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An Important Question That Needs to Be Proved: Is There Any Relationship between the Epicardial Fat Thickness and the Coronary Artery Complexity in Patients with Acute Non-ST Elevation Myocardial Infarction?

ORIGINAL INVESTIGATION

Ahmet Karakurt[1], Cennet Yıldız[2]

ABSTRACT

Objective: In this study, we aimed to investigate the association of epicardial fat thickness (EFT) and coronary artery lesion complexity with patients having acute non-ST elevation myocardial infarction (NSTEMI).

Materials and Methods: The patients (n=328) were divided into low syntax score (SS) group (SS≤17; Low-SSG), intermediate SS group (SS=18-28; In-SSG), and high SS group (SS≥29; High-SSG) based on the SS value. EFT, SS, distributions of the critical coronary artery lesions, and the neutrophil-lymphocyte ratio (NLR) were determined for all the groups. EFT was measured by transthoracic echocardiography and was recorded on a digital storage device.

Results: High-SSG had a significantly higher mean of EFT (6.65±0.82 mm) when compared to Low-SSG (5.12±1.13 mm) and In-SSG (5.79±0.83 mm) (p<0.001). EFT showed a significant positive correlation with SS (r=0.607, p<0.001). Further, a significant positive correlation was revealed with the distributions of critical coronary artery lesions of the left anterior descending (LAD), circumflex artery (Cx), and right coronary artery (RCA) (r=0.260, p<0.001; r=0.213, p=0.001; and r=0.275, p<0.001, respectively). However, no correlation was demonstrated between EFT and NLR (r=0.081, p=0.145) in patients with NSTEMI.

Conclusion: These results showed that EFT is significantly associated with coronary artery lesion complexity in patients with NSTEMI and can work as a risk marker in these patients.

Keywords: Epicardial fat thickness, coronary artery lesion complexity, acute non-ST elevation myocardial infarction

INTRODUCTION

Obesity has been accepted as an important risk factor in the development of atherosclerotic cardiovascular disease (1). A marked increase in local body adipose tissue has been shown to play a significant role in atherosclerotic cardiovascular heart disease (2).

The epicardial fat tissue is a regional visceral deposit of adipose tissue located between the myocardium and visceral pericardium, particularly around subepicardial coronary vessels (3). It acts as an endocrine and paracrine organ, secreting many proinflammatory and proatherogenic cytokines that are involved in plaque formation, plaque instability, accelerated atherosclerosis, and arterial thrombosis (4-12).

Several studies have shown the association between epicardial fat thickness (EFT) and atherosclerotic coronary disease by means of transthoracic echocardiography (TTE), magnetic resonance imaging (MRI), and computerized tomography (CT) (13, 14). EFT is associated with the severity and burden of coronary artery disease (CAD) (6, 7, 12). In this study, we investigated the association between EFT and the severity of CAD in patients with non-ST elevation myocardial infarction (NSTEMI) using TTE.

MATERIALS and METHODS

Study design

We included 328 consecutive patients (n=328) with NSTEMI who underwent coronary angiography (CAG). Diagnoses for NSTEMI were defined according to the American College of Cardiology guidelines (15). The patients were divided into three groups based on the syntax score (SS). The groups were described as Low SS group (Low-SSG, SS≤17, n=177), intermediate SS group (In-SSG, SS: 18-28, n=101), and high SS group (High-SSG, SS≥29, n=50). The age, gender, weight, height, body mass index (BMI), and waist circumference of each patient were recorded. EFT was measured by TTE on the next day following CAG.

[1] Department of Cardiology, Kafkas University Faculty of Medicine, Kars, Turkey
[2] Department of Cardiology, Bağcılar Tekden Hospital, İstanbul, Turkey

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Correspondence
Ahmet Karakurt, Department of Cardiology, Kafkas University Faculty of Medicine, Kars, Turkey
Phone: +905052556152
e.mail: karakurt38@hotmail.com

We excluded the cases with acute or chronic infections, collagen vascular diseases, severe valvular heart disease, arrhythmia, congestive heart failure, previous coronary artery bypass graft (CABG) operations, and percutaneous coronary intervention (PCI). Patients with severe respiratory diseases, liver or kidney diseases with glomerular filtration rate <30 mL/min, and abnormal thyroid function were also excluded from the study. Patients with a slow coronary flow in the absence of any noticeable lesions and morbid obesity were also excluded. All the patients participating in this study were informed about the aim of the study, including oral and written information regarding the procedure, and the study was approved by the local ethics committee (local ethics committee number: 80576354-050-99/60).

