

Comparison of the monocyte-to-HDL cholesterol ratio between patients with STEMI and NSTEMI: A retrospective observational study

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Abstract

Introduction: This study sought to compare patients with ST-segment elevation myocardial infarction and non-ST-segment elevation myocardial infarction in terms of the monocyte-to-HDL cholesterol ratio.

Material and methods: A total of 79 patients with non-ST-segment elevation myocardial infarction and 30 patients with ST-segment elevation myocardial infarction were included in the study. Demographics, comorbidities, smoking status, medical history, and initial laboratory findings were retrospectively noted from the hospital computer-based patient data system.

Results: Significant differences were detected between the ST-segment elevation myocardial infarction and non-ST-segment elevation myocardial infarction groups in relation to the neutrophil count [7.27 (6.05-9.05) versus 5.41 (4.26-7.21), $p < 0.001$] and mean platelet volume [9.4 (8.8-10) versus 8.6 (7.3-9.5), $p = 0.002$]. There was no statistically significant difference between the two groups in the term of the monocyte-to-HDL cholesterol ratio [0.016 (0.012-0.021) versus 0.016 (0.011-0.024), $p = 0.757$, Bonferroni-corrected p value: 0.0033].

Conclusion: Based on the results of our study, the monocyte-to-HDL cholesterol ratio did not significantly differ between the patients with ST-segment elevation myocardial infarction and those with non-ST-segment elevation myocardial infarction.

Key words: atherosclerosis, coronary artery disease, high-density lipoprotein cholesterol, monocyte count

Introduction

Across the world, acute coronary syndrome (ACS) is one of the most important causes of mortality and morbidity [1]. It is a clinical syndrome that includes unstable angina pectoris (USAP), ST-segment elevation myocardial infarction (STEMI), and non-ST-segment elevation myocardial infarction (NSTEMI) [1]. Along with the developing technologies in diagnostic and treatment modalities and the increase in survival in patients with acute coronary syndrome, the importance of the early diagnosis of diseases and modification of risk factors has increased [2]. Researchers have studied many biochemical markers, such as hematological

parameters, D-lactate, intestinal fatty acid-binding protein, and ischemia-modified albumin and scoring systems, including GRACE, SYNTAX, and Gensini scores in the diagnosis and risk scoring of patients [1-5]. Moreover, emerging biochemical markers provide better complementary information in risk assessment, although there is still a need to better recognize the pathophysiology of ACS and develop a specific treatment [6]. Recently, researchers have reported that the combination of monocyte count, which represents the pro-inflammatory effect of the monocytes, and high-density lipoprotein (HDL) cholesterol, which represents antioxidant and anti-inflammatory effects, can be used as a biomarker in

ACS [7-11]. According to the literature, the value obtained by dividing the monocyte count by HDL cholesterol will have an increased predictive ability in patients with ACS [12].

When a thrombus that develops due to the rupture of a plaque causes total occlusion in the coronary artery, ST elevations are observed in the electrocardiogram, and all or almost all the affected ventricular wall remains within the necrosis area. This condition is referred to as transmural myocardial infarction or STEMI. In cases where the thrombus is less occlusive or there is less fibrin structure in the thrombus and platelets predominate, clinical USAP or NSTEMI develops [3,4,6]. Based on these different pathogeneses, we speculated that the monocyte-to-HDL cholesterol ratio (MHR) might differ between STEMI and NSTEMI cases. Therefore, in this study, we sought to compare patients with STEMI and NSTEMI in terms of MHR.

Material and methods

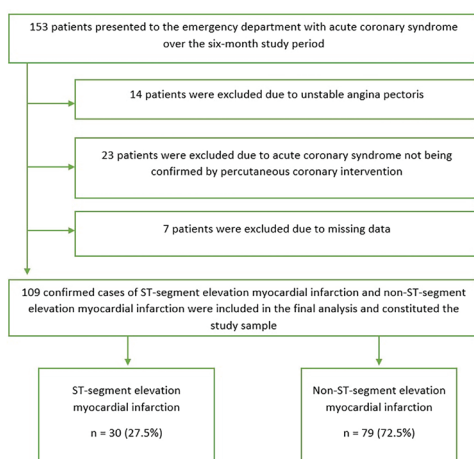
Study design

This retrospective cohort study was conducted at a 695-bed tertiary teaching hospital with 1,050 patient admissions per day (annual average) to the emergency department (ED). The data of the patients who presented to our ED between November 1, 2018 and May 1, 2019 were retrospectively collected.

