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Original Research Article

Epicardial Fat Thickness Assessment by Echocardiography and its Association with Severity of CAD by Coronary Angiogram in a Tertiary Care Hospital, India

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Conflict of interest: Nil

Abstract:

Background: The term "Epicardial adipose tissue" (EAT) refers to the visceral fat that surrounds the heart and is easily assessed in the clinic using conventional transthoracic echocardiography. EAT can release free fatty acids close to coronary arteries, especially in people with coronary artery disease, which disrupts vascular homeostasis and endothelial function. The goal of this study was to determine the EFT cut-off echocardiographic EFT and CAD severity.

Material and Methods: This cross-sectional study was conducted at Department of Cardiology, KAPV medical college, Trichy. 250 study participants with CAD were included in this study. A semi-structured questionnaire is used to collect the demographic details and routine clinical examination, evaluation of risk factor profile, and anthropometric variables were also done. Epicardial fat thickness was measured Routine clinical examination, evaluation of risk factor profile, and anthropometric variables were also done. Epicardial fat thickness was measured by transthoracic echocardiography. Data analysis was done using SPSS and continuous variables and categorical variables were interpreted using frequencies (mean±SD) and proportions (%). Statistical differences between groups for categorical data will analyses using the Chi-squared test.

Results: This study was conducted among 250 patients with coronary artery disease to assess epicardial adipose tissue thickness and its association with CAG reports. The mean age of participants was 54.632±9.98 years and one-third of the population included in this study were male participants in which the male and female ratio was 3:1. In this study, the study population was presented with Diabetes (48.4%), Hypertension (35.2%), current smoker (34.4%), BMI ≥ 25 (64.8%) and Dyslipidemia. 15 patients (6%) had EATT more than 6mm. The mean EATT thickness was 3.1084±1.609 mm ranging from 0.6 mm – 8.10 mm and there was significant association of EATT with CAD with P value<0.01. The patients with triple vessel disease had higher EATT mean values than others and the p-value was found to be statistically significant.

Conclusion: In this study, patients with CAD had considerably higher EFT measured by transthoracic echocardiography than non-CAD. EFT may therefore be helpful in predicting the severity of CAD.

Keywords: Coronary Artery Disease, Epicardial Fat Thickness, Echocardiography.

Introduction

Globally, coronary artery disease (CAD) is a leading cause of mortality and morbidity. The World Health Organisation (WHO) reported in 2005 that 17.5 million (30%) of the 58 million deaths globally were attributable to cardiovascular disease (CVD).[1] India is undergoing an epidemiologic transition in which the prevalence of communicable diseases has been steadily declining while the prevalence of non-communicable diseases (NCD) has been rising quickly, creating a dual burden. In India, the prevalence of CHD has increased fourfold over the past 40 years.[2]

Epicardial fat thickness (EFT) is a measure of the probability of having cardiovascular disease, particularly coronary artery disease (CAD). In physiological conditions, 20% of the heart's weight is made up of epicardial fat tissue, which is mostly deposited in the atrio-ventricular and inter-ventricular grooves exactly where the coronary arteries are situated and which may also interact with the myocardium.[3]

Epicardial fat is critical for maintaining the metabolic and energy equilibrium of the body, and it also plays a crucial role in the release of adipokines and pre-inflammatory cytokines, which have a significant impact on the function of the heart muscle. Since epicardial fat frequently surrounds the coronary artery's main branches and acts as a cushion in the atrioventricular or interventricular groove, it has the compressibility and elasticity necessary to mechanically shield the coronary artery from excessive distortion brought on by arterial pulse and myocardial contraction.[4, 5]