Biochemical parameters

Blood sampling was done with standard phlebotomy. Samples were collected in the early morning on the next day following CAG. Biochemical parameters of total cholesterol (TC), triglyceride (TG), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), serum creatinine, and C-reactive protein (CRP) were tested. Complete blood count including white blood cell (WBC) count, lymphocyte count (LC), neutrophil count (NC), and neutrophil-lymphocyte ratio (NLR) were measured.

Clinical variables

Hypertension (HT) was defined as systolic blood pressure ≥140 mmHg, diastolic blood pressure ≥90 mmHg, and patient's already using antihypertensive medication. Diabetes mellitus (DM) was defined as fasting glucose >126 mg/dL and patients already using antidiabetic medication. Hypercholesterolemia (HpC) was defined as total cholesterol >200 mg/dL and patients already using a cholesterol-lowering agent. Cigarette smoker was defined as a patient who smoked at least one cigarette per day in the year. A family history of CAD was defined as having a first-degree relative with a documented history of myocardial infarction or sudden death.

Epicardial fat tissue measurements

All the patients were checked for TTE imaging using the Vivid 7 System (GE Vingmed Ultrasound AS; Horten, Norway) with a 2.5-MHz transducer. All the echocardiograms were recorded on a digital storage device and analyzed offline for EFT measurements. All the echocardiographic measurements were performed and reviewed by a single cardiologist who had a substantial specialty in echocardiography to avoid variability between the observers. The observer was blinded to the clinical, biochemical, and angiographic data of the patients.

Epicardial fat tissue appears more frequently as echo-free space rather than hyperechoic space between the linear echo-dense parietal pericardium and right ventricular epicardium in the transthoracic long- and short-axis windows (3). EFT was measured according to Iacobellis et al. (16, 17) from the standard parasternal long- and short-axis views obtained in the left lateral decubitus position. We commonly used the aortic annulus as the anatomical reference to increase the confidence of the results. EFT was measured over the nearest axis next to the anatomic reference point where it was the widest. EFT was also measured perpendicularly to the free wall of the right ventricle at the end-diastole for at least three cardiac cycles (Figure 1). The mean value of these measurements was recorded.

Syntax score

Syntax score, an angiographic grading tool, was used to determine the complexity of CAD. This scoring system was developed from a combination of various grading systems, such as Bypass Angioplasty Revascularization Investigation (BARI) protocol, modified Arterial Revascularization Therapies Study ARTS, modified Leaman score, American College of Cardiology/American Heart Association (ACC/AHA) classification system, Duke and International Classification for Patient Safety, and the total occlusion classification grading system (18-23). The SS is based on complex parameters such as diameter reduction and the number of lesions, total occlusions, bifurcation or trifurcation lesions, aorto-ostial stenosis, tortuosity, length, calcification, thrombus, and widespread disease or small vessels (18). The SS of all the patients were calculated online using SS calculator software (version 2.02, Boston Scientific, Syntax Score Calculator). According to the online SS calculator, stenosis ≥20% in any coronary artery was defined as CAD. Stenosis between 20% and 50% was defined as minimal CAD and stenosis more than 50% was identified as significant CAD. Stenosis less than 20% was defined as normal.

