ASSOCIATION OF EPICARDIAL FAT THICKNESS WITH EJECTION FRACTION IN PATIENTS WITH HEART FAILURE

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Abstract

Background: Heart failure (HF) has significant mortality and morbidity worldwide and affects more than 37 million people. The mortality and morbidity when the left ventricular ejection fraction (LVEF) is > 40 %, is similar when there is low ejection fraction (LVEF < 40 %), and there is an increasing health problem. Studies have shown that epicardial adipose tissue (EAT) has a role in HF pathogenesis. A proinflammatory process on the basis of HF has been shown to be related to EAT.

Aim: We aimed to investigate ejection fraction and epicardial adipose tissue relationship.

Methods: 159 symptomatic HF patients (New York Heart Association functional class ≥II) were included in our study. Age, gender, height, weight, body mass index, waist and demographic characteristics (diabetes mellitus, hypertension, smoking-nonsmoking, coronary artery disease) of all patients were recorded.

Results: We examined 159 HF patients. In our population 46 (28.9 %) patients were female and 113 (71.1 %) patients, male. The mean age of our patients was calculated as 67.4 ± 12.6 years. In our study population 69 (43.4 %) of our patients had diabetes and 93 (58.5 %) had hypertension. 77 (48.4 %) of our patients had a history of smoking. We separated our patients into two groups: LV systolic function in HF with LVEF > 40 % (n: 36) and HF with reduced ejection fraction, LVEF < 40 % (n: 123). In our study EAT, LVEF, LVDD (left ventricular diastolic diameter), LVSD (left ventricular systolic diameter), diastolic septum wall thickness and diastolic posterior wall thickness had differences between groups. Differences in LVEF, LVDD, LVSD, diastolic septum wall thickness and diastolic posterior wall thickness were determined.

Conclusions: Epicardial fat thickness and LVEF had a positive correlation in heart failure patients.

Keywords: *Ejection fraction, Epicardial fat thickness, Heart failure*

Introduction

Heart failure (HF) has significant mortality and morbidity worldwide, and affects more than 37 million people (1). The HF mortality and morbidity from left ventricular ejection fraction (LVEF) > 40 % has similar mortality and morbidity as in low ejection fraction (LVEF < 40 %) HF, and is an increasing health problem (2, 3). There is no specific treatment that reduces mortality and morbidity (4). HF patients with LVEF > 40 % might require specific treatments (5, 6).

Epicardial adipose tissue (EAT) is located between the myocardium and the visceral pericardium, enveloping three-quarters of the heart surface (7). In the studies conducted, a relation was found between EAT and heart failure. In fact, a proinflammatory and adipokines production process has been identified as the basis of the pathogenesis of HF (8). EAT is thought to have an impact on this proinflammatory process and has been associated with the production of adipokines. However, EAT has not been fully associated with the pathogenesis of HF (9). EAT is biologically-active ectopic adipose tissue located around the heart. While EAT generally covers 80 % of the circumference of the heart, many factors affect its volume and thickness. Genetic, epigenetic and environmental factors affect the EAT volume and thickness. Since EAT

has many defined functions, and is also measurable, it has been investigated by various researchers. EAT has functions related to thermogenic and inflammatory processes. In cases where EAT is dysfunctional, coronary vessels and cardiomyocyte diseases have been observed frequently. EAT is thought to play a role in atherogenesis due to the imbalance between proinflammatory cytokines, chemokines and adipokines. It has a role in adjusting heart structure and function. It was also found to be associated with arrhythmia, coronary artery disease, and sleep apnea syndrome.

In this study, the relationship between EAT and LV systolic function in HF with LVEF > 40 % and HF with reduced ejection fraction, LVEF < 40 % was investigated.

Methods

Study population

The study population consisted of 159 patients with heart failure, admitted to Adana State Hospital in 2011-2015. The patients were collected retrospectively. 159 symptomatic HF patients (New York Heart Association functional class ≥II) were included in our study. Age, gender, height, weight, body mass index, waist and demographic characteristics (diabetes mellitus, hypertension, smoking-nonsmoking, coronary artery disease) of all patients were recorded. Since it was coronary artery disease, a history of by-pass, coronary artery intervention and angiography was obtained. Patients' blood pressure and pulse were recorded, as was the history of drugs. Laboratory parameters of routine heart failure patients were examined. We separated our patients into two groups: LV systolic function in HF with LVEF > 40 % and HF with reduced ejection fraction, LVEF < 40 %. Ethical approval was obtained from Adana State Hospital Ethics Committee (ANEAH.EK.2015/134).

