Research Brief

Study of correlation between epicardial fat thickness and severity of coronary artery disease

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Abstract
Epicardial fat thickness (EFT) reflects visceral adiposity and is associated with coronary artery disease (CAD). This study aimed to assess the correlation of echocardiographic EFT with the severity of CAD and to determine the EFT cut-off to predict CAD. EFT was measured in 503 patients undergoing coronary angiogram. 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). EFT correlated with Gensini score (r = 0.906, p < 0.001). EFT cut-off ≥ 4.75 mm had 87% sensitivity and 63% specificity for prediction of significant CAD (AUC: 0.831, p < 0.001).

1. Introduction

Visceral fat, perhaps more than total fat is implicated in atherosclerosis.1 Epicardial adipose tissue (EAT), a non-traditional visceral fat depot modulates coronary arteries through paracrine or vasocrine secretion of bioactive adipokines.2 EAT thickness can be measured by transthoracic echocardiography, cardiac CT, and cardiac MRI methods. Studies have documented an association between echocardiographic EFT and CAD.3, 4 This study was designed to assess correlation of EFT with severity of CAD and to determine EFT cut-off to predict significant CAD in Indian population.

2. Materials and methods

This is a cross-sectional observational study conducted in the Cardiology department, JSS Hospital, Mysore. 587 patients underwent coronary angiogram from February 2017 to January 2019. 503 patients were eligible for the analysis. Patients less than 18 years of age, poor acoustic window, not willing to give consent, k/c/o CAD - thrombolysed in the past or had undergone revascularization and minimal CAD were excluded from the study. Informed consent was taken. Institutional ethical committee approval was taken.

Transthoracic echocardiography was done by using Phillips HD 11XE ultrasound machine. EFT was measured prior to coronary angiogram except in STEMI where it was measured within 24 hours. Echocardiographers measuring EFT were blinded from patients’ clinical and angiographic data. Epicardial fat was measured perpendicularly on the free wall of the right ventricle at end-systole in parasternal short axis and parasternal long axis views in 3 cardiac cycles. The average value of 3 cardiac cycles was determined.3

Subjects were classified into control group (Normal coronaries) and CAD group (Significant coronary artery stenosis). Significant stenosis was defined as diameter stenosis of ≥50% in left main coronary artery and ≥70% in other major epicardial vessels. CAD
3. Statistical analysis

Descriptive and appropriate inferential statistics (parametric & non-parametric) were applied using SPSS (Version 25.0). ROC analysis and area under the curve (AUC) was calculated to derive EFT cut-off. Statistical significance was defined as P < 0.05.

4. Results

4.1. Demographics

Among 503 subjects, 18.3% (n = 92) had normal coronary arteries and 81.7% (n = 411) had significant CAD. 35.5% (n = 146) had SVD, 30.9% (n = 127) had DVD and 33.6% (n = 138) had TVD. Patient characteristics are depicted in Table 1. Acute coronary syndrome (ACS) was common indication for coronary angiogram [n = 386 (76.73%)].

4.2. Epidocardial Fat Thickness (EFT) & severity of coronary artery disease (CAD)

The mean EFT was higher in the CAD group compared to the control group (5.5 ± 1.21 mm vs 3.25 ± 1.15 mm, p < 0.0001). There was a graded increase in EFT with increasing severity of CAD (Normal coronaries: 3.25 ± 1.15 mm, SVD: 4.71 ± 1.05 mm, DVD: 5.36 ± 1.14 mm, TVD: 6.6 ± 1.24 mm, p < 0.001). EFT had positive correlation with severity of coronary artery disease as assessed by Gensini score (r = 0.906, p < 0.001).

4.3. EFT and clinical variables

Age (r = 0.259, p < 0.001) and Waist circumference (r = 0.413, p < 0.001) had positive correlation with EFT. Men had higher mean EFT values when compared to women (5.05 ± 1.23 mm vs 4.38 ± 1.02 mm, p < 0.001). Patients with diabetes mellitus and hypertension had higher mean EFT values (p < 0.05). No significant correlation was found between EFT and BMI.