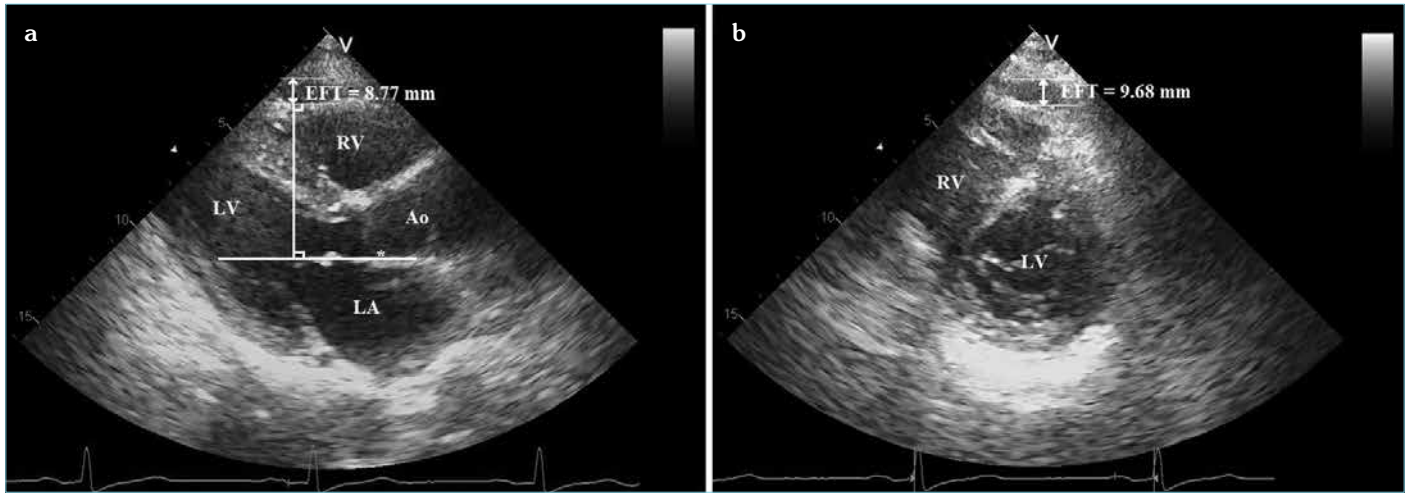

Figure 1a, b. EFT measurements obtained by using 2-dimensional echocardiography in the parasternal long- (a) and short-axis (b) views. The white arrows show the echo-free space between the subepicardium and pericardium.
LA: left atrium; LV: left ventricle; Ao: aorta; RV: right ventricle; *Aortic annulus

Table 1. Comparison of biochemical markers in low, intermediate, and high SS groups

	Low-SSG (n:177)	In-SSG (n:101)	High-SSG (n:50)	p
Age (years)	59.2±10.3	63.2±9.2	71.7±6	<0.001
Male gender, n (%)	117 (66.1%)	62 (61.4%)	30 (60%)	0.615
Length (cm)	167.6±7.9	164.9±8.6	164.2±9.8	0.008
Weight (kg)	80 (70-90)	75 (65-82.5)	75 (64.6-86)	0.017*
WC, cm	105.3±10.6	103.1±12.1	102.2±12.7	0.144
BMI (kg/m^2)	28.4 (25.5-31.2)	27.3 (25.1-30.5)	27.3 (24.6-32.7)	0.383*
HT, n (%)	66 (37.3%)	69 (68.3%)	47 (94%)	<0.001
Smokers, n (%)	75 (42.4%)	34 (33.7%)	17 (34%)	0.280
DM, n (%)	44 (24.9%)	60 (59.4%)	39 (78%)	<0.001
HPL, n (%)	61 (34.5%)	60 (39.6%)	30 (60%)	0.005
FCADH, n (%)	15 (8.5%)	5 (5%)	3 (6%)	0.518
SBP (mmHg)	121.1±25	122.9±18.1	127.1±21.7	0.252
DBP (mmHG)	75.8±13.5	76.9±11	79.5±14.6	0.197
PP (mmHg)	44.2±13.5	46.1±13.8	46.9±14.8	0.359
FPG, (mg/dL)	119 (95.5-149.5)	130 (105-205)	141.5 (6-8.1)	<0.001*
HbA1C, (mg/dL)	5.8 (4.5-6.6)	6.1 (5.6-8.1)	7 (4.5-12)	<0.001*
TC, (mg/dL)	193.1±39.3	201.1±41.3	215.8±37.7	0.002
LDL-C, (mg/dL)	126.8±33.3	134.9±35.2	139.3±35.1	0.034
HDL-C, (mg/dL)	40 (34.5-47)	38 (34-45.5)	37 (32.7-43.1)	0.076*
TG, (mg/dL)	148.5 (96-195.5)	163(117.5-249)	194.5(159.8-245.8)	0.001*
Tr-I (ng/mL)	6.96 (4.1-16.7)	6.49 (4.6-23.3)	20.71 (10.9-40.7)	<0.001*
Urea (mg/dL)	32.3±14.3	34.3±12±7	44±19.1	<0.001
Creatinine (mg/dL)	0.91±0.79	0.84±0.36	1.16±0.67	0.021
LVEF (%)	58 (53-60)	56 (49-58.5)	56 (45.7-58)	0.007*