Study population

The study population consisted of patients presenting to our ED between April 1, 2020 and May 1, 2020 with ACS. Patients with USAP, cases in which ACS could not be confirmed with percutaneous coronary intervention, and patients with missing data were excluded from the sample. The flowchart of the study is shown in Figure 1. All the patients were admitted to the wards of our hospital.

Figure 1 - Flowchart of the study



Data collection

Demographics, clinical characteristics (included comorbidities, smoking status, and medical history), and initial laboratory findings were obtained from the computer-based patient data system of the hospital and analyzed by the researchers. Comorbidities were recorded as chronic obstructive pulmonary diseases, hyperlipidemia, coronary artery disease, diabetes mellitus, hypertension, and congestive heart failure. Family history of coronary artery disease was noted. The documented laboratory parameters were total cholesterol, triglycerides, HDL cholesterol, low-density lipoprotein (LDL) cholesterol, monocyte count, monocyte %, white blood cell count, neutrophil count, lymphocyte count, platelet count, red

blood cell distribution width, and mean platelet volume. The neutrophil-to-lymphocyte ratio, mean platelet volume-to-platelet ratio, and MHR were calculated by the researchers (S. Ö., A. A.). MHR was calculated by dividing the monocyte count by the HDL cholesterol value. The patients were categorized into the STEMI and NSTEMI groups based on their electrocardiogram findings according to the guidelines of the American Heart Association.

HDL cholesterol was measured using the ARCHITECT ci16200 autoanalyzer with the ARCHITECT HDL Kit (Catalog number 3K33-21). Hematological parameters were analyzed with a hemogram device (Beckman Coulter Co.®LH 780 Analyzer, Krefeld, Germany).

Statistical analysis

We used IBM SPSS Statistics for Mac (NY, IBM Corp, version 27.0.) Armonk to perform statistical analyses. To evaluate the conformance of variables to the normal distribution, the Kolmogorov-Smirnov test was conducted. The data that were normally distributed were presented with mean and standard deviation values, and the remaining data were expressed as median and 25th-75th percentile values. Categorical data were presented with the number of cases and percentages. For the comparison of qualitative and quantitative data between the two groups, the chi-square and Mann-Whitney U tests were used. A p value of 0.05 was considered as the cut-off value of statistical significance. To respond to the problem of multiple comparisons, the Bonferroni correction was used.

Ethics

Ethical approval was received from the local ethical committee. We retrospectively reviewed secondary data recorded from the computer-based patient data system of the hospital. The recorded information did not include any personal identifiable information, and it only contained clinical information. Therefore, informed consent was waived.

Results

Patient characteristics

Of the 109 patients included in the study for the final analysis, 72 (61.1%) were male. The median of age of the 109 patients was 59 (25th-75th percentile: 50-73) years. Ten (9.2%) patients had chronic obstructive pulmonary disease, 43 (39.4%) had hypertension, 43 (39.4%) had diabetes mellitus, 17 (15.6%) had coronary artery disease, and 10 (9.2%) had hyperlipidemia. Fifteen (13.8%) patients had a history of smoking and 19 (17.4%) had a family history of coronary artery disease. The comparisons of the characteristics between the STEMI and NSTEMI groups are shown in Table 1.

Laboratory values and outcomes

When the laboratory parameters were analyzed, the median (25th-75th percentile) values were 197 (158-223) mg/dL for total cholesterol, 144 (101-195) mg/dL for triglycerides, 36 (32-42) mg/dL for HDL cholesterol, 131 (98-150) mg/dL for LDL cholesterol, 0.61 (0.46-0.88) for the monocyte count, 6 (4.9-8) for monocyte %, 10.14 (8.36-12.23) for the white blood cell count, 5.92 (4.63-7.92) for neutrophil count, 2.48 (1.88-3.65) for the lymphocyte count, 253 (220-299) for the platelet count, 13.1 (12.4-13.9) for red blood cell distribution width, and 8.8 (8.2-9.7) for the mean platelet volume. The median (25th-75th percentile) values calculated for the neutrophil-to-lymphocyte ratio, mean platelet volume-to-platelet ratio,

Table 1 Comparison of the characteristics between the STEMI and NSTEMI groups.