EFT cut-off ≥ 4.75 mm had a sensitivity of 87% and specificity of 63% (AUC: 0.831, p < 0.001) for predicting CAD. EFT cut-off ≥ 4.5 mm had a sensitivity of 98% and specificity of 44% (AUC: 0.307, p = 0.04) which was not statistically significant for predicting SVD. However, cut-off ≥ 5.2 mm for DVD and 6.2 mm for TVD prediction was statistically significant (AUC: 0.80 and 0.88 respectively, p < 0.001) Fig. 1.

Table 1: Patient characteristics.

| Parameter                  | No CAD (n = 92) | CAD (n = 411) | p-Value   |
|----------------------------|----------------|--------------|-----------|
| Age (years)                | 57.42 ± 13     | 61.7 ± 11.02 | 0.0012*   |
| Body Mass Index (kg/m2)    | 23.61 ± 3.16   | 25.74 ± 3.37 | <0.0001*  |
| Males                      | 62 (67.39%)    | 257 (62.53%) | 0.38      |
| Females                    | 30 (32.6%)     | 154 (37.46%) |           |
| Dyslipidemia               | 10 (11)        | 78 (19)      | 0.06      |
| Type 2 Diabetes Mellitus   | 33 (35.9%)     | 221 (53.8%)  | 0.0019    |
| Hypertension               | 33 (35.9%)     | 201 (48.9%)  | 0.02*     |
| Smoking                    | 29 (31.5%)     | 179 (43.5%)  | 0.03*     |
| Alcohol                    | 21 (22.8%)     | 99 (24.08)   | 0.67      |
| GENSINI Score              | 0              | 51.08 ± 29.07| <0.0001*  |
| Systolic EFT (mm)          | 3.25 ± 1.15    | 5.55 ± 1.21  | <0.0001*  |

*Statistical significance (p-value <0.05) has been obtained by comparing means using t-test and proportions by using chi-square test.

Multivariate analysis using logistic regression method revealed EFT as an independent predictor of CAD. Table 2.

5. Discussion

In our study, EFT had a strong relationship with the presence and severity of CAD. Earlier studies have shown an association between EFT and presence of CAD but not with severity of CAD because of inclusion of patients with minimal CAD. Minimal CAD underestimates atherosclerotic burden if <70% stenosis is present in multiple epicardial coronary arteries. Hence, we have excluded patients with minimal CAD to derive EFT cut-off for predicting significant CAD. Gensini score, a better quantitative tool was used to assess CAD severity. A similar observation was seen in other studies.

EFT was associated with conventional risk factors like age, diabetes mellitus, hypertension, waist circumference, smoking and alcohol use. EFT had no association with dyslipidemia and BMI corroborating the findings in other studies that visceral adiposity is more important than total adiposity for cardiovascular risk.

In our study, EFT cut-off ≥ 4.75 mm had a sensitivity of 87% and specificity of 63% for predicting CAD. However, a cut-off ≥ 5.2 mm had a better predictive probability of DVD and TVD. Studies conducted in different populations have reported EFT cut-offs ranging from 4.65 to 5.2 mm to predict significant CAD. Variation in EFT cut-off value could be due to ethnic differences, influencing
traditional risk factors and technique of EFT measurement. EFT is best measured at end-systole because it is compressed in end diastole.5

Multivariate regression analysis has revealed EFT as an independent predictor of CAD over other conventional risk factors. A similar observation was seen in other studies.9,14 Our study findings corroborate with literature from west and other parts in terms of correlation between EFT and severity of CAD except for the cut-off value to predict CAD. Epicardial fat volume assessed by cardiac CT when added to conventional risk factors and coronary calcium score offered a more accurate and effective estimation for pretest probability of CAD.15 Future studies are required to validate pretest probability model adding EFT to conventional risk factors for prediction of CAD. EAT is a 3-dimensional structure and 2D Echocardiography may not accurately measure epicardial adiposity. The findings in our study cannot be generalised since other parts may behave differently. Hence reproducibility has to be ascertained.

6. Conclusion

In this small pilot study, EFT measured by echocardiography correlated with the presence and severity of CAD in a select subgroup of patients. However, this will require validation in larger studies.

Declaration of Competing Interest

All authors have none to declare.

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