Data are presented as mean±SD or (%). BMI: Body Mass Index; WC: waist circumference; HT: hypertension; DM: diabetes mellitus; HPL: hyperlipidemia history; FHCAD: family history of coronary artery disease; SBP: systolic blood pressure; DBP: diastolic blood pressure; PP: pulse pressure; FPG: fasting plasma glucose; HbA1C: hemoglobin A1C; TC: total cholesterol; LDL-C: low-density lipoprotein cholesterol; HDL-C: high-density lipoprotein cholesterol; TG: triglycerides; Tr-I: troponin-I; LVEF: left ventricle ejection fraction; SS: syntax score; Low-SSG: low syntax score group *Data are expressed as median (IQR: interquartile range)

Statistical analysis

Statistical analyzes were carried out using the Statistical Package for the Social Sciences software for Windows, version 20.0 (IBM Corp.; Armonk, NY, USA). The distribution of the continuous variables was tested by using Skewness/Sd error rate. Skewness/Sd error rate in the range of ±1.96 was accepted as normal distribution. Normally distributed data were expressed as mean±standard deviation (SD) and non-distributed data were expressed as median and interquartile ratio (IQR). Categorical variables were defined as a percentage. Non-distributed values such as the CRP, WBC, LC, and NC were converted to parametric values with log-10 logarithmic transformation. Skew-distributed continuous variables were compared using the one-way ANOVA. Tukey's HDS test was used for pairwise comparison of the groups. Non-skew-distributed continuous variables were compared using the Kolmogorov-Smirnov test. For categorical variables, chi-square test was used. Correlations among the parametric data were tested by Pearson correlation test, and correlations among the non-parametric data were examined by Spearman correlation tests. Multivariate analysis was performed to determine the factors related to epicardial fat thickness. Statistical significance was set at $p<0.05$.

RESULTS

In this study, 328 patients who underwent CAG with the diagnosis of NSTEMI were included. The mean age of Low-SSG (59.2±10.3 years), In-SSG (63.2±9.2 years), and High-SSG (71.7±6.0 years) were recorded, and there were significant differences in the three groups ($p<0.001$). Further, there were significant differences among

Table 2. Comparison of EFT and SS and biochemical markers such as WBC, LC, NC, and NLR in markers in Low-SSG, In-SSG, and High-SSG

	Low-SSG (n:177)	In-SSG (n:101)	High-SSG (n:50)	p
EFT (mm)	5.12±1.13	5.79±0.83	6.65±0.82	<0.001
WBC (103/mm^3)	9203±1663	8444±2722	9303±2711	
Log-WBC	3.95±0.13	3.9±0.14	3.95±0.14	0.032
LC (103/mm^3)	2303±904	2110±1007	1946±977	
Log-LC	3.3±0.17	3.27±0.22	3.23±0.24	0.003
NC (103/mm^3)	1907±2437	5465±2163	6616±3187	
Log-NC	3.73±0.17	3.7±0.16	3.78±0.18	0.045
NLR	2.61 (1.77-3.73)	2.48 (1.84-3.42)	3.15 (2.06-5.68)	0.027*
CRP (mg/L)	0.52 (0.35-0.9)	0.7 (0.5-1.0)	1.1 (.84-1.43)	<0.001*
SS	13.8 (10.2-15)	22 (19.5-25)	30.8 (29.4-35.3)	<0.001*

