Turk Kardiyol Dern Ars 2021;49(6):430-438 doi: 10.5543/tkda.2021.50759

Epicardial fat tissue may predict new-onset atrial fibrillation in patients with non-ST-segment elevation myocardial infarction

ST segment yükselmesiz miyokart enfarktüsü olan hastalarda epikardiyal yağ dokusu yeni başlangıçlı atriyal fibrilasyonu öngördürebilir

Hayati Eren, M.D.[1], Muhammed Bahadır Omar, M.D.[2], Lütfi Öcal, M.D.[3]

[1]Department of Cardiology, Elbistan State Hospital, Kahramanmaraş, Turkey
[2]Department of Cardiology, İstanbul Fatih Sultan Mehmet Training and Research Hospital, İstanbul, Turkey
[3]Department of Cardiology, Koşuyolu Kartal Heart Training and Research Hospital, İstanbul, Turkey

ABSTRACT

Objective: In recent years, epicardial fat tissue (EFT) has been found to be strongly associated with the development of atrial fibrillation (AF). It was also reported to be a predictor of cardiac arrhythmias in different clinical situations. However, in the current literature, the role of EFT thickness in the development of AF in patients with non-ST-segment elevation myocardial infarction (NSTEMI) has not been studied. In this study, we aimed to investigate the relationship between EFT thickness and the development of new-onset AF in patients with NSTEMI during in-hospital follow-up.

Methods: We enrolled 493 consecutive patients who were diagnosed NSTEMI in this study. During in-hospital follow-up, 68 patients developed AF, and the remaining 425 patients were determined as the control group. The thrombolysis in myocardial infarction (TIMI) risk score for NSTEMI was calculated. All clinical, echocardiographic, and laboratory parameters were compared between the 2 groups.

Results: EFT thickness was higher in the AF group than in the controls (p<0.001). The TIMI risk scores were higher in the AF group (p<0.001). Logistic regression analysis demonstrated that EFT was an independent determinant for the development of AF (odds ratio 3.521, 95% confidence interval 1.616-6.314, p<0.001).

Conclusion: Incident AF was observed more frequently in patients with NSTEMI and higher EFT thickness. EFT was an important determinant of AF in patients with NSTEMI.

ÖZET

Amaç: Son yıllarda, epikardiyal yağ dokusu (EFT) ile atriyal fibrilasyon (AF) gelişimi arasında güçlü bir ilişki bulunmuştur. Ayrıca farklı klinik durumlarda EFT'nin kardiyak artimi gelişimi için bir prediktör olduğu gösterilmiştir. Bununla birlikte, mevcut literatürde ST segment yükselmesiz miyokart enfarktüsü (NSTEMI) olan hastalarda AF'nin gelişiminde EFT kalınlığının rolü çalışılmamıştır. Bu çalışmada NSTEMI'li hastalarda EFT kalınlığı ile hastanede takip sırasında yeni başlangıçlı AF gelişimi arasındaki ilişkiyi araştırmayı amaçladık.

Yöntemler: Bu çalışmaya NSTEMI tanısı konmuş 493 ardışık hasta dahil ettik. Hastane içi izlemde 68 hastada AF gelişti ve kalan 425 hasta kontrol grubu olarak belirlendi. NSTEMI için miyokart enfarktüsünde tromboliz (TIMI) risk skoru hesaplandı. Tüm klinik, ekokardiyografik ve laboratuvar parametreler iki grup arasında karşılaştırıldı.

Bulgular: AF grubunda kontrollere göre EFT kalınlığı daha yüksekti (p<0.001). AF grubunda TIMI risk skoru daha yüksekti (p<0.001). Lojistik regresyon analizi, EFT'nin AF gelişimi için bağımsız belirleyici olduğunu gösterdi (OR: 3.521, %95 CI 1.616-6.314, p<0.001).

Sonuç: EFT kalınlığı daha yüksek olan NSTEMI hastalarında AF ortaya çıkışı daha sık gözlenmiştir. EFT, NSTEMI hastalarında AF'nin önemli bir belirleyicisidir.

Received: December 1, 2020 *Accepted:* February 15, 2021
Correspondence: Hayati Eren, M.D. Department of Cardiology, Elbistan State Hospital, Kahramanmaraş, Turkey
Tel: +90 344 413 80 01 e-mail: drhayatieren@hotmail.com

New-onset atrial fibrillation (AF) is a common complication of non-ST-segment elevation myocardial infarction (NSTEMI), and its incidence varies between 9.4% and 37% according to the type of study group, diagnostic method, and treatment modality used.[1] Previous studies have revealed that AF development in patients with NSTEMI was associated with worsened short- and long-term prognosis.[2,3] Several clinical parameters were found to be associated with AF development, including hypertension (HT), diabetes mellitus (DM), older age, female gender, number of diseased vessels, and reduced left ventricular fraction.[1,4,5] Epicardial fat tissue (EFT) is defined as the fat tissue located between the myocardium and visceral pericardium.[6] Previous clinical studies have shown a strong relationship between EFT thickness and AF development.[7-9] EFT secretes hormones such as proinflammatory and anti-inflammatory cytokines (adipokine) like an endocrine organ.[6,10] Adiponectin is an adipokine secreted by EFT that has anti-inflammatory and anti-atherogenic properties.[11] Adiponectin levels are reduced in different pathologic conditions, including ischemic heart disease, and it has also been shown that adiponectin levels predicted development of AF.[12] However, there is limited data regarding the relationship between EFT and AF development in the setting of NSTEMI. In this study, we aimed to investigate the relationship between EFT thickness and the development of new-onset AF in patients with NSTEMI during in-hospital follow-up.

