

Relationship Between Epicardial Fat Thickness and Cardioversion Success in Patients with Atrial Fibrillation

Atriyal Fibrilasyon Hastalarında Epikardiyal Yağ Kalınlığı ile Kardiyoversiyon Başarısı Arasındaki İlişki

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Abstract

Objective	Epicardial fat tissue is known to be arrhythmogenic. In this study we aimed to evaluate if this arrhythmogenic effect affects cardioversion (CV) success in patients with atrial fibrillation (AF). (<i>Sakarya Med J</i> 2019, 9(1):125-130)
Materials and Methods	We studied 100 AF patients treated with CV in order to restore sinus rhythm. Patients were divided into two groups; Group 1 patients were successfully restored sinus rhythm and group 2 were failed to restore sinus rhythm. Demographic characteristics of study population, standard 2 dimensional Doppler and tissue Doppler echocardiographic findings were recorded.
Results	There were 94 patients (59.5±14.1, years) in group 1 and 6 patients (59±8.7, years) in group 2. There were no differences between the two groups in terms of patient demographics. Basic echocardiographic parameters such as left atrial diameter, left ventricular diameter, septal thickness, ejection fraction, and left ventricular mass index were also similar between two groups. Epicardial fat thickness (EFT) was higher in group 2 patients (p=0.002).
Conclusion	Increased epicardial fat thickness found to be related with reduced CV success rates in the AF patients.
Keywords	Epicardial fat thickness; atrial fibrillation; cardioversion

Öz

Amaç	Epikardiyal yağ dokusunun aritmogenik etkileri bilinmektedir. Bu çalışmada bu aritmogenik etkinin kardiyoversiyon (KV) başarısı üzerine olan etkisinin araştırılması amaçlanmıştır. (<i>Sakarya Tıp Dergisi</i> 2019, 9(1):125-130).
Gereç ve Yöntem	Çalışmaya sinüs ritminin sağlanması amacıyla KV uygulanan 100 atriyal fibrilasyon (AF) hastası alınmıştır. Hastalar iki gruba ayrıldı; sinüs ritmi sağlanan hastalar grup 1, sağlanamayan hastalar grup 2 olarak değerlendirildi. Çalışma popülasyonunun karakteristik özellikleri, standart 2 boyutlu ekokardiyografik ölçümler ve doku doppler ölçümleri kaydedildi.
Bulgular	Grup 1'de 94 (ortalama yaş 59,5±14,1) grup 2'de 6 (ortalama yaş 59±8,7) hasta vardı. Temel hasta özellikleri açısından gruplar arasında fark yoktu. Sol atriyum çapı, sol ventrikül çapları, septal duvar kalınlıkları, ejeksiyon fraksiyonu ve sol ventrikül kitle indeksi gibi ekokardiyografik parametreler açısından her iki grup benzerdi. Epikardiyal yağ kalınlığı (EYK) grup 2 hastalarda daha yüksekti (p=0,002).
Sonuç	Artmış EYK, AF hastalarında KV başarı oranlarında azalma ile ilişkili bulunmuştur.
Anahtar Kelimeler	Epikardiyal yağ kalınlığı; atriyal fibrilasyon; kardiyoversiyon

INTRODUCTION

Atrial fibrillation (AF) is the most common and leading type of arrhythmia responsible for hospitalization. AF is frequently related with structural and functional changes in myocardial tissue.¹ Epicardial fat membrane is a metabolically active tissue. Epicardial fat tissue is the brown lipid tissue present between epicard and visceral pericard.² It has been known that epicardial fat tissue is responsible from the release of inflammatory cytokines, growth factors and adipocytokines such as matrix metalloproteases (MMP) which are believed to be the cause of AF. Activin-A was shown to cause fibrosis in the atriums due to its pro-fibrotic effects. It has been shown that epicardial fat thickness (EFT) causes atrial fibrosis by increasing the production of extracellular matrix and transforming fibroblasts to myofibroblasts by releasing inflammatory cytokines and adipokines.³ Studies have shown that the two most important adipokines causing atrial fibrosis are activin-A and MMP.^{3,4} Among MMPs, especially increase in the activities of MMP-2 and MMP-7 is found to be related with fibrosis.⁴ There are studies which showed that the increase in EFT can cause an increase in AF risk with the mentioned mechanisms.^{5,6}

In this study, we aimed to evaluate the effect of EFT on cardioversion (CV) success in patients with AF. The results of this study will provide insight if EFT could predict CV success and could be used for determining treatment strategies of AF patients.