Data are presented as mean±SD or (%). EFT: epicardial fat thickness; WBC: white blood cell count; LC: lymphocyte count; Log-LC: logarithmic lymphocyte count; NC: neutrophil count; Log NC: logarithmic neutrophil count; NRL: neutrophil-lymphocyte ratio; CRP: C-reactive protein; SS: syntax score*Data are expressed as median (IQR: interquartile range)

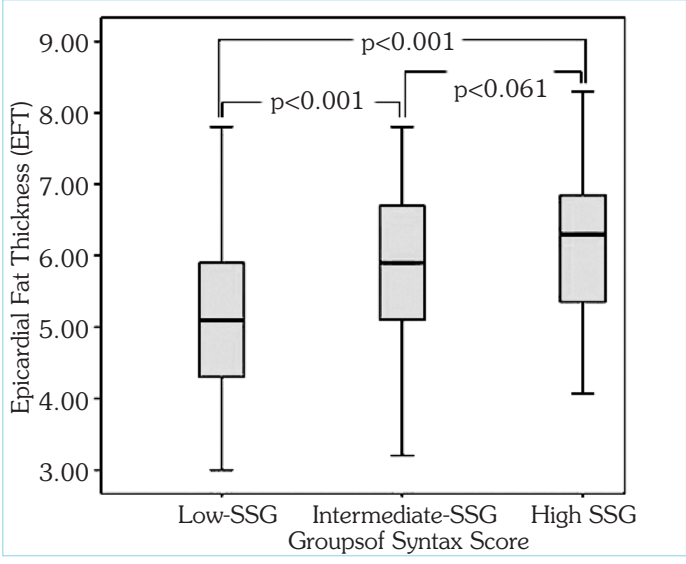

Figure 2. Mean levels of EFT in patients with non-STEMI who have low, intermediate, and high SS
non-STEMI: non-ST elevation myocardial infarction; SS: syntax score

the three groups regarding some baseline clinical and demographic characteristics. These differences included age, height, weight, presence of HT, DM history, hyperlipidemia (HPL) history, fasting plasma glucose (FPG) level, hemoglobin-A1C (HbA1C) level, TC and LDL-C, troponin-I (Tr-I), and left ventricle ejection fraction (LVEF). The demographic and clinical characteristics of the patients are shown in Table 1.

The mean values of EFT were measured in Low-SSG (5.12±1.13 mm), In-SSG (5.79±0.83 mm), and High-SSG (6.65±0.82 mm) (Table 2). There was a significant difference between mean EFT among the groups (p<0.001). When the groups were compared in pairs, significant differences were also demonstrated between Low-SSG and In-SSG (p<0.001) as well as between Low-SSG and High-SSG (p<0.001) (Figure 2).

Table 3. Distribution of severity coronary artery lesions according to the coronary artery groups

Distribution of severity coronary lesions	Low-SSG (n:177)	In-SSG (n:101)	High-SSG (n:50)	p
LMCA, (%)	1 (0.6)	1 (1)	4 (8)	0.002
LAD, (%)	79 (44.6)	77 (76.2)	48 (96)	<0.001
$LADD_1$, (%)	18 (10.2)	39 (38.6)	26 (52)	<0.001
$LADD_2$, (%)	1 (0.6)	11 (10.9)	11 (22)	<0.001
Cx, (%)	46 (26)	52 (51.5)	38 (76)	<0.001
$CxOM_1$, (%)	1 (0.6)	7 (6.9)	6 (12)	0.001
$CxOM_2$, (%)	12 (6.8)	15 (14.9)	12 (24)	0.002
$CxOM_3$, (%)	1 (0.6)	3 (3)	3 (6)	0.050
RCA, (%)	57 (32.2)	49 (48.5)	45 (90)	<0.001