METHODS

Study group

This study was designed as a cross-sectional and retrospective study. A total of 493 consecutive patients with NSTEMI (303 men, mean age: 61±13 years) who underwent coronary angiography between February 2016 and October 2019 were enrolled in the study. Patients with a chronic kidney disease; a history of coronary heart disease; previous stroke; valvular heart diseases; heart failure; a history of atrial fibrillation; a neoplastic, inflammatory, hepatic, or kidney disease; renal dysfunction; disabling diseases such as dementia and inability to cooperate; and poor echocardiographic quality were not included. Furthermore, patients who were admitted with cardiogenic shock and received inotropic agents, which could induce AF, were excluded from the study. All the patients provided written informed consent, and the protocol of study was approved by the Ethics Committee of İstanbul Fatih Sultan Mehmet Training and Research Hospital (Approval Date: April 27, 2020; Approval Number: 2020/6150) in accordance with the Declaration of Helsinki and Good Clinical Practice guidelines.

Abbreviations:

AF	*Atrial fibrillation*
AV	*Atrioventricular*
BMI	*Body mass index*
CAD	*Coronary artery disease*
CI	*Confidence interval*
CT	*Computed tomography*
DM	*Diabetes mellitus*
EAT	*Epicardial adipose tissue*
ECG	*Electrocardiogram*
EFT	*Epicardial fat tissue*
IV	*Interventricular*
LV	*Left ventricle*
LVEF	*LV ejection fraction*
MRI	*Magnetic resonance imaging*
NSTEMI	*Non-ST-segment elevation myocardial infarction*
OR	*Odds ratio*
TIMI	*Thrombolysis in myocardial infarction*
TTE	*Transthoracic echocardiography*

Definitions and laboratory measurements

Admission blood samples were used for laboratory assessment. The baseline clinical characteristics and risk factors for coronary artery disease (CAD), including age, sex, smoking history, HT, and DM, were collected. AF was defined as any episode of atrial fibrillation during the hospital stay after myocardial infarction. According to the current guidelines, NSTEMI was defined by the elevation of cardiac enzymes to more than the upper limit of normal in patients with ischemic symptoms but without ST-segment elevation or left bundle branch block.[13]

Angiographic analysis

Coronary angiography was performed with the Judkins technique via the physician's preferred access site. Conventional coronary angiograms were recorded in multiple projections for the left and right coronary arteries and reviewed for significant coronary artery obstructions (defined as >70% diameter stenosis in major coronary arteries) by 2 cardiologists.

Thrombolysis in myocardial infarction (TIMI) risk score

The TIMI risk score was calculated for each patient by combining the data from the medical history, electrocardiogram (ECG), and laboratory parameters on admission. A total score of 0-7 was possible according to the presence of the following characteristics: age >65 years, existence of ≥3 classic risk factors

(HT, hypercholesterolemia, DM, smoking, or family history of ischemic heart disease), previous significant CAD (stenosis of ≥50%), taking aspirin in the last 7 days, at least 2 episodes of angina within the previous 24 hours, elevation of cardiac necrosis markers, and ST deviations of at least 0.5 mm.[14]

ECG

Twelve-lead ECG was performed at 25 mm/s paper speed, with a 0.16-100 Hz filter range and 10 mm/mV height, in all the patients in the supine position. ECG was taken at the time of admission and at 6-hour intervals. Patients with ST elevation were not included in the study. The patients were divided into 2 groups as AF group and controls according to the development of AF during hospitalization. All clinical, demographic, echocardiographic, and laboratory parameters were compared between the AF group and controls.

Echocardiography

Transthoracic echocardiography (TTE) was performed according to the European Association of Cardiovascular Imaging and American Society of Echocardiography guidelines at the time of admission.[15] Two-dimensional, pulsed, and continuous wave tissue Doppler and color Doppler evaluations were performed. Left atrium size, interventricular septal thickness, posterior wall thickness, and left ventricle (LV) end-diastolic and end-systolic dimensions were measured in M-mode. During apical 4-chamber imaging, the transmitral flow waves (E and A velocities) were measured. Em wave was measured using tissue Doppler, and E/e' was calculated. The LV ejection fraction (LVEF) was calculated using Biplane Simpson's method.[15]

EFT measurement

Echocardiographic assessment of EFT thickness was performed as described by Iacobellis.[6] The measurement of EFT thickness was performed using TTE from a parasternal long-axis view on the right ventricle's free wall at end-diastole, and the greatest perpendicular distance to the aortic annulus was achieved and averaged over 3 cardiac cycles.[6] In the parasternal long-axis window, hypoechoic space on the right ventricular free wall was defined as EFT (Figure 1).[16] The intra-observer correlation coefficient was 0.956. EFT thickness can be measured by transthoracic echocardiography, cardiac computed tomography (CT), and cardiac magnetic resonance imaging (MRI) methods.

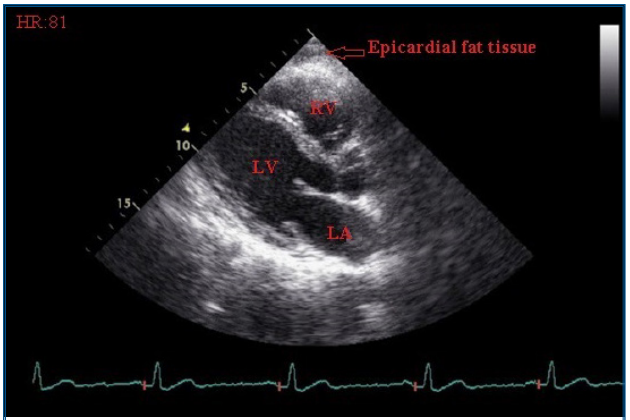


Figure 1. Transthoracic echocardiography parasternal long-axis view demonstrating the epicardial adipose tissue as the hypoechoic space on the right ventricular free wall at end-diastole.