MATERIALS and METHODS

Study Population

This observational, single center, cross sectional research was performed in Karadeniz Technical University Faculty of Medicine, Department of Cardiology between 2014 and 2016 years with 203 AF patients with planned CV for restoring sinus rhythm. Electrical CV applied to patients who did not return to sinus rhythm after 24 hours amiodarone infusion. After ruling out 103 patients for several reasons, remaining 100 patients were included

in the study. Demographic properties of all patients were recorded.

Study inclusion criteria was all patients who underwent CV for AF.

Study exclusion criteria were moderate or severe heart valve disease, heart valve replacement, congenital heart disease, hypertrophic cardiomyopathy, presence of permanent pacemaker, left ventricular ejection fraction (LVEF) less than %50, untreated thyroid disorders and those under 18 years old.

Ethics committee approval certificate was taken from Karadeniz Technical University Faculty of Medicine scientific research ethics committee on 26.04.2016.

Transthoracic Echocardiography

Study population were evaluated before CV procedure by transthoracic echocardiography (TTE), (Vivid 7, GE Vingmed Ultrasound, Horten, Norway). LVEF, dimensions of heart chambers and EFT measurements were recorded. A vertical line drawn from right ventricular free wall to aortic annulus in parasternal long axis image was used for determining the correct place for EFT measurement. Average of three measurements at the end of systole were used.⁷ Left ventricular mass index was determined by using Devereux formula. LVEF was measured by modified bip-lane Simpson's method from apical 4 and 2 chamber views.

Statistical Analysis

The descriptive statistics of the continuous variables obtained in the study were given as mean \pm SD. The normality of the numerical variables was determined by the 1-sample Kolmogorov-Smirnov test. Student t test was used to compare normally distributed variables, and Mann-Whitney U test was used to compare non-normally distributed variables. Chi-square test was used to calculate the categorical variables and described as percentages. Statistical significance level is accepted as $p < 0.05$. SPSS 21.0 statistical program was used for data analysis.

RESULTS

Between 2014 and 2016 years, 203 AF patients were planned CV (medical or electrical) for restoring sinus rhythm. Due to several reasons, 58 patients with LVEF <%50, 23 patients having moderate or severe valvular heart disease, 4 patients with permanent pacemakers, 8 patients with heart valve replacement, 7 patients with hypertrophic cardiomyopathy and 3 patients who did not want to participate in the study, a total of 103 patients were excluded from the study. Patients were divided into two groups as group 1; sinus rhythm restored and group 2; sinus rhythm couldn't be restored . There were 94 patients in group 1, and 6 patients in group 2. Mean age in group 1 was 59.5±14.1 and 59±8.7 in group 2 (p=0.93). Clinical and demographical properties of study patients are shown in Table 1.

Patients in the study were also evaluated by AF types; %64 of patients was paroxysmal, %31 was persistent and %6 was long persistent AF. Among the 6 patients who did not

return to sinus rhythm with CV, 1 had paroxysmal and 5 patient had long persistent AF. When the AF groups in the study compared with each other in terms of CV success, the group with long persistent AF had the lowest success rates (p<0.001) (Table 2).

There were no statistically significant differences between group 1 and group 2 for other TTE parameters, except right ventricular (RV) diameter, left ventricular posterior wall (PW) thickness and EFT. RV diameters and left ventricular PW thicknesses of patients in group 1 was higher compared to patients in group 2 and EFT of patients in group 2 was higher compared to group 1 (p=0,02; p=0,01; p=0,002). Basal TTE parameters of patients are shown in Table 3.

Table 1. Clinical and Demographic Characteristics of cardioversion process successful and non-successful patient groups

	Successful CV patients (n=94)	Unsuccessful CV patients (n=6)	P
Age (years)	59.5±14.1	59±8.7	0.93
Female,n (%)	50 (%53.2)	4 (%66.7)	0.52
BMI (kg/m ²)	30.1±5.9	32.1±5.1	0.29
Hypertension,n (%)	51 (%54.3)	4 (%66.7)	0.55
Diabetes Mellitus,n (%)	14 (%14.9)	0 (%0)	NA
Smoking,n (%)	11 (%11.7)	2 (%33.3)	0.17
Stroke/TIA history,n (%)	5 (%5.3)	1 (%16.7)	0.31
Heart failure,n (%)	10 (%10.6)	0 (%0)	NA
CHA2DS2-VASc score	2±1.7	2±1.3	0.81

CV: Cardioversion, BMI: Body mass index, TIA: Transient Ischemic Attack

Table 2. Cardioversion success rates by AF Type

Type of AF	Successful CV patients (n=94)	Unsuccessful CV patients (n=6)	P
Paroxysmal AF (%)	63 (%67)	1 (%17)	<0.001
Persistent AF (%)	31 (%33)	0 (%0)	
Long persistent AF (%)	0 (%0)	5 (%83)	