LMCA: left mean coronary artery; LAD: left anterior descending; $LADD_1$: left anterior descending diagonal 1; $LADD_2$: left anterior descending diagonal 2; Cx: circumflex artery; $CxOM_1$: circumflex obtuse marginal 1; $CxOM_2$: circumflex obtuse marginal 2; $CxOM_3$: circumflex obtuse marginal 3; RCA: right coronary artery; CABG: coronary artery bypass graft; PCI: percutaneous coronary interventions; SSG: syntax score group

The median value of CRP in Low-SSG (0.52; 0.35-0.90), In-SSG (0.70; 0.50-1.00), and High-SSG (1.10; 0.84-1.43) were recorded (Table 2). There was a significant difference in the mean CRP levels between the three groups (p<0.001). There were significant differences between the groups with regard to the median values of Low-SSG and In-SSG (p<0.001), Low-SSG and High-SSG (p<0.001), and In-SSG and High-SSG (p<0.001). However, no significant correlation was found between In-SSG and High-SSG (p>0.061).

Table 4. Univariate correlations value and multivariate analysis of EFT between SS and other markers in NSTEMI patients

	The univariate correlations		The multivariate analysis	
	r	p	OR (95% CI)	p
Age (years)	0.198	0.001	-0.042 (-0.143-0.005)	0.344
FBG (mg/dL)	0.248	<0.001	0.031 (-0.001-0.002)	0.556
HbA_1C (mg/dL)	0.289	0.001	0.093 (-0.007-0.120)	0.081
HDL-C (mg/dL)	-0.136	0.014	-0.011 (-0.008-0.006)	0.784
TG (mg/dL)	0.162	0.003	-0.007 (-0.001-0.001)	0.866
CRP (mg/L)	0.607	<0.001	0.435 (0.953-1.403)	<0.001
WBC ($10^3/mm^3$)	0.041	0.461	0.082 (-1.972-3.373)	0.606
LC ($10^3/mm^3$)	-0.051	0.354	-0.078 (-1.318-0.436)	0.323
NC ($10^3/mm^3$)	0.049	0.373	-0.054 (-2.225-1.518)	0.710
NLR	0.081	0.145	-0.125 (-0.104- -0.001)	0.051
Tr-I (ng/mL)	0.181	<0.001	0.218 (0.007-0.024)	<0.001
LVEF (%)	-0.143	0.009	0.056 (0-.005-0.023)	0.188
SS	0.607	<0.001	0.454 (0.049-0.072)	<0.001

FPG: fasting plasma glucose; HbA1C: hemoglobin A1C; HDL-C: high-density lipoprotein cholesterol; TG: triglycerides; CRP: c-reactive protein; WBC: white blood cell count; LC: lymphocyte count; NC: neutrophil count; NRL: neutrophil-lymphocyte ratio; Tr-I: troponin-I; LVEF: left ventricle ejection fraction; SS: syntax score; OR: odds ratio; CI: confidence interval; EFT: epicardial fat thickness

Table 5. Univariate correlation values of EFT between the distributions of severity coronary lesions in NSTEMI patients

	r	p
LMCA	0.067	0.227
LAD	0.260	<0.001
$LADD_1$	0.158	0.004
$LADD_2$	0.158	0.004
Cx	0.213	0.001
$CxOM_1$	0.058	0.292
$CxOM_2$	0.135	0.015
$CxOM_3$	0.065	0.243
RCA	0.275	<0.001

LMCA: left mean coronary artery; LAD: left anterior descending; $LADD_1$: left anterior descending diagonal 1; $LADD_2$: left anterior descending diagonal 2; Cx: circumflex artery; $CxOM_1$: circumflex obtuse marginal 1; $CxOM_2$: circumflex obtuse marginal 2; $CxOM_3$: circumflex obtuse marginal 3; RCA: right coronary artery; EFT: epicardial fat thickness

Pearson correlation analyzes demonstrated that the EFT had a significant positive correlation with SS (r=0.607, p<0.001). In addition, a significant positive correlation was revealed between EFT and age (r=0.198, p=0.001), CRP (r=0.607, p<0.001), fasting blood glucose (r=0.248, p<0.001), and HbA1C (r=0.289, p=0.001) (Table 4).