EFT thickness measurement by echocardiography has been first validated by Iacobellis et al.,[16] who reported a good correlation between MRI and echocardiographic measurements of epicardial fat. An echocardiographic study found a significant correlation between EFT in the parasternal long- and short-axis views and LV mass.[16] If measurements by the 2 investigators differed by >5% for any of the variables, the patient was excluded; if the difference was <5%, the measurements were averaged.

Statistical analysis

Continuous variables were expressed as mean±standard deviation, whereas categorical variables were expressed as percentage. The chi-square or Fisher exact tests were used for comparison of categorical data. The normality distribution of continuous variables was tested with the Kolmogorov-Smirnov test. Correlation of continuous variables was assessed by Pearson correlation test, and non-continuous variables were assessed by the Spearman test. Student t test or Mann-Whitney U test was used to compare continuous variables between the 2 groups. To identify the independent predictors of AF, multivariate logistic regression analysis was performed. A 2-sided p value of <0.05 was considered as significant. Data were analyzed using SPSS version 22.0 (IBM Corp., Armonk, NY, USA).

RESULTS

A total of 493 patients (303 [61%] men and 190 [39%] women with a mean age of 59.7±10.2 years) were in-

Table 1. Baseline characteristics and laboratory findings of study patients

	AF (n=68)	Control (n=425)	*p*
Demographic parameters			
Age, years	60.5±8.9	59.8±10.4	0.470
Gender, male	37 (54.4)	238 (56)	0.233
HT	35 (51.4)	208 (48.9)	0.176
Hyperlipidemia	29 (42.6)	177 (41.4)	0.131
Smoking	39 (57.3)	232 (54.5)	0.508
DM	27 (39.7)	121 (28.4)	<0.001
Body mass index (kg/m^2)	29.7±4.6	29.3±4.3	0.233
Family history	18 (26.4)	107 (25.1)	0.432
Biochemical parameters			
Glucose (mg/dL)	125±32	112±17	<0.001
Troponin peak level (ng/mL)	4.3±1.2	2.7±0.6	<0.001
Hg (mg/dL)	12.7±2.3	12.5±2.1	0.112
Creatinine (mg/dL)	0.89±0.18	0.87±0.16	0.231
Total cholesterol (mg/dL)	191±36	189±27	0.304
Triglyceride (mg/dL)	161±67	158±45	0.239
Low-density lipoprotein (mg/dL)	120±25	118±21	0.129
High-density lipoprotein (mg/dL)	36±8	37±11	0.716
White blood cell	11.3±3.1	11.1±3.2	0.102
CRP	1.28±0.53	1.13±0.41	0.097

AF: atrial fibrillation; CRP: C-reactive protein; DM: diabetes mellitus; Hg: hemoglobin; HT: hypertension.

Table 2. Comparison of echocardiographic and angiographic findings of both groups

Parameters	AF (n=68)	Control (n=425)	*p*
Echocardiographic parameters			
Epicardial fat tissue thickness (mm)	8.3±2.0	6.1±2.1	<0.001
LV ejection fraction (%)	59±5	61±5	0.422
LV end-diastolic diameter (cm)	4.6±0.4	4.5±0.4	0.211
LV end-systolic diameter (cm)	3.1±0.5	2.9±0.4	0.213
Interventricular septal thickness (cm)	0.86±0.06	0.84±0.07	0.211
Posterior wall thickness (cm)	0.83±0.09	0.82±0.07	0.112
Left atrial diameter (cm)	3.7±0.5	3.6±0.4	0.114
E/e'	9.1±1.2	5.5±0.9	<0.001
Angiographic features			
Number of coronary arteries with >70% stenosis	44 (64.7)	220 (51.7)	0.006
PCI decision	51 (75.1)	328 (77.1)	0.312
CABG decision	8 (11.7)	45 (10.6)	0.561
Medical decision	9 (13.2)	52 (12.3)	0.279
TIMI risk score	4.6±1.2	2.1±0.9	<0.001

AF: atrial fibrillation; CABG: coronary artery bypass grafting; LV: left ventricle; PCI: percutaneous coronary intervention; TIMI: thrombolysis in myocardial infarction.

cluded in the study. During the follow-up, AF was observed in 68 (14%) patients. The baseline clinical and laboratory characteristics of the patients are shown in Table 1. There was no significant difference between the 2 groups in terms of age, gender, HT frequency, HL frequency, smoking status, family history of CAD, and body mass index (BMI). However, the frequency of DM was observed to be higher in patients with AF (p<0.001). Laboratory parameters were not found to be significantly different between the patient groups with and without AF, except for fasting blood glucose levels (Table 1). However, troponin-I value was observed to be significantly higher in patients with AF (p<0.001). Among the echocardiographic parameters, there was no difference between LVEF, left ventricular systolic and diastolic diameters, and left ventricular wall thickness. However, left atrial diameters were similar between the 2 groups (p=0.114) (Table 2). EFT thickness was higher in the AF group than in the control group (8.3±2.0 vs. 6.1±2.1, p<0.001). In addition, E/e', which reflects left ventricular filling pressure, was found to be higher in the AF group (p<0.001). Patients with AF showed higher rates of multivessel disease (p=0.006). No difference was observed between the 2 groups in the number of patients who underwent percutaneous coronary intervention, bypass, or medical decision. In addition, the TIMI risk score was found to be significantly higher in the AF group (p<0.001). The univariate linear regression analysis showed that there was a positive correlation of EFT with TIMI risk score (Table 3). Multiple logistic regression analysis proved that EFT (odds ratio [OR] 3.521, 95% confidence interval [CI] 1.616-6.314, p<0.001), troponin peak level (OR 1.328, 95% CI 1.013-3.248, p=0.004), and TIMI risk score (OR 1.713, 95% CI 1.225-4.173, p=0.002)

