Epicardial Fat Thickness May be Used in the Differential Diagnosis of Atrioventricular Nodal Re-entrant and Atrioventricular Re-entrant Tachycardia

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ABSTRACT

Introduction: Epicardial fat thickness (EFT) is known to play a role in arrhythmic events. In this study, we analysed the feasibility of using EFT in the differential diagnosis of supraventricular arrhythmias.

Patients and Methods: A total of 259 patients were included in the study, all of whom had applied to our outpatient clinic with palpitation complaints or who had been diagnosed with SVT by surface electrocardiogram (ECG) and had undergone complete electrophysiological studies (EPS). The patients' demographic and echocardiography data along with their EPS-based diagnoses were recorded.

Results: We included 88 control patients, 95 atrioventricular nodal re-entrant tachycardia (AVNRT) patients and 65 atrioventricular re-entrant tachycardia (AVRT) patients. Transthoracic echocardiography (TTE) data showed that the EFT in AVRT group was increased significantly (p= 0.001). In multinomial logistic regression analysis, EFT was identified as an independent predictor (OR:2.2 95% CI: 1.456-5.478, p< 0.001). receiver operating characteristic analysis showed that, when EFT is given at 15 mm, AVNRT and AVRT differentiation can be performed with 77.3% sensitivity and 58.9% specificity.

Conclusion: EFT may be increased in patients with AVRT and can be used in differential diagnoses.

Key Words: Epicardial fat thickness; supraventricular arrhythmia; differential diagnosis

Atriyoventriküler Nodal Reentran ve Atriyoventriküler Reentran Taşikardili Hastaların Ayırıcı Tanısında Epikardiyal Yağ Kalınlığı Kullanılabilir

ÖZET

Giriş: Epikardiyal yağ kalınlığı (EYK) aritmik olaylarda rolü olduğu bilinmektedir. Biz bu çalışmada supraventriküler aritmilerin ayırıcı tanısında EYK'nın kullanılabilirliğini araştırdık.

Hastalar ve Yöntem: Kliniğimize çarpıntı şikayeti ile başvuran veya yüzeyel EKG'de SVT tanısı olan ve elektrofizyolojik çalışma (EFÇ) yapılmış 259 hasta dahil edildi. Hastaların demografik, ekokardiyografik verileri ile birlikte EFÇ ile belirlenmiş tanıları kaydedildi.

Bulgular: Çalışmamıza; 88 adet kontrol, 95 adet AVNRT ve 66 adet AVRT'li hastayı dahil ettik. TTE verileri karşılaştırıldığında ise; epikardiyal yağ kalınlığı (p= 0.001) AVRT'li hasta grubunda anlamlı oranda artmış olarak tespit edildi. Binominal lojistik regresyon analizinde EYK bağımsız prediktor olarak tespit edildi (OR:2.2 %95 GA: 1.456-5.478, p< 0.001). Yapılan ROC analizinde, EYK kesim değeri 15 mm olarak alındığında %77.3 sensitivite ve %58.9 spesifite ile AVNRT, AVRT ayrımının yapılabileceği tespit edildi.

Sonuç: Epikardiyal yağ kalınlığı AVRT'li hastalarda artmış olabilir ve ayırıcı tanıda kullanılabilir.

Anahtar Kelimeler: Epikardiyal yağ kalınlığı, supraventriküler aritmi, ayırıcı tanı

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INTRODUCTION

Supraventricular tachycardia (SVT) is seen at 3.5% in the community and varies with race, age and gender[1,2]. SVT is a frequently recurring, episodic and rarely life-threatening form of arrhythmia. Among the SVT, atrioventricular re-entrant tachycardia (AVRT) and atrioventricular nodal re-entrant tachycardia (AVNRT) are the most frequent types of arrhythmias. Both form the majority of arrhythmias that have a sudden onset and resolution[1].

A diagnosis of AVNRT and AVRT can be made by surface electrocardiograms (ECG) and also with the help of a few manoeuvres during electrophysiological study (EPS)[3,4]. In patients with AVNRT and AVRT, the origination of tachycardia can be anatomically different[4,5].

