artery disease. In another study, it was reported that LDL-C/HDL-C ratio can predict whether patients with chest pain have IMA-EST (AUC: 0.880, 95%CI: 0.847-0.912, p<0.05). At a cut-off of 2.15, the LDL-C/HDL-C ratio has a sensitivity of 84.5% and specificity of 20.2% in predicting patients with chest pain experiencing IMA-EST.7 According to Lippi et al, the LDL/HDL-C ratio is the most sensitive parameter in describing the severity of coronary artery disease with a predictive value of 83.3%, sensitivity of 77.7% and specificity of 76.6% (cut-off: 3.20).[14]

The results of a study by Chen et al reported that the LDL-C/HDL-C ratio value of 2.5 is the optimal cut-off value in men and women in estimating cardiovascular disease risk factors.[15] According to Katakami et al, the LDL/HDL-C ratio showed a linear and posited relationship with the prevalence of carotid plaque (OR: 1.54, p<0.001). LDL-C/HDL-C ratio is also a useful parameter in assessing the risk of early-stage atherosclerosis in patients with type 2 diabetes.[16] A retrospective study conducted by Zhang et al reported patients with higher LDL-C/HDL-C ratio (⩾2.33) had a significantly higher incidence of major cardiovascular events (HR: 1.47. 95%CI 1.25-1.72, p<0.001).[17] Similar results were also reported by Xu et al, during the

2-year follow-up period, the incidence of major cardiovascular events was significantly higher in the high LDL-C/HDL-C group compared to the low LDL-C/HDL-C group (9.1% vs 6.9%, p=0.011).[18] The results of another study stated that an increase in the LDL/HDL ratio was an independent risk factor for long-term coronary revascularization in IMA-EST patients undergoing percutaneous coronary intervention procedures. The risk of coronary revascularization was significantly increased in patients with LDL/HDL ratio >2.595.[8]

CONCLUSION

LDL/HDL ratio was significantly associated with coronary lesion severity based on SYNTAX score with a statistically significant value of p<0.001. The LDL/HDL ratio had a sensitivity of 67.7% and a specificity of 69%.

DECLARATIONS

The research has received approval from Faculty of Medicine, Universitas Sumatera Utara of Research and Ethics Committee. Participants were informed about this report.

CONSENT FOR PUBLICATION

The Authors agree to publication in Journal of Society Medicine.

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