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| RESEARCH ARTICLE

Lipid Fractions and Severity of Coronary Artery Lesions in Acute Myocardial Infarction: A Retrospective Single-Center Study

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| ABSTRACT
The relationship between different lipid fractions and the occurrence of atherosclerotic coronary artery disease(CAD) is a well-known fact. However, knowledge of the association of different lipid fractions and the severity and extension of coronary lesions has been rarely reported in clinical studies and is often contradictory. This study aimed to evaluate the association between different lipid fractions and the severity and extent of the coronary atherosclerotic lesion in patients with ST elevated acute myocardial infarction (STEMI). We analyzed data from 50 consecutive patients with STEMI who underwent coronary angiography during hospitalization at the Clinical Hospital in Tetovo. The severity and extent of CAD were defined using the Syntax score (SXscore) algorithm stratified according to tertiles. Laboratory analysis for lipid fractions was performed. It was noticed a statistically significant association between SXscore tertiles and the mean of total cholesterol (TC) to high-density lipoprotein cholesterol (HDL) ratio (TC/HDL), (p=0.008). Correlation test showed week but significant positive correlation between SXscore tertiles and TC/HDL ratio (r=0.339, p=0.016) and Non-HDL (r=0.309, p=0.034). In regression analysis, reduced HDL and increased TC values statistically significantly predicted SXscore (p<0.05). Among all lipid variables examined, the TC/HDL ratio appeared as the most powerful indicator of severity and extension of the coronary lesion in patients with STEMI. The TC/HDL ratio should be used as an easy, non-invasive, and inexpensive method to measure the severity of CAD to determine the diagnosis strategy and treatment of patients with atherosclerotic coronary diseases at risk of acute infarction.

| KEYWORDS

Lipid variable, Syntax score, Acute myocardial infarction.

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1. Introduction

The relationship between different lipid fractions and atherosclerotic coronary artery disease is a well-known fact [Choy, 2014; Lewington et al., 2017; Zhao, 2021]. Low-density lipoproteins (LDL) are the main carriers of plasma cholesterol, and their increase in concentration is directly associated with the development of coronary artery disease [Ference et al., 2017]. High density lipoproteins (HDL) particles exert antiatherogenic features [Rye, 2009]. Observational studies have consistently shown an inverse association between plasma HDL levels and the risk of atherosclerotic cardiovascular diseases [Wilson, 1988]. Also, in terms of triglycerides, it has been ascertained association between hypertriglyceridemia and the risk of atherosclerotic cardiovascular diseases [Sarwar, 2007]. Although the relationship between lipoprotein fractions and the occurrence of atherosclerotic coronary artery disease is known, knowledge of the association of different lipoprotein profiles and the severity and extension of the coronary lesion is still limited and often contradictory. In an observational study performed, patients with higher levels of serum TC, LDL, and Non-HDL had more severe coronary atherosclerosis [Jin, 2009]. Another study showed that severity and extension of coronary artery disease were directly related to total triglycerides and TG/HDL ratio and inversely related to HDL [Conkbayir, 2015]. These studies included patients undergoing diagnostic coronary angiography. There is another study included patients with Non-ST segment elevation myocardial infarction(NSTEMI), which reported a significant link between the severity of coronary lesions

and the levels of TC/HDL ratio [Penalva, 2008]. Association of the severity and extension of coronary lesions in patients with ST-elevation acute myocardial infarction (STEMI), according to our data, has not been reported so far.

SXscore is a tool used during coronary angiography introduced to quantify the extent and severity of coronary artery lesions. This score has been shown to be an effective tool to risk-stratify patients with complex coronary arteries before revascularization and guide treatment [Serruys, 2009; Yadav, 2013]. If there was a link between the complexity of coronary lesions and the levels of a particular lipid variable in patients with acute myocardial infarction, then this could be used as an easily applicable non-invasive method in deciding on the strategy of diagnostic and therapeutic decisions for patients with atherosclerotic coronary diseases at risk of acute infarction. In this regard, we conducted a study in order to evaluate the association between different lipid profiles and the severity of coronary atherosclerotic disease in patients with acute myocardial infarction at a group of patients at the Clinical Hospital in Tetovo in North Macedonia.