Epicardial fat shares a common embryogenic origin with visceral adipose tissue, a key component of the metabolic syndrome. Clinical studies indicate a connection between the thickness of the epicardial adipose tissue (EATT) to coronary artery disease, metabolic syndrome, subclinical atherosclerosis, abdominal visceral fat, and cardiac morphology. Epicardial fat is a highly active organ that produces a number of bioactive adipokines,[6] It is a source of various pro-inflammatory and pro-atherogenic cytokines, including tumour necrosis factor-a, monocyte chemoattractant protein-1, interlukin-6, nerve growth factor, resistin, visfatin, omentin, leptin, plasminogen activator inhibitor-1, and angiotensinogen.[7]

The two-dimensional (2D) echocardiography technology can be used to visualize and measure epicardial fat thickness, which is more accurate, non-invasive, readily available and certainly more affordable assessment technique of visceral fat than MRI or CT. If there is a significant amount of epicardial fat (>15 mm), it can appear as hyperechoic space.[8] The echocardiographic measurement of epicardial fat offers a more sensitive and specific measure of real visceral fat content avoiding the possible confounding effect of increased subcutaneous abdominal fat.[9]

Because of increase in prevalence of CAD in developing countries like India, it is essential to identify the risk factors at an early stage and taking measures to prevent them, so that we can reduce the mortality and morbidity of CAD. In view of this, the main goal of the current study is to assess the relationship between EFT and CAD severity as determined by transthoracic echocardiography. Hence this study was conducted.

Objective

- To assess epicardial adipose tissue thickness (EATT) using Echocardiography among patients with coronary artery disease.
- To determine the association between EATT and coronary angiogram based on number of vessels involved in CAD.

Material and Methods

- **Study design**
  - A cross sectional study
- **Study area**
  - Department of Cardiology, KAPV Medical College and Hospital, Trichy.
- **Study duration**
  - Nine months
- **Study population**
  - 250 consecutive patients who underwent coronary angiography because of suspected CAD were included.
- **Inclusion criteria**
  - Patients with coronary artery disease who underwent a coronary angiography but did not meet the exclusion criteria.
- **Exclusion criteria**
  - Participants not willing to give consent.
  - Epicardial fat thickness could not be measured accurately using trans-thoracic echo imaging (poor echo window).
  - Previous history of coronary artery bypass graft surgery (CABG) and PTCA (percutaneous coronary intervention)
  - Chest deformities
  - Severe valvular heart disease and non-sinus rhythm
  - Chronic kidney disease
  - Chronic lung disease
  - Transthoracic echocardiography revealed pericardial and/or pleural effusion.
- **Sampling technique**
  - Convenient sampling
- **Study instrument**
  - A semi structured questionnaire
- **Measurement of variables**
  - Age was a continuous variable expressed in numbers.
  - Gender was a categorical variable (male/female)
- **Data collection**
  - Data was collected in Department of using semi structured questionnaire among participants by interview method after getting their consent.
- **Data analysis**

- Data was entered in Microsoft excel 2019 and analysed using software SPSS (Statistical Package of Social Sciences) version 21. Continuous variables and categorical variables were interpreted using frequencies (mean±SD) and proportions (%). Student t-test was used for statistical comparisons of continuous variables between CAD and EATT

- **Ethical issues**

  - Participants were informed about the study and informed consent was obtained.
  - This study was presented to Institutional Ethical Committee of KAPV Medical College, Trichy.

Results

This study was conducted among 250 patients with coronary artery disease to assess epicardial adipose tissue thickness and its association with CAG reports.

The mean age of participants was 54.632±9.98 years with a minimum age of 28 years and a maximum age of 79 years. One-third of the population included in this study were male participants in which the male and female ratio was 3:1. Table 1 shows the distribution of modifiable risk factors among the study population. In this study, the study population was presented with Diabetes (48.4%), Hypertension (35.2%), current smoker (34.4%), BMI ≥ 25 (64.8%) and Dyslipidemia. Table 1 describes the distribution of study population based on risk factors.