In previous studies, the anatomic structure was analysed by fluoroscopy, computed tomography scanning, 3-D mapping and transthoracic echocardiography (TTE)[6-8].

Epicardial fat thickness (EFT) measurement is a non-invasive, easy and cheap method that can be performed by TTE and is reported to play a role in arrhythmic events[9]. EFT measurement may be used before EPS and the procedure time may be shorter. Although there are reports that indicate a close link with atrial fibrillation (AF), there is no clear evidence showing its association with any other SVT.

In this study, our aim is to study the differences in EFT measured by TTE in patients with AVNRT and AVRT.

PATIENTS and METHODS

Demographics

A total of 259 patients were included in this cross-sectional study, all of whom had applied to our outpatient clinic with palpitation complaints or who had been diagnosed with SVT by surface electrocardiogram (ECG) and had undergone complete electrophysiological studies (EPS) between January 2019 and April 2019. The study was conducted according to the Declaration of Helsinki and the study protocol was approved by the Local Ethics Committee of Adana City Training and Research Hospital. Patients with a history of coronary disease, valvular heart disease, heart failure and pregnancy or suspected pregnancy were excluded. Systolic and diastolic blood pressure measurements were recorded and risk factors were examined. Demographic data of the study cases were recorded.

Transthoracic Echocardiography Measurements

TTE examinations were performed by the EPIQ 7 (Philips Healthcare, Andover, MA, USA) device. Examinations were performed in supine and left lateral recumbent positions with adequate echocardiographic windows using M-mode, two-dimensional, coloured Doppler and pulse-wave Doppler echocardiography procedures. The parasternal and long-axis images obtained were in conformity with the American Echocardiography Association. Left ventricle systolic and diastolic dimensions, end diastolic septum, rear wall thickness and left atrium dimensions were measured by the M-mode method. Wall movements, valve structure and functions and pericardial pathological examination of both ventricles were done. The patients' available apical four-space images were obtained in the left lateral recumbent position. Minimum and maximum volume images in the systole and diastole of the left ventricle were obtained. End systolic and end diastolic volume and ejection fraction calculations were done according to the Simpson's method. Left atrium spaces based on two-space and four-space images were calculated according to the Simpson's method. The end systolic right ventricle-free wall and the parasternal long- and short-axis images were measured for three cardiac cycles and the average was used to determine the EFT.

Electrophysiological Study

The EPS of the patients were performed with the Shimadzu coronary angiography device (Shimadzu, Kyoto, Japan) using standard techniques with right femoral venous catheterisation. Prior to the procedure, informed consent was obtained from all the participants. The high right atrium, tricuspid annulus and right ventricular apex were catheterised using standard techniques and procedures. Base conduction time intervals, automaticity and conduction of sinoatrial node, conduction and refractory period of the AV node and conduction and refractory period of the Purkinje system were evaluated. Stimulation for supraventricular arrhythmias was performed. During the procedure, 1-3 mg of atropine was given to some of the patients when considered necessary by the operator. Ablation was performed for AVNRT and AVRT patients according to the protocol. Patients with no arrythmias were accepted as the control group.

Statistical Analysis

Variables were dichotomised as continuous and categorical. Distribution of the continuous variables was evaluated by Kolmogorov-Smirnov test. Continuous variables in the group data were identified by mean ± standard deviation. Categorical variables were identified as numbers and percentages. Comparisons of continuous variables between the groups were performed with the one-way ANOVA or Kruskal-Wallis test based on the distribution pattern. Comparisons of categorical variables were performed with the Pearson Chi-Square or Fisher's exact test. Multinomial logistic regression analysis was performed for statistically significant variables and independent predictors were determined. The sensitivity and specificity were determined by performing receiver operating characteristic (ROC) analysis on independent predictors. A p-value of < 0.05 was considered statistically significant.

All statistical analyses tests were done by the SPSS version 20.0 (Chicago, IL, USA) statistical software package.