2. Materials and Methods

In this retrospective study, we analyzed data from 50 consecutive patients with STEMI who underwent coronary angiography during hospitalization at the Clinical Hospital in Tetovo in North Macedonia from January to April 2022. The diagnosis of acute myocardial infarction was made in patients who presented with characteristic retrosternal pain or discomfort lasting more than 30 minutes, with ST segment elevation and increased biochemical markers of myocardial necrosis (total CK and CK-MB).

Blood for examination was taken according to the protocol during the admission to the intensive care unit. Fasting before the blood test was not mandatory. Laboratory evaluation included values for glycaemia, total cholesterol (TC), low density lipoprotein cholesterol (LDL), high density lipoprotein cholesterol (HDL), and triglycerides (TG). Tri-glyceride to HDL (TG/HDL) and total cholesterol to HDL (TC/HDL) ratios were calculated by dividing triglyceride and total cholesterol levels by the level of HDL. Non-HDL is calculated as total cholesterol minus HDL. All patients underwent coronary angiography within 12 hours from admission to the intensive care unit by trans radial route using standard percutaneous techniques. Se-verity and extent of CAD were defined by using the Syntax score (SXscore) algorithm, by calculating all lesions in the coronary arteries, with a diameter of stenosis >50%, in vessels >1.5 mm. Details of SXscore calculation are described in Syntax Study [Serruys, 2009]. The measures were stratified according to tertiles among all patients with a calculated SXscore to: Tertile I (Syntax score ≤ 8), Tertile II (Syntax score >8 – ≥16), and Tertile III (Syntax score > 16).

3. Results

Table 1 presents the demographic and clinical data of the studied subjects. The mean age was 60.12 ± 12.12 years; of them, 7 (14%) were females. Diabetes had 36%, hypertension had 46%, while smokers were 60% of the total number of patients. Lipid profile analysis showed the mean value TC was 4.93 ± 1.362 mmol/L, for TG 1.81 ± .93 mmol/L, for LDL 2.79 ± 1.27 mmol/L, and for HDL 1.05 ± 0.29 mmol/L. Trig/HDL ratio was 1.92 ± 1.40, TC/HDL ratio was 4.96 ± 1.85 and Non-HDL was 3.88 ± 1.33. The mean value for the SXscore of all patients was 12.58 ± 5.73, whereas Tertile I SXscore classified 14 patients, Tertile II SXscore 22 patients, and 14 patients with Tertile III SXscore.

Table 1: Demographic and clinical characteristics of the study population

Variable	
Age (years), (min-max)	60.12 ± 12.12, (33-88)
Female, n (%)	7 (14)
Hypertension, n (%)	23 (46)
Diabetes mellitus, n (%)	18 (36)
Smoking, n (%)	23 (60)
Total cholesterol (TC) (mmol/L)	4.93 ± 1.362
Low density lipoprotein (LDL) (mmol/L)	2.79 ± 1.27
Triglycerides (TG) (mmol/L)	1.81 ± .93
High density lipoprotein (HDL) (mmol/L)	1.05 ± .29
TG/HDL (ratio)	1.92 ± 1.40

TC/HDL (ratio)	4.96 ± 1.85
Non-HDL	3.88 ± 1.33
Syntax score	12.58 ± 5.73
Tertile I ≤8 n (%)	14 (28)
Tertile II, >8–≤16 n (%)	22 (44)
Tertile III >16 n (%)	14 (28)

One-way analysis of variance (ANOVA) for the association of lipid profiles and tertiles of SXscore showed that the mean of TC/HDL ratio was higher in the Tertile III group in comparison with Tertile I group (6.17±2.53 and 4.15 ± 1.38). The difference was statistically significant (p=0.008). Although there were higher Non-HDL values for the Tertile III group faced to Tertile I group (4.59 ± 1.40 and 3.44 ± 1.35), the association was not statistically significant (p=0.051). Between the means of HDL, LDL, TG, and TG/HDL ratio, no statistically significant difference was found (p=0.35, p= 0.659, p=0.145, and p=0.63, respectively). Corresponding mean lipid levels and ratios classified in tertiles according to SXscore are presented in Table 2.