Table 1: Distribution of population based on risk factors (n = 250)

S No	Risk Factors		Frequency	Proportion
1	Diabetes	Present	121	48.4%
		Absent	129	51.6%
2	Hypertension	Present	88	35.2%
		Absent	162	64.8%
3	Smoking	Present	86	34.4%
		Absent	164	65.6%
4	BMI	18 – 24.9	88	35.2%
		25 and above	162	64.8%
5	Dyslipidemia	Present	86	34.4%
		Absent	164	65.6%

The mean systolic blood pressure was 117.24±12.6 with a minimum of 90 to a maximum of 190 mmHg. The mean diastolic blood pressure was 75.408±9.69 mm Hg ranging from 60 – 112 mmHg. The mean M. GENSINI score was 6.604±5.181 which scored from 0 – 21.5.

209 patients (83.6%) had ST – T changes in their ECG readings. Figure 1 shows the ECG changes among study population.

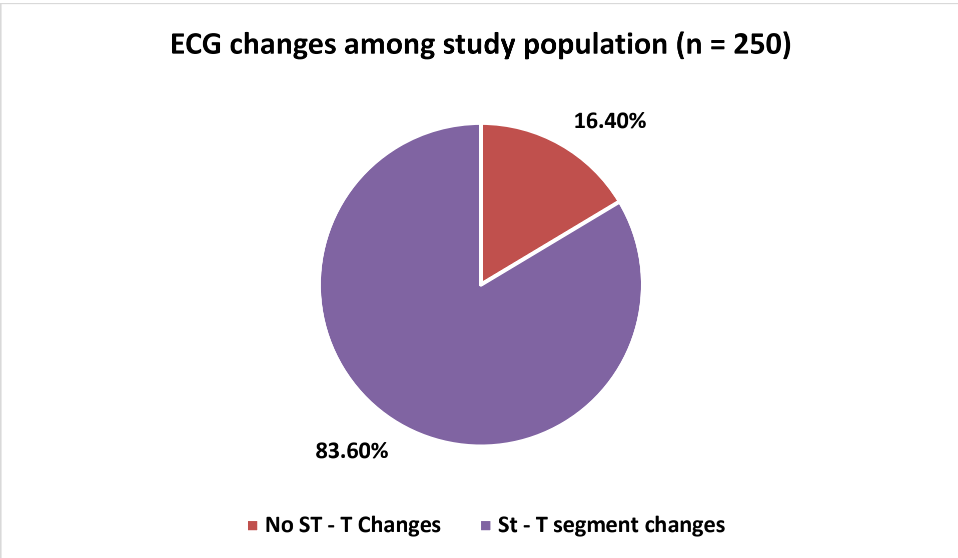

Figure1: ECG changes among study population (n = 250)

Table 2: describes ejection fraction results among study population. 5.6% of patients had severe Left ventricular dysfunction.

Table 2: Ejection fraction on echocardiography among study population (n = 250)

S No	EF	Frequency	Proportion
1	Good LV Function	62	24.8%
2	Mild LV function	99	39.6%
3	Moderate LV function	75	30%
4	Severe LV function	14	5.6%

Table 3 describes CAG reports among study population. 7.6% of patients had triple vessel disease.

Table 3: CAG reports among study population (n = 250)

S No	CAG report	Frequency	Proportion
1	Normal	33	13.2%
2	Single vessel disease	154	61.6%
3	Double vessel disease	44	17.6%
4	Triple vessel disease	19	7.6%

15 patients (6%) had EATT more than 6mm. Figure 2 exhibits Epicardial tissue thickness among study population. The mean EATT thickness was 3.1084±1.609 mm ranging from 0.6 mm – 8.10 mm.