Although WBC, LC, NC, and NLR demonstrated statistical significance between each other, there were statistically significant differences in the mean WBC, LC, NC, and NLR values among the three groups (p=0.032, p=0.003, p=0.045, and p=0.027, respectively). Further, they were not statistically correlated with EFT (r=0.041, p=0.461; r=−0.051, p=0.354; r=0.049, p=0.373; and r=0.081, p=0.145, respectively) (Table 2, 4).

Multivariate analysis showed that CRP (odds ratio (OR) 0.435, p<0.001), Tr-I (OR 0.218, p<0.001), and SS (OR 0.454, p<0.001) were independent factors affecting the epicardial fat thickness (Table 4).

Severity coronary lesion distribution percentages among groups are listed in Table 3. EFT and percentage of severity coronary lesions were found to increase proportionally as the SS increased. In each group, the LAD was found to have the highest ratio in terms of the severity lesions, followed by Cx and RCA. In addition, Pearson correlation analyzes demonstrated that EFT had a significant influence on the distribution of severity coronary artery lesions of LAD, Cx, and RCA [(r=0.260, p<0.001; r=0.213, p=0.001; and r=0.275, p<0.001, respectively) (Table 5)].

DISCUSSION

In our study, we demonstrated that EFT was positively correlated with SS in patients with NSTEMI and was independent of clinical characteristics including age, DM, and HbA1C. Increased EFT may reflect the atherosclerotic burden with an increased number and percentage of severity coronary artery lesions. EFT has been positively correlated with the atherosclerotic burden of LAD, LADD1, LADD2, Cx, and RCA, except LMCA and CxOM1-3. The branches of Cx have weak correlation, while LAD (and its branches), Cx, and RCA have a strong correlation. This may be because LAD, Cx,

and RCA have larger epicardial fat around them as compared to their main branches. In addition, SS, age, FBG, HDL-C, TG, and HgA1C were correlated with blood cell count, CRP, and LVEF. This may be a useful predictive tool for coronary artery complexity in NSTEMI.

The epicardial fat tissue is concentrated on the atrioventricular and interventricular grooves and along the major branches of the coronary arteries. It is widely recognized that the accumulation of epicardial fat tissue is strongly related to the development of atherosclerotic CAD (4, 17, 24, 24-28). Certain locally secreted bioactive molecules including low-molecular-weight adiponectin, resistin, interleukin (IL)-1β, IL-6, tumor necrosis factor (TNF)-α, and monocyte chemotactic protein (MCP)-1 may affect the immunologic and inflammatory responses and, therefore, contribute toward the development of CAD (5, 29-31). Some sources have suggested the possible mechanism of increased EFT in the development and progression of CAD by decreasing the synthesis of anti-inflammatory cytokines (adiponectin and resistin) and increasing the synthesis of inflammatory cytokines (IL-1, IL-6, and TNF-α) (5-8, 13, 16).

Although the relationship between EFT and CAD has been demonstrated in some studies, there are only a limited number of publications demonstrating the correlation between EFT and CAD complexity. Wang T. et al. (32) suggested that EFT could serve as a marker of severe CAD in patients with acute myocardial infarction (AMI). This study highlights the correlation between echocardiographic EFT and the severity of CAD. The results showed that EFT in High-SSG (5.6±1.1 mm) was significantly greater than that in Low-SSG (4.1±1.0 mm) ($p<0.01$). EFT had a positive correlation with SS and the severity of CAD. These results are in agreement with our findings. Further, that study showed a significant positive correlation with BMI, waist circumference, LDL, and serum TG levels. The authors emphasized that EFT measured by TTE was significantly correlated with severe multiple coronary artery stenosis in patients with AMI. They concluded that EFT could be used for the risk stratification of those patients. Fukamachi et al. (33) investigated the association between EFT and the presence of multivessel CAD in patients with AMI undergoing primary PCI. They found that EFT in patients with multi-vessel CAD (2.8±1.3 mm) was significantly greater than that in the patients with single-vessel disease (1.9±0.9 mm) ($p=0.005$). EFT was the only independent predictor of multi-vessel CAD. The authors also emphasized that EFT was closely associated with the presence of multi-vessel CAD in patients with AMI. Picard et al. (34) suggested that EFT measured by CT was correlated with the presence and extent of angiographically proven CAD. Another study investigated whether there was a relationship between EFT and the severity and prognosis of acute coronary syndrome (ACS) (35). In that study, EFT was correlated with the angiographic severity of ACS, but was not correlated with the clinical outcome. It has been reported that the selective surgical excision of adipose tissue in direct contiguity with an epicardial coronary artery attenuated the progression of atherosclerosis in pigs (36). According to these results, it may be hypothesized that factors generated by the epicardial adipose tissue could contribute toward atherogenesis by direct diffusion through adventitia into the coronary intima-media and might locally contribute to stenosis progression.