Table 3. Independent predictors of atrial fibrillation in multivariate logistic regression analysis

Variables	Univariate OR (95% CI)	Univariate *p* value	Multivariate OR (95% CI)	Multivariate *p* value
EFT thickness	5.850 (1.778-11.491)	<0.001	3.521 (1.616-6.314)	<0.001
TIMI risk score	2.547 (1.381-8.732)	<0.001	1.713 (1.225-4.173)	0.002
Troponin peak level	1.977 (1.442-5.287)	<0.001	1.328 (1.013-3.248)	0.004
DM	2.123 (1.098-7.323)	0.002		
Age	0.980 (0.938-1.023)	0.105		
Gender	1.333 (0.719-2.472)	0.162		
Smoking	1.447 (0.749-2.792)	0.171		
EF	0.966 (0.896-1.042)	0.370		
HT	1.534 (1.156-2.178)	0.017		
Number of coronary arteries with >70% stenosis	1.992 (1.062-3.025)	0.022		
E/e'	1.612 (1.219-2.133)	0.001		

CI: confidence interval; DM: diabetes mellitus; EF: ejection fraction; EFT: epicardial fat tissue; HT: hypertension; OR: odds ratio; TIMI: thrombolysis in myocardial infarction.

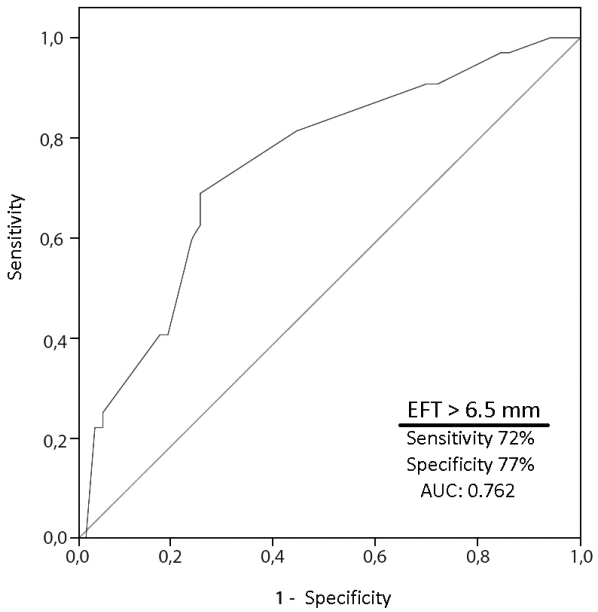


Figure 2. The receiver operating curve analysis showed that an epicardial adipose tissue thickness greater than 6.5 mm predicted the occurrence of atrial fibrillation with a sensitivity of 72% and a specificity of 77%.
AUC: area under the curve; EFT: epicardial fat tissue.

were the independent predictors of AF (Table 3). In receiver observing characteristic analysis, a cut-off point of 6.5 mm was the optimal for EFT thickness to predict the occurrence of new-onset AF (sensitivity 72%, specificity 77%, and area under curve 0.762; p<0.001) (Figure 2).

DISCUSSION

In this study, we focused on the potential relationship between EFT and the development of AF in patients with NSTEMI. Our results indicate that EFT thickness is independently associated with AF and may be a useful marker to predict AF in patients with NSTEMI. We also found that EFT thickness was associated with the TIMI risk score, which has a prognostic significance in NSTEMI. To our knowledge, this is the first study demonstrating the potential role of EFT in the development AF in patients with NSTEMI.

EFT covers 80% of the surface of the heart and constitutes 20% of its total weight.[17] In contrast with subcutaneous fat tissue, EFT is metabolically active and produces cytokines, hormones, and other vasoactive agents that affect the functions of the ventricular and atrial myocardium.[6,17] These adipokines may cause arrhythmogenic effects on myocyte, and because of the absence of a fibrous fascia layer between EFT and the myocardium, adipokines can affect directly on myocardium.[6,17] The EFT has been also suggested to play a significant role in promoting arrhythmogenesis owing to its proinflammatory properties and anatomical proximity to the myocardium.[17,18] In addition, EFT has an additional role in the modulation of different triggers, including meta-