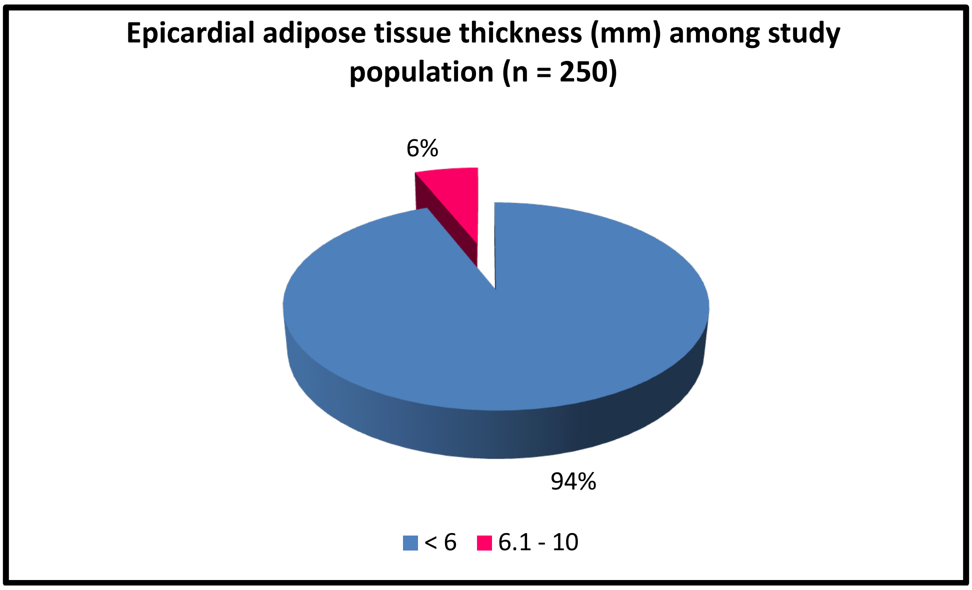

Figure 2: Epicardial adipose tissue thickness (mm) among study population (n = 250)

The mean value of EATT was higher among dyslipidemic patients compared to the absence of dyslipidemia and the p-value was found to be statistically significant. The patients with ST – T changes had higher EATT mean values compared with No significant ST -T changes in their ECG findings and this finding was found to be statistically significant. The patients with Severe LV function had higher EATT mean values than others and the p-value was found to be statistically significant. The patients with triple vessel disease had higher EATT mean values than others and the p-value was found to be statistically significant. Table

Table 3: Association between variables and EATT (Mean and SD)

S No	Variables		Mean	SD	p value
1	Dyslipidemia	Present	3.636	1.701	**0.001**
		Absent	2.831	1.49	
2	ECG changes	No ST - T Changes	2.525	1.64	**0.019**
		ST - T segment changes	3.134	1.54	
3	EF	Good LV Function	2.52	1.64	**0.01**
		Mild LV function	3.13	1.54	
		Moderate LV function	3.27	1.45	

		Severe LV function	4.62	1.60	
4	CAG	Normal	2.50	0.81	**<0.001**
		Single vessel disease	4.52	0.976	
		Double vessel disease	6.65	1.131	
		Triple vessel disease	7.75	1.37	

Discussion

The present study was conducted to show an association between echocardiographic EFT and severity of CAD in patients with CAD. The mean age of participants was 54.632±9.98 years and one-third of the population included in this study were male participants in which the male and female ratio was 3:1. In this study, the study population was presented with Diabetes (48.4%), Hypertension (35.2%), current smoker (34.4%), BMI ≥ 25 (64.8%) and Dyslipidemia. 15 patients (6%) had EATT more than 6mm. The mean EATT thickness was 3.1084±1.609 mm ranging from 0.6 mm – 8.10 mm and there was significant association of EATT with severity of CAD with higher EATT of 7.75+/-1.37 mm among triple vessel disease with P value<0.01.

A study by Shambu et al[10] also found that there is significant correlation of echocardiographic epicardial fat thickness (EFT) with the severity of CAD and the mean EFT was significantly higher in the CAD group than control group 5.55 ± 1.21 mm vs 3.25 ± 1.15 mm, p < 0.0001 which is similar to our study report. They also found that EFT cut-off ≥ 4.75 mm had 87% sensitivity and 63% specificity for prediction of significant CAD.