We found that SS had a significant positive correlation with EFT. We also found a statistically significant difference between High-SSG, Low-SSG, and In-SSG. This was further intensified by the presence of a significant difference between Low-SSG and In-SSG. Additionally, positive correlation existed between EFT and BMI, HbA1C, and Tr-I measurements. Our results are in accordance with Gul et al. (37) who investigated whether end-systolic and end-diastolic EFT was more closely associated with NSTEMI patients according to the Global Registry of Acute Coronary Events (GRACE) risk score (GS). They found that both end-systolic and end-diastolic EFT values were increased in high GS patients as compared to those of low-moderate GS patients. In addition, the GS showed a positive correlation with end-systolic and end-diastolic EFT.

Epicardial fat thickness is an active organ that secretes several proinflammatory cytokines (3, 5-7). In recent years, NLR has been used as a marker of inflammation and has been shown to be an independent predictor of mortality in ischemic heart disease (38). Ozcicek et al. (39) showed that NLR levels were independently associated with EFT in patients with end-stage renal disease receiving hemodialysis. Another study found that NLR and EFT were increased in non-dipper hypertensive patients and they were significantly correlated with each other (40). In the present study, although patients with more complex CAD had significantly higher levels of NLR, we did not find any correlation between NLR and EFT.

Study limitations

There are some limitations to this study. First, the present study has a small sample size. Second, it is a single-center study. Third, there are other techniques, such as TTE, MRI (the golden standard for EFT assessment), and multidetector CT, for the detection of EFT. While MRI and multidetector CT can be used to readily evaluate EFT, these methods are not always easily accessible and applicable. We used echocardiography to assess the quantitative value of EFT. Echocardiographic EFT measurement is a linear measure at a single location and may not exactly represent the total EFT volume. However, the echocardiographic assessments of EFT are simple, practical, repeatable, readily available, and applicable to perform in a coronary care unit. The fourth limitation is that all the echocardiographic measurements were performed by a single cardiologist, and this may have caused some intraobserver variability of the measurements.

CONCLUSION

Epicardial fat thickness can be quantified in vivo in patients with CAD in an objective manner by TTE. Increased EFT is associated with coronary artery lesion complexity and shown to have positive correlations in patients with NSETMI. This study suggests that EFT measured by TTE may be used as a risk marker in these patient groups. Additionally, as EFT increases around the coronaries, the risk of severity coronary lesion development is also increased. EFT may locally interact and modulate the coronary arteries through the release of proinflammatory adipokines and contribute to the development and progression of CAD. These results indicate that EFT should be checked properly, as well as the other coronary risk factors (HPL, DM, smoking, HT, etc.).

Ethics Committee Approval: This study protocol was approved by the Ethics Committee of Kafkas University of Medical Sciences (Local Ethics Committee Number: 80576354-050-99/60).

Informed Consent: Informed consent was obtained from patients who participated in this study.

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Authors' Contributions: Conceived and designed the experiments or case: AK. Performed the experiments or case: AK, CY. Analyzed the data: AK. Wrote the paper: AK, CY. All authors have read and approved the final manuscript.

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