Variables	STEMI n = 30 (27.5%)	NSTEMI n = 79 (72.5%)	p values
Age, years Median (25th-75th percentile)	60 (48-69)	59 (50-74)	0.618
Gender			0.149
Male	23 (76.7%)	49 (62%)	
Female	7 (23.3%)	30 (38%)	
Comorbidities			
Chronic obstructive pulmonary diseases	4(13.3%)	6 (7.6%)	0.458
Hypertension	10 (33.3%)	33 (41.8%)	0.421
Diabetes mellitus	9 (30%)	34 (43%)	0.214
Coronary artery disease	6 (20%)	11 (13.9%)	0.555
Hyperlipidemia	2 (6.7%)	8 (10.1%)	0.724
Smoking	6 (20%)	9 (11.4%)	0.349
Family history of coronary artery disease	3 (10%)	16 (20.3%)	0.208

STEMI, ST-segment elevation myocardial infarction; NSTEMI, non-ST-segment elevation myocardial infarction

Table 2 Comparison of the laboratory parameters between the STEMI and NSTEMI groups STEMI, ST-segment elevation myocardial infarction; NSTEMI, non-ST-segment elevation myocardial infarction; HDL, high-density lipoprotein; LDL, low-density lipoprotein. Bonferroni-corrected p value: 0.0033

Variables	STEMI Median (25th-75th percentile)	NSTEMI Median (25th-75th percentile)	p values
Total cholesterol, mg/dL	219 (208-240)	186 (144-218)	0.007
Triglycerides, mg/dL	171 (111-215)	141 (91-194)	0.136
HDL cholesterol, mg/dL	36 (30-40)	36 (32-43)	0.783
LDL cholesterol, mg/dL	146 (121-159)	126 (84-145)	0.004
Monocyte count	0.60 (0.47-0.82)	0.63 (0.45-0.90)	0.962
Monocyte%	5.2 (4.5-7.4)	6.5 (5.4-8.6)	0.012
White blood cell count	11.25 (9.46-13.44)	9.70 (7.75-11.99)	0.010
Neutrophil count	7.27 (6.05-9.05)	5.41 (4.26-7.21)	<0.001
Lymphocyte count	2.16 (1.67-5.59)	2.57 (1.90-3.48)	0.924
Platelet count	259 (220-304)	253 (219-296)	0.500
Red blood cell distribution width	13.4 (12.9- 14)	12.9 (12.1-13.9)	0.077
Mean platelet volume	9.4 (8.8-10)	8.6 (7.3-9.5)	0.002
Neutrophil-to-lymphocyte ratio	3.60 (1.41-5.16)	2.15 (1.49-3.16)	0.143
Mean platelet volume-to-platelet ratio	0.035 (0.029-0.043)	0.035 (0.028-0.041)	0.515
Monocyte-to-HDL cholesterol ratio	0.016 (0.012-0.021)	0.016 (0.011-0.024)	0.757

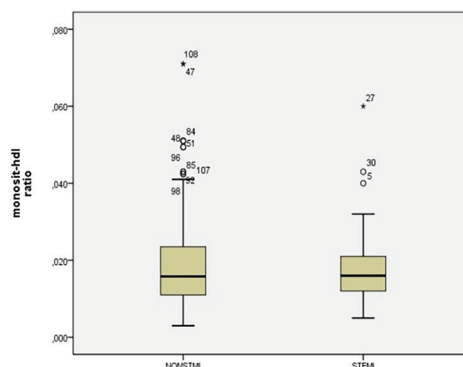
Discussion

In this study, we compared the MHR values between the patients with STEMI and those with NSTEMI and found no statistically significant difference. To the best of our knowledge, this is the first study to determine that there is no significant difference between the STEMI and NSTEMI groups in terms of MHR.