A study conducted by Eroglu et al also found that EFT thickness increased with the severity of CAD with the mean value of 7.4+/-1.2 mm in multivessel disease and with the mean value of 5.7+/-1.7 mm in single vessel disease with significant P<0.001 which is also similar to our study report.[11]

Another study by Kamal et al[12] also found that epicardial fat thickness among CAD patients ranging from 4 mm to 9 mm with mean thickness of 7.4 ± 1.3 mm and there is a significant correlation between EFT and number of vessels affected with 39% among SVD, 33% among DVD and 28% among TVD which is also comparable to our study report.

Our study is also similar to a study conducted by Sinha et al[13] showed that mean EFT in CAD group was 5.10 ± 1.06 and in non-CAD group was 3.36 ± 1.01 and there higher EFT was associated with severe CAD with the mean value of 7.6+/-1.3 mm is seen in multi-vessel disease.

A study by Picard et al[14] also found that patients with angiographic CAD had thicker EAT on the left ventricle lateral wall when compared with non-CAD patients with the mean value of 2.74±2.4 mm and 2.08±2.1 mm respectively. EAT also significantly correlated with the number of diseased vessels (p=0.0001). They found that EAT value ≥2.8 mm is the best predictor for the presence of>50% diameter coronary artery stenosis, with a sensitivity and specificity of 46.1% and 66.5% respectively which is also comparable to our study report.

Our study report is similar to a study conducted by Rostamzadeh A et al[15] also stated that the mean age of study participants was 59.2 ± 11.1 years, among them majority were males. He also stated that In terms of the severity of CAD, there was a significant correlation between PLAX (EFT_s) (P = 0.05), PLAX (EFT_d) (P = 0.04).

Another study by Meenakshi et al[16] also stated that in their study mean age of study participants was 51.5±10.6 and majority were males. They also found that mean epicardial fat thickness in non-CAD and acute coronary syndromes were 4.4±1.2 and 6.9±1.9, respectively and showed that epicardial fat is independently and linearly associated with CAD and its severity which is also similar to our study report.

Another study by Nasri et al[17] also stated that the patients with EPT of over 7 mm were significantly older with the mean age of 62.6 ± 7.83 yrs and had more severe CAD. They also used echocardiography for measurement of epicardial fat thickness, for estimation of epicardial fat content which is also similar to our study report.

Another study by Ahn et al[18] also stated that the patients with EAT was thicker in patients with CAD than in those without CAD (4.0 vs 1.5 mm, p<0.001). They also found that 2D echocardiographic measurement of epicardial fat thickness for assessing CAD risk and predicting the extent and activity of CAD is a simpler tool for early diagnosis which is also similar to our study report.

Conclusion

In this study, patients with CAD had considerably higher epicardial fat thickness (EFT) measured by transthoracic echocardiography than non-CAD patients. EFT also statistically strongly correlated with the CAG-measured severity of coronary artery stenosis. Several benefits of echocardiographic EFT assessment, such as its low cost, easy accessibility, quick applicability, and high reproducibility, may help in the early detection of patients with complex CAD.

Limitations

- Single centre study.

- The larger sample size might be considered for generalising results.