RESULTS

A total of 95 AVNRT, 66 AVRT and 88 control patients were included in our study. Regarding the demographics, there were no significant differences between the groups (Table 1). The TTE findings were similar between the groups. In the SVT group, EFT was significantly higher than the control group ($p< 0.001$) and it was significantly higher in AVRT patients than in AVNRT patients ($p= 0.001$) (Table 2). Multinomial logistic regression analysis was performed on EFT, which showed significant differences in single variable analysis and determined the independent predictor for SVT patients (OR: 2.2 95% CI: 1.456-5.478, $p< 0.001$). ROC analysis showed that, when EFT is given at 15 mm, AVNRT and AVRT differentiation could be

Table 1. Comparisons of patients' demographic findings

	AVNRT (n= 95)	AVRT (n= 66)	Control (n= 88)	p
Age (years)	47.8 ± 12.4	46.1 ± 12.4	48.1 ± 12.5	0.575
Male gender, n (%)	44 (46.3)	32 (48.5)	41 (46.6)	0.578
SBP (mmHg)	121.9 ± 16.7	123.2 ± 16.2	121.2 ± 16.7	0.861
DBP (mmHg)	77.9 ± 11.5	76.3 ± 9.7	78.0 ± 11.5	0.646
Pulse (beat/minute)	77.9 ± 11.9	79.4 ± 12.1	78.4 ± 11.8	0.764
Weight (kg)	73.7 ± 11.2	77.5 ± 11.8	76.5 ± 10.4	0.198
Height (cm)	169.8 ± 9.6	171.1 ± 9.7	171.6 ± 9.6	0.202
Smoking, n (%)	35 (36.8)	25 (37.9)	34 (38.6)	0.696
Diabetes, n (%)	15 (15.8)	13 (19.7)	11 (11.4)	0.114
HT, n (%)	37 (38.9)	24 (36.4)	30 (34.1)	0.241
HPL, n (%)	18 (18.9)	9 (13.6)	10 (17.1)	0.245

AVNRT: Atrioventricular nodal re-entrant tachycardia, AVRT: Atrioventricular re-entrant tachycardia, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, HT: Hypertension, HPL: Hyperlipidaemia.

Table 2. Comparisons of patient 2-D transthoracic echocardiographic findings

	AVNRT (n= 72)	AVRT (n= 58)	Control (n= 88)	p
IVSDD (mm)	9.9 ± 1.6	9.6 ± 1.7	9.8 ± 1.8	0.324
IVSSD (mm)	12.7 ± 1.7	12.3 ± 1.9	12.5 ± 1.6	0.226
PWDD (mm)	10.3 ± 1.7	10.3 ± 1.3	10.4 ± 1.5	0.732
PWSD (mm)	13.1 ± 1.4	12.8 ± 1.4	12.9 ± 1.6	0.241
LVDD (mm)	43.7 ± 5.4	43.7 ± 5.1	44.8 ± 1.5	0.889
LVSD (mm)	28.2 ± 4.2	28.1 ± 4.3	30.4 ± 8.1	0.975
EF (%)	66.4 ± 6.1	65.4 ± 8.6	65.4 ± 7.1	0.506
LAD (mm)	29.4 ± 4.8	29.2 ± 4.9	29.8 ± 0.4	0.824
LAA (2 space) (cm^2)	13.1 ± 3.3	12.8 ± 3.2	13.0 ± 3.4	0.815
LAA (4 space) (cm^2)	12.4 ± 2.8	12.9 ± 2.9	12.1 ± 3.0	0.231
AoD (mm)	25.4 ± 3.4	24.9 ± 3.5	26.1 ± 3.0	0.412
EFT (mm)	16.5 ± 10.4[a]	21.9± 9.5[b]	11.7 ± 4.9[c]	< 0.001

AVNRT: Atrioventricular nodal re-entrant tachycardia, AVRT: Atrioventricular re-entrant tachycardia, IVSDD: Interventricular septum diastolic diameter, IVSD: Interventricular septum systolic diameter, PWDD: Posterior wall diastolic diameter, PWSD: Posterior wall systolic diameter, LVDD: Left ventricular diastolic diameter, LVSD: Left ventricular systolic diameter, EF: Ejection fraction, LAD: Left atrium diameter, LAA: Left atrium area, AoD: Aortic diameter, EFT: Epicardial fatty thickness.