Echocardiography

Echocardiographic imaging was done with an iE33 ultrasound system (Philips Healthcare, Bothell, WA, USA) with an S5-1 transducer (Philips Healthcare). Imaging was done in the left lateral decubitus position. All measurements were recorded as apical four and two chambers with parasternal long axis and short axis views. All images were recorded by single cardiologists. In echocardiography, EAT, tricuspid regurgitation, mitral deficiency, left ventricular ejection fraction (LVEF), left ventricular diastolic diameter (LVDD), left ventricular systolic diameter (LVSD), pulmonary artery pressure (PAP), left atrium (LA), septum and posterior wall thickness were measured.

Evaluation of EAT thickness

EAT thickness was evaluated echocardiographically (10). EAT thickness was measured from the free wall of the right ventricle at the end of diastole in the parasternal long and short axis (10-14). The average of these two measured values was specified as EAT thickness. For the measurement of EAT, the depth of the views was increased until the aortic and mitral valves were at their lowest position.

EF

LV volume was measured in apical four and two-chamber views, in the end diastolic and in the end systolic period. Modified Simpson's method was used for EF measurement (15).

Biomarkers

Plasma biomarkers for HF (NT-proBNP), inflammation [C-reactive protein (CRP) and leukocytes], lipid profile and kidney function were recorded from patient files.

Statistical analysis

Statistical analyzes were carried out, using SPSS (version 23, SPSS Inc., Chicago, IL, USA). A p value < 0.05 was considered statistically significant. The differences between the groups were analyzed using independent sample *t*-test.

Results

Baseline characteristics

We examined 159 HF patients. In our population 46 (28.9 %) patients were female and 113 (71.1 %) patients, male. The mean age of our patients was calculated as 67.4 ± 12.6 years. In our study population, 69 (43.4 %) of our patients had diabetes and 93 (58.5 %) had hypertension. 77 (48.4 %) of our patients had a history of smoking. We separated our patients into two groups: LV systolic function in HF with LVEF > 40 % (n: 36) and HF with reduced ejection fraction, LVEF < 40 % (n: 123). The body characteristics of our patients are given in table 1. There were no significant differences between groups in patient baseline characteristics. Vital signs of our patients are given in table 2, and there were no differences between groups. The laboratory parameters of our patients are given in table 3. There was no significant difference between the two groups

Table 1: Demographic characteristics of patients with LVEF > 40 % and patients with LVEF < 40 % with P value

	HF with LVEF > 40 % (n: 36)	HF with LVEF < 40 % (n:123)	P-value
Age (years)	71.4±9	66.3±13	0.05
Male sex, n (%)	28 (77)	85 (69)	0.3
Height (cm)	168.1 ± 7	165.5 ± 9.6	0.08
Weight (kg)	76.8 ± 11	76 ±15	0.7
BMI (kg/m^2)	27 ±3.7	27.6 ±5	0.5
Waist (cm)	99 ±13	98 ±15	0.5

Table 2: Clinical parameters of patients with LVEF > 40 % and patients with LVEF < 40 % with P value

	HF with LVEF > 40 % (n: 36)	HF with LVEF <40% (n:123)	P-value
Heart rate (b.p.m.)	81.5±14	82±16.7	0.8
SBP (mmHg)	125±22	119±23.7	0.3
DBP (mmHg)	75±12	73±12	0.2

Table 3: Laboratory parameters of patients with LVEF > 40 % and patients with LVEF < 40 % with P value