bolic and biochemical triggers, leading to AF.[19] The relationship between the increase in EFT thickness and AF occurrence and severity has been similarly shown in several recent studies.[17,18] In previous studies, EFT was generally measured by CT or MRI. In recent years, EFT evaluated by echocardiography is being used as a practical method to evaluate visceral adiposity and cardiometabolic risk.[18,19] Echocardiography is less expensive and easier to perform than both MRI and CT. Unlike CT, echocardiography does not expose patients to radiation and prevents the unnecessary use of contrast agents. Therefore, we preferred echocardiography in our study for the evaluation of EFT. In recent studies, it has been determined that the differences in epicardial fat (adipose) tissue (EFT-EAT) localization may be associated with different effects. There is an increasing interest in the localization of EFT thickness as a potential predictor of cardioembolic conditions, particularly because of the uneven regional distribution of EFT, which is located in the atrioventricular (AV) groove and interventricular (IV) groove, around the heart. In particular, the relationship between the adipose tissue in the atrioventricular groove and CAD has been clearly demonstrated.[20-22] Nevertheless, echocardiographic measurement of EFT localized in the right ventricular free wall is the most commonly used measurement method in current studies, as it is a simple and easy-to-apply method and correlates well with advanced imaging techniques.[16,23] A significant relationship was demonstrated between CAD and EFT thickness measured in the free wall of the right ventricle in several studies carried out using echocardiography.[20-22] There is no consensus on its use in clinical practice, but there are some recommendations with regard to EFT measurement using echocardiography.[16] EFT thickness should be measured on the free wall of the right ventricle and in at least 2 locations from both parasternal longitudinal and transverse parasternal views, using the mean value of 3 consecutive cardiac cycles. These measurements were reported to have correlated well with the MRI measurements.[16] Thus, as a result of the literature review, it was decided to use EFT measurement on the free wall of the right ventricle in this study. There are several recent studies describing the relationship between EFT and the occurrence and severity of AF.[7,8] The Framingham Heart Study indicated that higher pericardial fat volume was associated with a nearly 40% higher odds of prevalent AF, and the association remained significant even after adjustment for other AF risk factors, including age, sex, myocardial infarction, heart failure, BMI, and other regional fat deposits.[8] In our study, the higher thickness of EFT in the AF group is consistent with the current literature. In addition, Duman et al.[24] found a significant relationship between the development of AF and EFT thickness in patients with paroxysmal AF. Furthermore, in another study, it was found that the EFT tissue was significantly thicker in patients with AF than in the controls.[25]

TIMI risk score predicts poor prognosis and increased cardiovascular complications in patients with NSTEMI.[12] Therefore, it was not surprising that we found a high TIMI risk score in the AF group. Many reasons for increased risk factors for TIMI score have also been associated with increased EFT in different studies.[26-28] Harada et al.[26] have found a higher EFT volume in patients with acute coronary syndrome (both STEMI and NSTEMI) in their study. There are several studies with evidence of the association of EFT with major adverse cardiovascular events[27,28] and vulnerable coronary plaque characteristics.[29] Similarly, in our study, we found a significant correlation between EFT thickness and TIMI risk scores. In our study, the frequency of multivessel disease was also significantly higher in the AF group. Similar to the findings of this study, it was also reported in the Global Utilization of Streptokinase and Tissue Plasminogen Activator for Occluded Coronary Arteries (GUSTO-1) study that the patients who developed AF after acute myocardial infarction had a higher rate of multivessel disease.[1] In addition, the fact that a relationship was found between the EFT thickness and the prevalence of CAD in patients with NSTEMI in 2 different studies supports the results of this study.[30,31]

AF is the most common supraventricular arrhythmia following NSTEMI.[1,32,33] Previous studies have demonstrated that AF development in the setting of acute myocardial infarction during hospitalization is associated with a worse short- and long-term prognosis in patients with NSTEMI.[1-3] There are many factors associated with the development of AF after myocardial infarction.[33,34] As previous HT, presence of DM, and a high troponin level in the blood at the time of diagnosis are indicative of increased ischemia and increased ventricular systolic functions, these pa-

rameters are among the main risk factors.[35] In our study, the high frequency of DM and higher troponin values in the AF group seem to be associated with increased arrhythmia development. Moreover, the fact that patients with NSTEMI and AF were found to have higher frequency of DM and higher EFT values compared with the other group in this study stands out as an important finding in terms of the relation between EFT and DM. Concordantly, it has been demonstrated that risk factors such as DM are associated with increased EFT thickness in the long term.[36] The relevant results of this study are consistent with the results of previously conducted studies.[37-39] To cite a few examples, both the thickness and the volume of EFT were found to be increased in patients with DM in several studies,[38,39] and it was reported in a study recently carried out by Iacobellis et al.[36] that patients with DM have higher EFT values than patients without DM. However, epicardial fat deposition reduces insulin sensitivity and adiponectin levels in patients with DM, leading to increased inflammation in adipose tissue and increased expression and secretion of proinflammatory cytokines, contributing to the development of adverse outcomes such as AF, CAD, and ventricular dysfunction in patients with DM.[40-42] Therefore, in patients with DM, both the presence of DM and the increase in EFT thickness increase the risk of AF development. The findings of this study in relation thereto support the relevant findings reported in the literature.

In a recent study that evaluated the prognostic effect of AF after NSTEMI, the reported incidence of AF was 6.4%.[43] In a different study, the incidence of silent AF after acute myocardial infarction and in-hospital mortality in patients with AF were reported as 16% and 17.8%, respectively.[44] In our study, AF development was observed in 68 (14%) patients during follow-up. Despite similar left atrial diameters between the groups with and without AF development, EFT thickness was significantly higher in the AF group.

Consequently, the EFT thickness in the echocardiography of patients with NSTEMI may help and guide clinicians to identify the patients with high risk of AF development and to begin preventive therapies.

Limitations

This study had some limitations. First, the sample size was quite small. EFT assessment was based on the measurement of thickness in our study rather than on volume measurement, which can be precisely measured by CT or MRI. We could not explain the mechanism between EFT and AF with our results.

Another important limitation was that intermittent AF episodes might have been missed, as patients with AF were examined via 6-hour ECG. Nevertheless, most of the patients included in the study were monitored while on intermediate care beds. In addition, the patients were informed to report any complaints they might have or any palpitations or irregular heartbeats they might feel. The fact that patient visits were carried out frequently has been another factor to minimize the effects of the said limitation. No significant difference was found between the TTE parameters of the patients included in this study. The similarities observed between the echocardiography results may be attributed to factors such as the fact that echocardiograms were taken at the time of admission, the absence of total occlusion such as the ST elevation, and similar demographic characteristics.