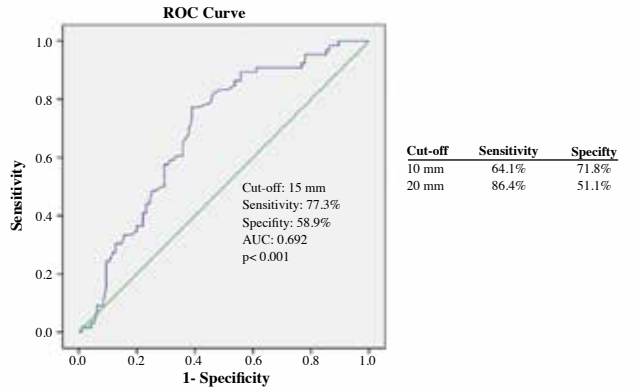

Figure 1. ROC analysis shows the predictive value of epicardial fat thickness in the differential diagnosis of supraventricular arrhythmia patients.

performed with 77.3% sensitivity and 58.9% specificity (AUC: 0.692 (0.611-0.774), p< 0.001, Figure 1).

DISCUSSION

As far as we know, this is the first study in which EFT is investigated in AVNRT and AVRT patients. EFT in SVT patients was higher than that of the control group and was found to be significantly increased in patients with AVRT as compared to patients with AVNRT.

The differentiation of supraventricular arrhythmia is generally performed by measuring the distance from the peak of the R-wave to the retrograde P-wave by a 12-derivation surface ECG.1 In some of the surface ECG records, the P-wave may not be clearly defined and thus, the differentiation may not be performed. Such conditions result in more time being spent in the electrophysiology laboratory and increased radiation exposure for the patient. The EFT increase in AVRT patients that we have shown in our study indicates a simple, non-invasive method that may be very useful to the operator for performing differential diagnosis prior to the EPS.

Epicardial fat tissue is located between parietal and visceral pericardia and is in direct contact with the coronaries. It is derived from the splanchnopleuric mesoderm and secretes cytokines such as interleukin-6, tumour necrosis factor-6, interleukin-1β[11]. Due to direct contact with the coronaries, the secreted cytokines are immediately mixed with the blood stream. There are reports suggesting that increased EFT is associated with increased cardiovascular mortality[13,14]. Many mechanisms are involved in the pathogenesis of AF, a supraventricular arrhythmia, such as inflammation and EFT, as has been seen in some reports[15]. The key mechanism in the development of the AVNRT and AVRT is re-entry[1]. The cytokines secreted from the EFT may stimulate the re-entry mechanism and result in tachycardia. In our study, both groups of EFT were found to be significantly thickened. Dual atrioventricular node physiology is seen in 5%-10% of a healthy population[16]. In this asymptomatic group of patients, due to the increasing number of cytokines secreted from a thickened EFT, some may become symptomatic. The sinus node is a subepicardial structure and covered with a pad of fat[17]. Although the AV node and accessory pathways are usually distributed in the endocardial tissue, there are reports of patients with AVRT showing an epicardial location[18,19]. We think that EFT and accessory pathways may be in a closer contact than in dual node physiology, therefore, EFT may be found thickened in patients with AVRT. Considering this, we can suggest that patients having accessory pathways of inflammatory cytokines that get secreted from epicardial fat tissue may trigger AVRT.

There are some limitations to our study. Despite the fact that we suggested that EFT is found to be increased in AVRT and AVRNT patients, we did not have a control group. We do not know about the mechanism of EFT increase in patients with AVRT. More studies with larger populations are needed to clearly suggest that EFT may be useful in differential diagnosis for these two patient groups.

CONCLUSION

In patients with supraventricular tachycardia and an unclear retrograde P-wave in surface ECG, determining the EFT using TTE may give an idea of the diagnosis. In patients with increased EFT, an AVRT diagnosis may be considered in the first place. EFT measurement before EPS may be useful in achieving a differential diagnosis.

CONFLICT of INTEREST

The authors reported no conflict of interest related to this article.

AUTHORSHIP CONTRIBUTIONS

Concept/Design: AB
Analysis/Interpretation: AB
Data Acquisition: AB
Writting: AB
Critical Revision: AB
Final Approval: AB

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