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ORIGINAL RESEARCH

The Correlation between Epicardial Adipose Tissue Thickness and Severity of Coronary Artery Disease; An Echocardiographic Evaluation

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Abstract: Introduction: Epicardial adipose tissue (EAT), as a visceral adipose tissue, is associated with various cardiometabolic risk factors, such as fasting plasma glucose, systemic blood pressure and serum low-density lipoprotein. Using EAT thickness as a cost-efficient assessment tool for stratifying the risk of coronary artery disease (CAD) is still controversial. Methods: We enrolled 250 consecutive patients who underwent coronary angiography during 2016 and gathered their demographic. Echocardiographic examinations were performed in the left lateral decubitus position and EAT thickness was measured in standard parasternal long-axis (PLAX) and apical four chamber views. Results: 250 patients including 156 men (mean age: 57.66) and 94 women (mean age: 61.19) were enrolled. Two vessel disease (2VD) and three vessel disease (3VD) were significantly associated with hyperlipidemia (P: 0.04), CKD (Chronic Kidney Disease) (P: 0.001), diabetes mellitus (P: 0.001) and smoking habits (P: 0.001). Also, EAT thickness in PLAX view (P<0.001), and not four chamber view (P: 0.136), was significantly associated and correlated with increased involvement of coronary arteries in catheterization. Conclusion: Although EAT thickness in PLAX view was significantly correlated with 2VD and 3VD, this correlation was not strong and the accuracy of this approach needs further evaluation.

Keywords: Epicardial Adipose Tissue, Coronary artery disease, Echocardiography, Coronary angiography, Atherosclerosis

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1. Introduction

Excessive epicardial adipose tissue (EAT), as a true visceral fat deposit, accumulates within the pericardial sac and interacts locally through the paracrine or endocrine mechanism by exertion of pro-inflammatory mediators and adipocytokines (1-3) . EAT has a significant correlation with visceral adipose tissue, which has been extensively discussed as a cardiometabolic risk factor (4). Furthermore, several studies have reported a relationship between EAT and other cardiometabolic risk factors, such as fasting plasma glucose, systemic blood pressure and serum low-density lipoprotein (5) . Several studies have discussed the association between EAT thickness and the severity of coronary artery disease (CAD) (6,7). Using echocardiography, previous studies have shown a significant association between CAD and location-specific EAT, although some others did not observe such a relationship using CT or echocardiography (8). Presence and severity of CAD in relation to EAT were studied and coronary angiography approved the mentioned association. Researchers are interested in finding a cost-benefit approach for the imaging of EAT which is reliable for estimating CAD risk. We aimed to investigate EAT by means of transthoracic echocardiography in standard parasternal long-axis (PLAX) and apical four chamber views, in order to assess its association with coronary artery stenosis and patients' demographics.

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2. Materials and Methods

2.1. Patients and methods

250 patients who underwent coronary angiography because of chest pain, an abnormal stress test and/or other clinical conditions were enrolled. All participants contributed to the study in 2016 in Modarres Hospital and all of them were informed and gave their consent to participate in the

study. Patients were excluded if they had abnormal images on transthoracic echocardiography, a history of coronary artery bypass graft surgery or severe vascular disease. Echocardiographic examinations were performed in the left lateral decubitus position. EAT appears as an echo-lucent space between the linear echo-dense parietal pericardium and the right ventricular epicardium, in standard parasternal long-axis (PLAX) and apical four chamber views. Significant stenosis was recorded as a stenosis diameter of ≥50% in the left main coronary artery (LMCA) and ≥70% in vessels other than LMCA and non-obstructive CAD was defined as ≤50%. Severity of CAD was described as non-obstructive CAD (normal), single vessel disease (SVD), two vessel disease (2VD), and three vessel disease (3VD).

2.2. Sample size

This work was designed as a comparative observational study. According to the data from previous published studies and using the formula N=1.96xP/(1-P), we calculate 250 individuals as our sample size.