	HF with LVEF > 40% (n: 36)	HF with LVEF <40% (n:123)	P-value
MPV	10.7±1	11.4±8.8	0.3
LDL (mg/dl)	89.4±36	89.2±32.4	0.9
TG (mg/dl)	99±35.7	97.9±39	0.8
HDL (mg/dl)	36.3±12.9	33.7±12	0.2
BNP (mg/dl)	4958±4529	7179±8220	0.1
CRP (mg/dl)	3.7±3.8	3.8±6	0.9
Lymphocyte (10^9/L)	1.5±0.7	1.8±1.1	0.1
Monocytes (10^9/L)	0.87±0.3	0.9±0.4	0.7
WBC (10^9/L)	10±3.8	9.9±4.8	0.6
Platelet (10^9/L)	239±85.7	266.9±152	0.1
Hb (mg/dl)	11.6±1.4	12±2	0.2
HCT	37.4±4.7	37.9±6.5	0.6
Uric acid (mg/dl)	7.2±1.6	7.6±2.3	0.3
BUN (mg/dl)	50.5±21.9	61±32	0.06
Creatinine (mg/dl)	1±0.2	1.2±0.6	0.06
AST (mg/dl)	25.8±13	53.4±107	0.1
ALT (mg/dl)	22±13	55.2±139	0.1

Echocardiographic findings

Echocardiographic findings are given table 4. In our study, EAT, LVEF, EAT; LVEF, LVDD (left ventricular diastolic diameter), LVSD (left ventricular systolic diameter), diastolic septum wall thickness and diastolic posterior wall thickness had differences between groups. Differences of LVEF, LVDD, LVSD, diastolic septum wall thickness and diastolic posterior wall thickness were determined. EAT and LVEF, mean LVDD, LVSD, diastolic septum wall thickness and diastolic posterior wall thickness were correlated and there were differences in groups, as shown in table 5.

Table 4: Echocardiographic data of patients with LVEF > 40 % and patients with LVEF < 40 % with P value

	HF with LVEF > 40% (n: 36)	HF with LVEF <40% (n:123)	P-value
PAP (mmHg)	33.6±12.3	37.2±14	0.1
LVEF (%)	45.6±5.4	27.8±6.1	0
LVDD (cm)	5.3±0.6	6.1±0.8	0
LVSD (cm)	4.2±0.7	5.1±0.8	0
LA (cm)	5.2±5	4.5±0.8	0.1
Diastolic septum wall thickness (cm)	1.2±0.2	0.9±0.2	0
Diastolic posterior wall thickness (cm)	1.1±0.2	1±0.2	0
EAT (mm)	5.5±1.1	3.5±0.9	0

Table 5: Correlations between EAT and LVEF, LVDD, LVSD, diastolic septum wall thickness, and diastolic posterior wall thickness

		LVEF	LVDD	LVSD	Diastolic septum wall thickness	Diastolic posterior wall thickness
EAT (mm)	Pearson Correlation	.619**	-.435**	-.491**	.409**	.359**
	Sig. (2-tailed)	.000	.000	.000	.000	.000
	N	159	159	159	159	159

**Correlation is significant at the 0.01 level (2-tailed)

Discussion

Many studies have shown many factors that correlate with EAT. In our study, there was a correlation between LVEF and EAT. There was a difference between patients with LVEF > 40 % and those with LVEF < 40 %, while EAT was similar in all characteristics. Studies have shown that there is a relationship between EAT and BMI (16). In our study, while there was no relationship between BMI and EAT, there was a relationship between LVEF and EAT. It is associated with increased EAT thickness and HF. Its effect on diastolic and systolic functions has been studied (17,18). Tabakci et al. showed in their study that EAT and EF had positive correlation in patients with nonischemic dilated cardiomyopathy (18). EAT has positive effects on heart health. However, the studies were still insufficient to clearly explain the mechanism. Because EAT is adjacent

to myocardial and coronary vessels, it was thought to be associated with cardiovascular diseases, and this relationship has been linked to the metabolic activity of EAT (19). The reason for the relationship between EAT and systolic function was not fully identified in the studies. In some studies, EAT has been associated with cardiac protective effect due to the cytokines released and energy dependence (20-23).

Study limitations

In our study, EAT thickness was measured from the right ventricular free wall. The total volume measurement of EAT was not performed.

Conclusions

EAT and LVEF had a positive correlation in heart failure patients. It may have occurred as a result of the protective effect of EAT and its metabolic activity. Echocardiographic measurement of EAT is a valuable, practical and cost-effective method that may be used in HF patients to understand the degree of disease.

Competing interests

The authors declare that there are no conflicts of interest.

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