AF: Atrial fibrillation, CV: Cardioversion

Table 3. Transthoracic Echocardiography Parameters of cardioversion process successful and non-successful patient groups

	Successful CV patients (n=94)	Unsuccessful CV patients (n=6)	P
LVEF (%)	62.2±4.5	60.3±3.7	0.21
LVSD (mm)	31.5±4.2	33.3±4.1	0.29
LVDD (mm)	47.9±4.2	48±5.2	0.95
LA (mm)	40±4.9	43.2±3.8	0.12
IVS (mm)	11.2±1.5	10.3±0.5	0.18
PW (mm)	10.5±1.3	9.7±0.5	0.01
LVMI (gr/m ²)	98.2±21.5	83.3±9.3	0.07
DT (msn)	180.3±35.5	180.7±37.5	0.84
RV (mm)	34.8±3.4	31.5±2.7	0.02
RA (mm)	39.7±4.3	38.8±2.1	0.64
TAPSE	22±3.9	19.8±1.6	0.14
sPAP (mmHg)	26.1±9.2	22.3±3.6	0.34
Epicardial fat (mm)	2.37±1.0	4.17±1.33	0.002

CV: Cardioversion, LVEF: Left ventricular ejection fraction, LVSD: Left ventricular systolic diameter, LVDD: Left ventricular diastolic diameter, LA: Left atrium, IVS: Interventricular septum, PW: Posterior wall, LVMI: Left ventricular mass index, DT: Deceleration time, RV: Right ventricle, RA: Right atrium, TAPSE: Tricuspid annular plane systolic excursion, sPAP: Systolic pulmonary artery pressure

DISCUSSION

In this study, we investigated the effect of EFT on CV success in the AF patients who were planned to restore sinus rhythm. There were no statistically significant differences in terms of demographic properties of patients who returned to sinus rhythm (group 1) and those who did not return to sinus rhythm (group 2). Except RV diameter, left ventricular PW thickness and EFT, there were no statistically significant differences between group 1 and group 2 among TTE parameters. When compared with group 1 and group 2, RV diameters and left ventricular PW thicknesses were higher in group 1 and EFT was higher in group 2.

Although studies have shown that EFT is related with AF, there is not enough evidence about the effect of the increased EFT on CV success in the AF patients. This study was performed to investigate whether changes in EFT affects CV success in patients with AF.

Several studies have been performed to investigate the relationship between epicardial fat tissue and AF.⁸⁻¹² In Framingham study, after other risk factors related to AF were adjusted, total epicardial fat tissue was found to be related with AF.¹³ Batal et al. investigated 169 AF patients with coronary artery disease and found that EFT measured with computerized tomography (CT) was independently related to AF aside from body mass index (BMI) and left atrium (LA) diameter.⁹ It has been found that the increase in EFT increases AF risk. Chekakie et al. showed that after adjusting BMI, LA diameter and other conventional risk factors, there is a relation between EFT and AF. In another study that EFT was measured with cardiac magnetic resonance imaging,⁸ Wong et. al found that the increase in EFT was related with the prevalence and severity of AF.¹²

Iacobellis et al. and Nagashima et. al, found that increase in EFT is related to chronic or persistent AF.^{10,11} In our study, EFT was higher in the group with long persistent AF compared to persistent and paroxysmal AF groups. Out of 6

patients that sinus rhythm can not be achieved, 5 of them had long persistent AF and the EFT of these patients were found to be statistically higher than other patient groups and this finding is consistent with other studies.

Jadranka et al. measured epicardial fat volume of AF patients with CT that radiofrequency ablation performed and found that increase in epicardial fat tissue decreases the success of AF ablation procedure and was related with early relapse of AF.¹⁴ Our study results also support these findings that EFT is closely related with AF and resistance to treatment strategies.

In our study we found that EFT thickness were higher in unseccesful cardioversion group statistical significantly. This result suggests that EFT thickness measurement, which will be easy and take less time during the measurement of routine echocardiographic parameters, may give an idea about the success of CV procedure in AF patients. Thus, we consider that patients with higher risk of relapse and failure of CV procedure measurement of EFT may be beneficial in reducing the procedures rate and related hospitalization.

Limitations

Low patient numbers included in the study and numerical differences between study groups were important limitations. Similar distrubution of several risk factors which are accepted to form tendency towards AF between the groups, reduced the disadvantage of patient number.

CONCLUSION

An increase in epicardial fat tissue thickness was found to be associated with the success of CV procedure. In conclusion, this study suggests that EFT may be associated with CV success and may be used as a promising parameter in evaluating the treatment approach of the patient before CV. Due to small number of patients in our study, larger studies are needed.

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