2.3. Data analysis

Descriptive indexes, including mean and standard deviation were used to express quantitative data. Qualitative data were expressed by frequency and percentage. Continuous variables were analyzed by t test and nominal variables were analyzed by Chi-square test. All analyses were done using SPSS software for Windows (version 20) and the significance level was set at 0.05.

3. Results

3.1. Patients Demographics

156 male and 94 female patients were enrolled with the mean±SD ages of 57.66±14.72 and 61.19±9.98, respectively The demographic, catheterization, and echocardiographic findings, are shown in table 1. The significant difference was in smoking habit between male and female patients (33.3% of men were smokers compared to 3.2 % of the women). Furthermore, there were significantly higher rates of 2VD and 3VD among men, still SVD and normal catheterization were observed more in women.

3.2. Relationship between severity of CAD and clinical features

We assessed the severity of coronary artery disease by catheterization among the patients with different cardiovascular risk factors (Table 2). Increased frequency of hyperlipidemia was significantly associated with severity of CAD (P<0.05). This pattern was also observed in patients with Chronic Kidney Disease, diabetes mellitus (DM) and smoking habits (P<0.05 for patients with CKD and DM and P<0.005 for patients with smoking habit). Accordingly, 3VD diagnosis was more frequent among patients with hyperlipidemia, DM and smoking habit (49%, 49%, and 40%, respectively). Still, most diagnosed 3VD were among the patients without any mentioned risk factors. Many patients with CKD had normal angiography (63%). This could be attributed to routine angiography before kidney transplantation in patients with end stage renal disease. This should be noted that significant differences were not observed in the trend of hypertension-CAD association between patients with and without hypertension.

3.3. Relationship between severity of CAD, age and EAT

We further assessed the EAT in PLAX and four chamber views in relation to severity of CAD (table 3). We found that EAT thickness in PLAX view was significantly associated with increased involvement of coronary arteries in catheterization (P<0.005). This association was not observed in EAT measurement by four chamber view. The correlation between EAT in PLAX and four chamber view and severity of CAD is shown in table 4. EAT thickness in both PLAX and four chamber views were significantly correlated with severity of CAD (rho=0.279 and rho=0.178, respectively, P<0.05). However, these correlations were not strong in PLAX view. We also recorded a signification relationship between the patients' mean age and severity of CAD (P<0.005).

4. Discussion

EAT thickness is associated with various cardio-metabolic risk factors such as hypertension, DM and hyperlipidemia (5). Our data suggested that increased severity of CAD was significantly associated with more EAT, assessed by echocardiography. We also observed a similar correlation between history of hyperlipidemia, CKD, DM, smoking habit and increased number of significant coronary artery stenosis.

Recently, Sinha and colleagues studied 549 consecutive patients with and without CAD and observed that EAT thickness had the potential to stratify the risk of CAD risk with a significant sensitivity and reliability (6). Accordingly, Wang and coworkers discussed that increased SYNTAX score in patients with MI has a strong correlation with the severity of CAD assessed by coronary artery catheterization (9). Although we recorded an important direct correlation of increased EAT thickness in PLAX view with 2VD and 3VD, this correlation was not strong enough to conclude that EAT thickness was a sensitive and reliable measure to detect and evaluate the presence and severity of CAD. With respect to EAT-CAD association, Wu and colleagues analyzed ten observed studies to investigate the relation between location-specific EAT thickness and obstructive CAD (8). They concluded that EAT thickness at the left atrioventricular groove could be a good

predictor of CAD, however, the impact of location-specific EAT at the right ventricular free wall on CAD is still uncertain.
Our risk factor analysis also showed a consistent result with previous studies showing a significant relationship between severity of CAD and its risk factors such as age, hyperlipidemia and diabetes mellitus (10). Overall, we found a significant correlation between EAT thickness in PLAX view of right ventricle as a visceral fat tissue with presence and increased severity of CAD, although this correlation was not strong. Moreover, we also concluded that increased number of coronary artery stenosis had a strong correlation with presence of CAD risk factors.