Table 2. Association between lipid variables and Syntax Score

	Syntax Score			**p**
	Tertile I	**Tertile II**	**Tertile III**	
TC (mmol/L)	4.62 ± 1.43	4.74 ± 1.25	5.55 ± 1.34	0.129
Total Cholesterol (TC) (mmol/L)	2.62 ± 1.32	2.62 ± 1.14	3.21 ± 1.39	0.659
Low density lipoprotein (LDL) mmol/L)	1.83 ± 1.17	1.69 ± 0.88	1.98±0.75	0.145
Triglycerides (TG) (mmol/L)	1.18 ± .41	1.03 ± .23	0.96 ± .20	0.352
High density lipoprotein(HDL) (mmol/L)	1.80±1.60	1.80 ± 1.38	2.23 ± 1.28	0.63
TC/HDL ratio	4.15 ± 1.38	4.71±1.19	6.17±2.53	0.008*
Non-HDL (mmol/L)	3.44 ± 1.35	3.71 ± 1.14	4.59 ± 1.40	0.051

*P<0.05

The association between Sxscore tertiles with gender, diabetes, smoking, and hypertension is presented in Table 3. We found that only smoking showed a significant association.

Table 3. SXscore tertiles associations with gender, diabetes, smoking, and hypertension.

		SXscore			
		Tertile I	**Tertile II**	**Tertile III**	**p-value**
Gender	Female	3	2	2	0.582
	Male	11	20	12	
Diabetes	Diabetic	5	8	4	0.879
	Non Diabetic	9	14	10	
Smoking	Smoker	5	12	12	0.025*
	Non Smoker	9	10	2	

Hypertension	Hypertensive	5	9	9	0.258
	Non-hypertensive	9	13	5	

Pearson Chi-Square Tests. *p<0.05

In addition, Spearman's correlation test showed a significantly positive but weak correlation between SXscore tertiles and TC/HDL ratio and Non-HDL. For TC and HDL, there were positive but not significant correlations. On the contrary, an inverse correlation was observed between SXscore tertile and HDL cholesterol levels. However, the correlation was not significant. (Table 4).

Table 4. Correlation between Syntax Score tertiles and lipid variables

	Syntax Score	
	Correlation coefficient	**p-value**
Total Cholesterol (TC)	.253	.076
Low density lipoprotein (LDL)	.152	.292
Triglycerides (TG)	.207	.148
High density lipoprotein(HDL)	-.247	.083
TG/HDL (ratio)	.249	.081
TC/HDL (ratio)	.339*	.016*
Non-HDL	.301*	.034*

*Correlation is significant at the 0.05 level.

Multiple regression was run to predict SXscore value according to gender, age, smoking hypertension, diabetes mellitus, and lipid profile (Table 4). HDL and TC statistically significantly predicted SXscore (p<0.05). Reducing HDL by 1 mmol / L, the SXscore value increases by 6.8 (t= -2.276, p=0.028) and also by increasing the TC value by 1 mmol/L, the SXscore value increases by 1.17 (t = 2.060, p=0.046). Variables were statistically significant to the prediction for p < 0.05. Of other risk factors, only smoking shows as a significant predictor for SXscore values. Smoking increases the SXscore value to 3.88.