Conclusion

The major finding of this study is that EFT thickness may predict AF development in patients with NSTEMI. EFT is a simple, cheap, and non-invasive modality that could be a valuable tool for predicting cardiac arrhythmias. Future studies with larger sample size will be needed to confirm the results of this study.

The visual summary of the article can be seen in the Appendix 1.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of İstanbul Fatih Sultan Mehmet Training and Research Hospital (Approval Date: April 27, 2020; Approval Number: 2020/6150).

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

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept - H.E.; Design - H.E., M.B.O.; Supervision - H.E.; Resources - H.E., M.B.O., L.Ö.; Materials - H.E., M.B.O., L.Ö.; Data Collection and/or Processing - H.E., M.B.O., L.Ö.; Analysis and/or Interpretation - H.E., M.B.O.; Literature Search - H.E., M.B.O., L.Ö.; Writing - H.E., M.B.O., L.Ö.; Critical Revision - H.E., M.B.O., L.Ö.

Funding: No funding was received for this research.

Conflict-of-interest: None.

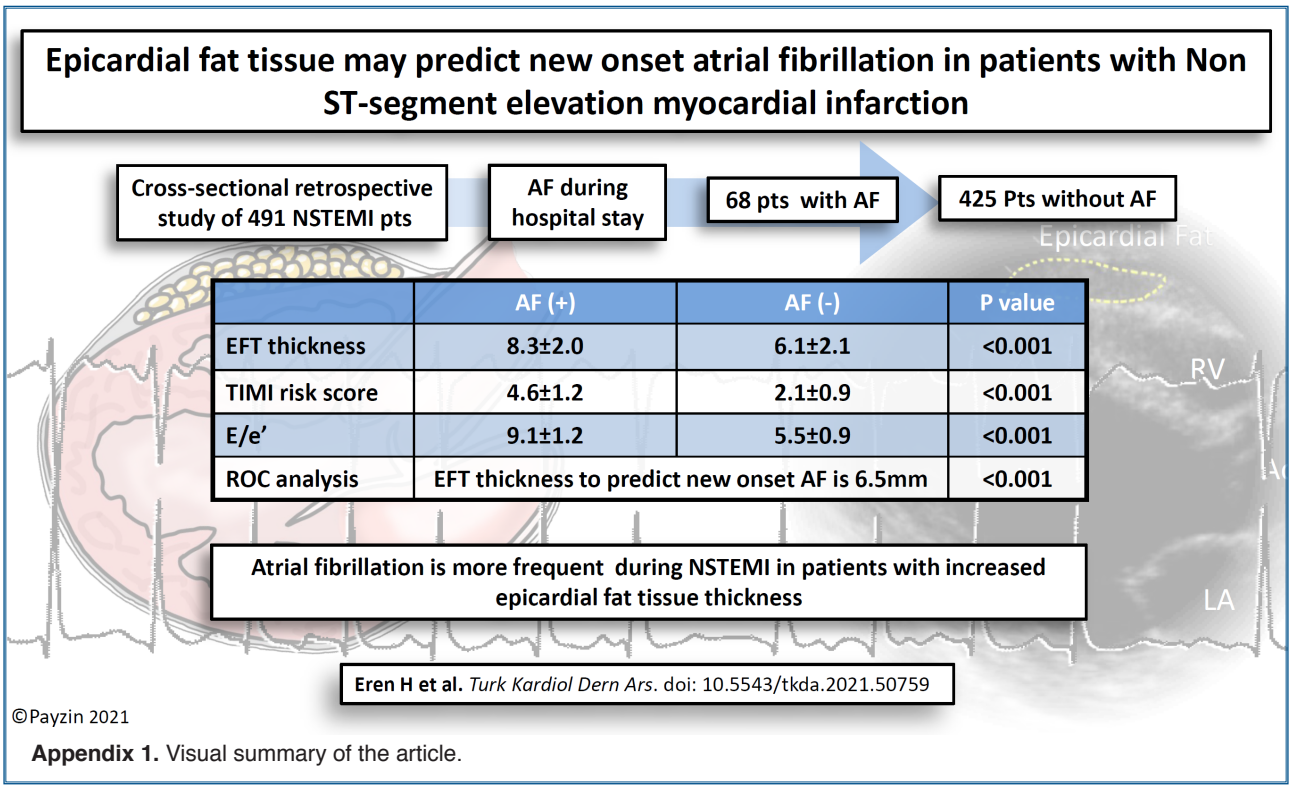
REFERENCES

1. Crenshaw BS, Ward SR, Granger CB, Stebbins AL, Topol EJ, Califf RM. Atrial fibrillation in the setting of acute myocardial infarction: the GUSTO-I experience. Global Utilization of Streptokinase and TPA for Occluded Coronary Arteries. J Am Coll Cardiol 1997;30:406-13.
2. Mohamed MO, Kirchhof P, Vidovich M, Savage M, Rashid M, Kwok CS, et al. Effect of concomitant atrial fibrillation on in-hospital outcomes of non-st-elevation-acute coronary syndrome-related hospitalizations in the United States. Am J Cardiol 2019;124:465-475. [Crossref]
3. Narasimhan B, Patel N, Chakraborty S, Bandyopadhyay D, Sreenivasan J, Hajra A, et al. Impact of atrial fibrillation on acute coronary syndrome; analysis of in-hospital outcomes and 30-day readmissions. Curr Probl Cardiol 2020;46:100764. [Crossref]
4. Kinjo K, Sato H, Sato H, Ohnishi Y, Hishida E, Nakatani D, et al. Osaka Acute Coronary Insufficiency Study (OACIS) Group. Prognostic significance of atrial fibrillation/atrial flutter in patients with acute myocardial infarction treated with percutaneous coronary intervention. Am J Cardiol 2003;92:1150-4. [Crossref]
5. Mrdovic I, Savic L, Krljanac G, Perunicic J, Asanin M, Lasica R, et al. Incidence, predictors, and 30-day outcomes of new-onset atrial fibrillation after primary percutaneous coronary intervention: insight into the RISK-PCI trial. Coron Artery Dis 2012;23:1-8. [Crossref]
6. Iacobellis G. Local and systemic effects of the multifaceted epicardial adipose tissue depot. Nat Rev Endocrinol 2015;11:363-71. [Crossref]
7. Al Chekakie MO, Welles CC, Metoyer R, Ibrahim A, Shapira AR, Cytron J, et al. Pericardial fat is independently associated with human atrial fibrillation. J Am Coll Cardiol 2010;56:784-8. [Crossref]
8. Thanassoulis G, Massaro JM, O'Donnell CJ, Hoffmann U, Levy D, Ellinor PT, et al. Pericardial fat is associated with prevalent atrial fibrillation: the Framingham Heart Study. Circ Arrhythm Electrophysiol 2010;3:345-50. [Crossref]
9. Savaş Ö, Mürsel Ş, Merih K. Relationship between epicardial fat thickness and cardioversion success in patients with atrial fibrillation. Sakarya Medical Journal 2019;9:125-30. [Crossref]
10. Çullu N, Kantarcı M, Kızrak Y, Pirimoğlu B, Bayraktutan Ü, Oğul H, et al. Does epicardial adipose tissue volume provide information about the presence and localization of coronary artery disease? Anatol J Cardiol 2015;15:355-9. [Crossref]