5. Conclusion

EAT has been described as a cardiometabolic risk factor, we wonder if it had correlation with severity of CAD. Although EAT thickness in PLAX view was significantly correlated with 2VD and 3VD, this correlation was not strong and accuracy of this approach needs further evaluation.

6. Appendix

6.1. Acknowledgement

None.

6.2. Conflict of interest

No conflict of interest.

6.3. Funding and support

None.

6.4. Author's contributions

All the authors have shared the same workload and thereby are entitled to equal contribution.

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Table 1: Demographic data of the studied patients.

Demographic characteristics	Male	Female	P value
Gender (N, %)	156 (62.4 %)	94 (37.6 %)	
Age (mean ± SD)	57.66 ± 14.72	61.19 ± 9.98	0.041
Risk Factors (N, % within males/females)			
CKD	17 (10.9 %)	10 (10.6 %)	0.563
Hypertension	55 (35.3 %)	33 (37.5 %)	0.546
Diabetes Mellitus	46 (29.5 %)	27 (28.7 %)	0.508
Hyperlipidemia	25 (16 %)	24 (25.5 %)	0.049
Smoking	52 (33.3 %)	3 (3.2 %)	0.0001 *
Catheterization (N, % within males/females)			
Normal	47 (30.2 %)	44 (46.8 %)	0.0001 *
SVD	20 (12.8 %)	21 (22.4 %)	
2VD	31 (19.8 %)	6 (6.4 %)	
3VD	58 (37.2 %)	23 (24.4 %)	
Epicardial Adipose Tissue Thickness (mean ± SD)			
PLAX	4.92 ± 2.62	4.87 ± 2.69	0.888
Four Chamber	3.69 ± 2.61	3.64 ± 2.15	0.862

Table 2: Frequency (%) of CAD risk factors and its association with severity of CAD.

		Normal	SVD	2VD	3VD	P value
Hyperlipidemia	Yes	12 (25 %)	6 (12 %)	7 (14 %)	24 (49 %)	0.042 *
	No	79 (39 %)	35 (17 %)	30 (15 %)	57 (29 %)	
CKD	Yes	17 (63 %)	0 (0 %)	0 (0 %)	10 (37 %)	0.001 *
	No	74 (33 %)	41 (18 %)	37 (17 %)	71 (32 %)	
Hypertension	Yes	30 (34 %)	9 (10 %)	12 (14 %)	37 (42 %)	0.061
	No	61 (38 %)	32 (20 %)	25 (15 %)	44 (27 %)	
Diabetes Mellitus	Yes	19 (26 %)	6 (8 %)	12 (17 %)	36 (49 %)	0.001 *
	No	72 (41 %)	35 (20 %)	25 (14 %)	45 (25 %)	
Smoking	Yes	0 (0 %)	15 (27 %)	18 (33 %)	22 (40 %)	0.0001 *
	No	91 (47 %)	26 (13 %)	19 (10 %)	59 (30 %)	

Table 3: The mean age and EAT thickness in PLAX and four chamber views compared with severity of diagnosed CAD.

	Normal	SVD	2VD	3VD	P value
Age (mean ± SD)	54.3 ± 14.1	56.3 ± 10.7	61.7 ± 12.4	64.2 ± 11.5	0.0001 *
PLAX (mean ± SD)	4.14 ± 2.95	4.63 ±1.39	4.71 ± 1.87	5.99 ± 2.7	0.0001 *
Four Chamber (mean ± SD)	3.43 ± 3	3.39 ± 1.1	3.45 ± 1.99	4.21 ± 2.39	0.136

Table 4: Correlation analysis of echocardiographic views for measuring EAT thickness with severity of CAD.

View	r	P value
PLAX	0.279	0.01
Four Chamber	0.178	0.01