References

1. World Health Organization. World Health Organization; Geneva: 2005. Preventing Chronic Diseases: A Vital Investment
2. Kalçık M, Yesin M, Güner A, Bayam E, Yetim M, Doğan T, et al. Echocardiographic measurement of epicardial adipose tissue thickness in patients with microvascular angina. Interventional Medicine and Applied Science. 2019 Jun 1;11(2) :106–11.
3. Krishnan MN. Coronary heart disease and risk factors in India – On the brink of an epidemic? Indian Heart J. 2012 Jul;64(4):364–7.
4. Iacobellis G, Willens HJ. Echocardiographic Epicardial Fat: A Review of Research and Clinical Applications. Journal of the American Society of Echocardiography. 2009 Dec;22(12):1311–9.
5. Rabkin SW. Epicardial fat: properties, function and relationship to obesity. Obes Rev 2007; 8:253-61.
6. Yu W, Liu B, Zhang F, Wang J, Shao X, Yang X, et al. Association of Epicardial Fat Volume with Increased Risk of Obstructive Coronary Artery Disease in Chinese Patients With Suspected Coronary Artery Disease. Journal of the American Heart Association. 2021 Mar 16;10(6):e018080.
7. Kang J, Kim YC, Park JJ, Kim S, Kang SH, Cho YJ, et al. Increased epicardial adipose tissue thickness is a predictor of new-onset diabetes mellitus in patients with coronary artery disease treated with high-intensity statins. Cardiovascular Diabetology. 2018 Jan 11;17(1):10.
8. Votavová R, Linhartová A, Kořínek J, Marek J, Linhart A. Echocardiography in coronary artery disease. Cor et Vasa. 2015 Dec 1;57(6):e408–18.
9. Esmaeilzadeh M, Parsaee M, Maleki M. The Role of Echocardiography in Coronary Artery Disease and Acute Myocardial Infarction. J Tehran Heart Cent. 2013 Jan;8(1):1–13.
10. Shambu SK, Desai N, Sundaresh N, Babu MS, Madhu B, Gona OJ. Study of correlation between epicardial fat thickness and severity of coronary artery disease. Indian Heart Journal. 2020 Sep 1;72(5):445–7.
11. Eroglu, S., Sade, L. E., Yildirir, A., Bal, U., Ozbicer, S., Ozgul, A. S., Bozbas, H., Aydinalp, A., & Muderrisoglu, H. Epicardial adipose tissue thickness by echocardiography is a marker for the presence and severity of coronary artery disease. Nutrition, metabolism, and cardiovascular diseases: NMCD, 2009;19(3): 211–217.
12. Kamal D, Abd ElMoteleb AM, Samir R, Saeed M. Epicardial fat thickness can predict severity and multivessel distribution in Egyptian patients with atherosclerotic coronary artery stenosis. The Egyptian Heart Journal. 2018 Dec 1;70 (4):323–7.
13. Sinha SK, Thakur R, Jha MJ, Goel A, Kumar V, Kumar A, et al. Epicardial Adipose Tissue Thickness and Its Association with the Presence and Severity of Coronary Artery Disease in Clinical Setting: A Cross-Sectional Observational Study. J Clin Med Res. 2016 May;8(5):410–9.
14. Picard FA, Gueret P, Laissy JP, Champagne S, Leclercq F, Carrié D, et al. Epicardial Adipose Tissue Thickness Correlates with the Presence and Severity of Angiographic Coronary Artery Disease in Stable Patients with Chest Pain. PLOS ONE. 2014 Oct 21;9(10):e110005.
15. Rostamzadeh A, Khademvatani K, Seyed Mohammadzadeh MH, Ashori S, Hajahmadi Poorrafsanjani M, Rahimi B, et al. Association of epicardial fat thickness assessed by echocardiography with the severity of coronary artery disease. J Cardiovasc Thorac Res. 2020;12(2):114–9.
16. Meenakshi K, Rajendran M, Srikumar S, Chidambaram S. Epicardial fat thickness: A surrogate marker of coronary artery disease - Assessment by echocardiography. Indian Heart J. 2016; 68(3):336–41.
17. Nasri A, Najafian J, Derakhshandeh SM, Madjlesi F. Epicardial fat thickness and severity of coronary heart disease in patients with diabetes mellitus type II. ARYA Atheroscler 2018; 14(1): 32-7.
18. Ahn SG, Lim HS, Joe DY, Kang SJ, Choi BJ, Choi SY, et al. Relationship of epicardial adipose tissue by echocardiography to coronary artery disease. Heart. 2008 Mar;94(3):e7.