11. Karmazyn M, Purdham DM, Rajapurohitam V, Zeidan A. Signalling mechanisms underlying the metabolic and other effects of adipokines on the heart. Cardiovasc Res 2008;79:279-86. [Crossref]
12. Hernández-Romero D, Jover E, Marín F, Vilchez JA, Manzano-Fernandez S, Romera M, et al. The prognostic role of the adiponectin levels in atrial fibrillation. Eur J Clin Invest 2013;43:168-73. [Crossref]
13. Roffi M, Patrono C, Collet JP, Mueller C, Valgimigli M, Andreotti F, et al. ESC Scientific Document Group. 2015 ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation: Task Force for the Management of Acute Coronary Syndromes in Patients Presenting without Persistent ST-Segment Elevation of the European Society of Cardiology (ESC). Eur Heart J 2016;37:267-315. [Crossref]
14. Antman EM, Cohen M, Bernink PJ, McCabe CH, Horacek T, Papuchis G, et al. The TIMI risk score for unstable angina/non-ST elevation MI: a method for prognostication and therapeutic decision making. JAMA 2000;284:835-42. [Crossref]
15. Lang RM, Badano LP, Mor-Avi V, Afilalo J, Armstrong A, Ernande L, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr 2015;28:1-39.e14. [Crossref]
16. Iacobellis G, Assael F, Ribaudo MC, Zappaterreno A, Alessi G, Di Mario U, et al. Epicardial fat from echocardiography: a new method for visceral adipose tissue prediction. Obes Res 2003;11:304-10. [Crossref]
17. Wong CX, Ganesan AN, Selvanayagam JB. Epicardial fat and atrial fibrillation: current evidence, potential mechanisms, clinical implications, and future directions. Eur Heart J 2017;38:1294-302. [Crossref]
18. Goudis CA, Vasileiadis IE, Liu T. Epicardial adipose tissue and atrial fibrillation: pathophysiological mechanisms, clinical implications, and potential therapies. Curr Med Res Opin 2018;34:1933-43. [Crossref]
19. Okumura Y. Cardiac arrhythmia due to epicardial fat: is it a modifiable risk? Curr Cardiovasc Risk Rep 2017;11-23. [Crossref]
20. Gorter PM, de Vos AM, van der Graaf Y, Stella PR, Doevendans PA, Meijs MF, et al. Relation of epicardial and pericoronary fat to coronary atherosclerosis and coronary artery calcium in patients undergoing coronary angiography. Am J Cardiol 2008;102:380-5. [Crossref]
21. de Vos AM, Prokop M, Roos CJ, Meijs MF, van der Schouw YT, Rutten A, et al. Peri-coronary epicardial adipose tissue is related to cardiovascular risk factors and coronary artery calcification in postmenopausal women. Eur Heart J 2008;29:777-83. [Crossref]
22. Wang TD, Lee WJ, Shih FY, Huang CH, Chen WJ, Lee YT, et al. Association of epicardial adipose tissue with coronary atherosclerosis is region-specific and independent of conventional risk factors and intra-abdominal adiposity. Atherosclerosis 2010;213:279-87. [Crossref]
23. Shemirani H, Khoshavi M. Correlation of echocardiographic epicardial fat thickness with severity of coronary artery disease-an observational study. Anadolu Kardiyol Derg 2012;12:200-5. [Crossref]
24. Duman, H, Değirmenci H, Bakırcı EM, Demirelli S, Hamur H, Demirtaş L. Paroksismal Atriyal Fibrilasyonda Epikardiyal Yağ Dokusu Kalınlığı ve Sol Atriyum Global Longitudinal Strain Arasındaki İlişki. Medical Network Cardiology 2015;22:14-20.
25. Kurt M, Tanboğa İH, Aksakal E, Karakoyun S. Relation between epicardial fat tissue and atrial fibrillation. J Clin Exp Invest 2012;3:13-7. [Crossref]
26. Harada K, Amano T, Uetani T, Tokuda Y, Kitagawa K, Shimbo Y, et al. Cardiac 64-multislice computed tomogra-