Table 5. A multiple regression analysis to predict SXscore value

Variables	**β**	**Std. Error**	**t-value**	**p-value**
Age	.031	.076	.409	.685
Gender	1.886	2.633	.717	.478
Smoking	3.884	1.745	2.226	.032*
Hypertension	2.464	1.668	1.477	.147
Diabetes mellitus	.206	1.759	.117	.907
Total Cholesterol (TC)	1.175	.571	2.060	.046*
Triglycerides (TG)	.753	1.025	.734	.467
High density lipoprotein (HDL)	-6.802	2.989	-2.276	.028

*p<0.05

4. Discussion

We investigated the possible association between coronary lesion extent and severity and levels of different lipid profiles. In our study, the levels of all lipid variables assessed were associated with severity and extension of the coronary lesions, but only the ratio of total cholesterol to HDL (TC/HDL) was associated significantly. Studies related to this topic in the literature are very few and contradictory. A conclusion similar to that of our study was found in an earlier study by Panalve et al.(2008), where the TC /

HDL ratio proved to be a marker for the severity of coronary heart disease in relation to the number of coronary arteries involved. Their patients were with non ST elevation myocardial infarction. But this fact did not seem to make a difference [Penalva, 2008]. Another study found a significant association between TG, HDL, and TG/HDL quartiles and the extent and severity of coronary heart disease, but in this study, patients with diabetes mellitus and chronic comorbidities were excluded, whereas the severity of lesions was assessed by the Friesinger index [Conkbayir, 2015]. In our study population, 36% were diabetics, and 46% with hypertension. The effect of these factors and the methodology used may have influenced the results.

In our study regarding the association of the other risk factors and SXscore tertiles in patients with AMI, a significant association was observed only in smokers. The association with arterial hypertension, although positive, was not significant. In another study where the sample selected was composed of patients undergoing coronary angiography for diagnostic purposes, an important association with SXscor, in addition to smoking, also showed diabetes and hypertension [Agarwal, 2015].

In terms of correlation study, we noticed an important positive correlation between SXscore tertiles and the values of TC/HD and Non-HDL. The correlations with TC and HDL were not significant. A Chinese population sample with 363 patients shows that TC, LDL, and Non-HDL correlate positively with the severity of coronary artery atherosclerosis, defined by the Gensini score, in patients undergoing diagnostic coronary angiography [Jin, 2006]. It seems that the selection of samples, the concomitant diseases, and the tool used for the quantification of coronary lesions was the cause of some different results.

From the risk factors calculated in our study, an important predictive role for SXscor had smoking, HDL, and TC. The ratio of the TC/HDL and Non-HDL were excluded from regression analysis due to multicollinearity. This data is in line with other studies that find that high TC and decreased HDL increase the predisposition to IAM at-risk individuals [Khan, 2013].

In the study presented, the calculated lipid values (TC/HDL and Non-HDL) were shown to be better indicators of coronary lesion severity than TC and HDL itself. Several studies have demonstrated that TC/HDL and Non-HDL were more sensitive also as indicators for coronary risk, as well as a better determinant of subclinical atherosclerosis than TC and HDL themselves [Millán, 2009; Acevedo, 2012; Calling, 2021].

Although acute myocardial infarction is not always initiated in a severe and extended atherosclerotic lesion, as well as atherosclerosis is not only caused by dyslipidemias, the possibility of preventing or even reducing the progression of atherosclerotic plaques through pharmacological preparations (statins) is a good opportunity [Choy, 2004]. Therefore, non-invasive documentation of the severity and extension of atherosclerotic lesions remains an important objective.

5. Conclusions

In our study, among all lipid variables examined, TC to HDL ratio (TC/HDL) appeared as the most powerful indicator of severity and extension of the coronary lesion in patients with ST elevated acute myocardial infarction. Therefore, in patients with suspected CAD, the TC/HDL ratio should be used as an easy, non-invasive, and not expensive method to measure the extent and severity of coronary heart disease in order to determine the diagnosis strategy and treatment of these patients. The limitation of our study consists in the fact that it was conducted in a single center with a relatively small number of participants. Studies involving a larger number of participants could also investigate the potential impact of comorbidities on study results.

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