Oxidative stress and inflammation are two central factors that play a role in the progression and development of the atherosclerotic process [8]. Macrophages changes from circulating monocytes during the inflammation stage, and

and MHR were 2.22 (1.47-4.14), 0.035 (0.029-0.042), and 0.016 (0.011-0.022), respectively. The comparisons of the laboratory parameters between the STEMI and NSTEMI groups are shown in Table 2, and the comparison of the MHR between the two groups is presented in Figure 2. Significant differences were detected between the STEMI and NSTEMI groups in relation to the neutrophil count [7.27 (6.05-9.05) versus 5.41 (4.26-7.21), $p < 0.001$] and mean platelet volume [9.4 (8.8-10) versus 8.6 (7.3-9.5), $p = 0.002$]. However, there was no statistically significant difference between the two groups in the term of MHR [0.016 (0.012-0.021) versus 0.016 (0.011-0.024), $p = 0.757$].

Figure 2 - Comparisons of MHR of the enrolled patients between the STEMI and NSTEMI groups



they are one of the main cell types for atherosclerotic plaque formation. Monocyte activation is a critical step in the triggering of atherosclerosis [12,13]. During the atherosclerotic process, monocytes in blood are recruited into the intima and turn into foam cells, taking up oxidized LDL cholesterol and other lipids [12,13]. Thus, tissue macrophages and increased monocytes as a source of circulating foam cells play a decisive role in the development of a new atherosclerotic process [12]. In previous studies, it has been reported that a high monocyte count is a factor in the development of atherosclerotic diseases, such as coronary artery disease [8,14].

HDL cholesterol is a lipoprotein that plays an important role in reverse cholesterol transport. It transfers cholesterol back to the liver from peripheral tissue [15]. This is the main mechanism through which HDL cholesterol shows antioxidant, anti-inflammatory and antithrombotic effects [15]. HDL cholesterol has been shown to protect the endothelium against the harmful effects of LDL cholesterol and prevent the oxidation of LDL cholesterol [16]. In addition, HDL cholesterol is a highly active molecule in preventing monocyte recruitment into the arterial wall and inhibiting the endothelial release of adhesion molecules (17). Previous studies have detected that a low HDL cholesterol level increases the risk of coronary artery disease and is associated with the severity of myocardial infarction [17-19].

In light of all these data, an increase in MHR, calculated by the ratio of monocytes with antioxidant, anti-inflammatory and antithrombotic effects and HDL cholesterol with anti-inflammatory effects, is associated with an increase in inflammation and acceleration in the atherosclerotic process [7-11,18]. In a study conducted with more than 2,500 patients, Çetin et al. reported that MHR could be a predictor of the severity of coronary artery disease and future major adverse cardiovascular events in patients with ACS [7]. Canpolat et al. showed that high MHR values were associated with inflammation and a slow coronary flow [8]. In a study evaluating patients with chronic kidney disease, Kanbay et al. demonstrated MHR to be an independent predictor of major cardiovascular events [9]. In a study on patients with STEMI who underwent percutaneous coronary intervention, Arısoy et al. reported that MHR was an independent predictor of a high thrombus burden in STEMI [10]. In another study including over 750 patients with STEMI who underwent percutaneous coronary intervention, Kızıltunç et al. showed a correlation between the increased coronary atherosclerotic burden and MHR [11]. In light of this information in the literature, we sought to determine whether there was a

difference in MHR between patients with STEMI and those with NSTEMI patients. According to our results, MHR did not significantly differ between these two patient groups.

Limitations

The main limitation of our study was its retrospective nature. There may have been other risk factors that could not be measured due to the retrospective design. Retrospective studies cannot determine causation; they only evaluate association. Secondly, there was no control group in our study. Therefore, we were not able to reveal the relationship between increased MHR and myocardial infarction as in previous studies. On the other hand, our groups were similar to evaluate differences in MHR between the patients with STEMI and NSTEMI, which was the primary outcome of our study. Lastly, our study had a single-center design, and therefore the results cannot be generalized to other healthcare institutions.

Conclusion

Based on the results of our study, there was no significant difference between the patients with STEMI and those with NSTEMI in terms of MHR. Therefore, it can be concluded that MHR is of similar importance for these two patient groups. We recommend multicenter studies in larger populations to increase the generalizability of the results and to confirm our findings.

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