phy reveals increased epicardial fat volume in patients with acute coronary syndrome. Am J Cardiol 2011;108:1119-23. [Crossref]
27. Cheng VY, Dey D, Tamarappoo B, Nakazato R, Gransar H, Miranda-Peats R, et al. Pericardial fat burden on ECG-gated noncontrast CT in asymptomatic patients who subsequently experience adverse cardiovascular events. JACC Cardiovasc Imaging 2010;3:352-60. [Crossref]
28. Ding J, Hsu FC, Harris TB, Liu Y, Kritchevsky SB, Szklo M, et al. The association of pericardial fat with incident coronary heart disease: the Multi-Ethnic Study of Atherosclerosis (MESA). Am J Clin Nutr 2009;90:499-504. [Crossref]
29. Alexopoulos N, McLean DS, Janik M, Arepalli CD, Stillman AE, Raggi P. Epicardial adipose tissue and coronary artery plaque characteristics. Atherosclerosis 2010;210:150-4. [Crossref]
30. Akcay M, Sahin M. Association of epicardial adipose tissue thickness with extent and complexity of coronary artery disease in patients with acute coronary syndrome. Acta Cardiol Sin 2019;35:459-67.
31. Gul I, Zungur M, Aykan AC, Gokdeniz T, Kalaycioğlu E, Turan T, et al. The relationship between GRACE score and epicardial fat thickness in non-STEMI patients. Arq Bras Cardiol 2016;106:194-200. [Crossref]
32. Dai Y, Yang J, Gao Z, Xu H, Sun Y, Wu Y, et al. CAMI Registry study group. Atrial fibrillation in patients hospitalized with acute myocardial infarction: analysis of the china acute myocardial infarction (CAMI) registry. BMC Cardiovasc Disord 2017;17:2. [Crossref]
33. Bengtson LG, Chen LY, Chamberlain AM, Michos ED, Whitsel EA, Lutsey PL, et al. Temporal trends in the occurrence and outcomes of atrial fibrillation in patients with acute myocardial infarction (from the Atherosclerosis Risk in Communities Surveillance Study). Am J Cardiol 2014;114:692-7. [Crossref]
34. Kudaiberdieva G, Gorenek B. Post PCI atrial fibrillation. Acute Card Care 2007;9:69-76. [Crossref]
35. Calkins H, Kuck KH, Cappato R, Brugada J, Camm AJ, Chen SA, et al. 2012 HRS/EHRA/ECAS Expert Consensus Statement on Catheter and Surgical Ablation of Atrial Fibrillation: recommendations for patient selection, procedural techniques, patient management and follow-up, definitions, endpoints, and research trial design. Europace 2012;14:528-606.
36. Iacobellis G, Diaz S, Mendez A, Goldberg R. Increased epicardial fat and plasma leptin in type 1 diabetes independently of obesity. Nutr Metab Cardiovasc Dis 2014;24:725-9. [Crossref]
37. Iacobellis G. Epicardial adipose tissue in endocrine and metabolic diseases. Endocrine 2014;46:8-15. [Crossref]
38. Cetin M, Cakici M, Polat M, Suner A, Zencir C, Ardic I. Relation of epicardial fat thickness with carotid intima-media thickness in patients with type 2 diabetes mellitus. Int J Endocrinol 2013;2013:769175. [Crossref]
39. Wang CP, Hsu HL, Hung WC, Yu TH, Chen YH, Chiu CA, et al. Increased epicardial adipose tissue (EAT) volume in type 2 diabetes mellitus and association with metabolic syndrome and severity of coronary atherosclerosis. Clin Endocrinol (Oxf) 2009;70:876-82. [Crossref]
40. Iacobellis G, Malavazos AE. Pericardial adipose tissue, atherosclerosis, and cardiovascular disease risk factors: the Jackson Heart Study: comment on Liu et al. Diabetes Care 2010;33:e127. [Crossref]
41. Iacobellis G, Ribaudo MC, Assael F, Vecci E, Tiberti C, Zappaterreno A, et al. Echocardiographic epicardial adipose tissue is related to anthropometric and clinical parameters of metabolic syndrome: a new indicator of cardiovascular risk. J Clin Endocrinol Metab 2003;88:5163-8. [Crossref]
42. Eroğlu S, Sade LE, Yıldırır A, Demir Ö, Müderrisoğlu H. Association of epicardial adipose tissue thickness by echocardiography and hypertension. Turk Kardiyol Dern Ars 2013;41:115-22. [Crossref]
43. Yoshizaki T, Umetani K, Ino Y, Takahashi S, Nakamura M, Seto T, et al. Activated inflammation is related to the incidence of atrial fibrillation in patients with acute myocardial infarction. Intern Med 2012;51:1467-71. [Crossref]
44. Stamboul K, Fauchier L, Gudjoncik A, Buffet P, Garnier F, Lorgis L, et al. New insights into symptomatic or silent atrial fibrillation complicating acute myocardial infarction. Arch Cardiovasc Dis 2015;108:598-605. [Crossref]

Keywords: Coronary artery disease; new-onset atrial fibrillation; epicardial fat tissue; non-ST-elevation myocardial infarction

Anahtar Kelimeler: Koroner arter hastalığı; yeni başlangıçlı atriyal fibrilasyon; epikardiyal yağ dokusu; ST elevasyonsuz miyokart enfarktüsü



	AF (+)	AF (-)	P value
EFT thickness	8.3±2.0	6.1±2.1	<0.001
TIMI risk score	4.6±1.2	2.1±0.9	<0.001
E/e'	9.1±1.2	5.5±0.9	<0.001
ROC analysis	EFT thickness to predict new onset AF is 6.5mm		<0.001

Appendix 1. Visual summary of the article.