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Review Article

Epicardial fat thickness and severity of coronary artery disease: a review

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ABSTRACT

People with diabetes are at high risk of coronary artery disease (CAD,) duration of diabetes is directly proportional to macro vascular complications. Epicardial fat through its various mechanism and anatomical closeness to the myocardium it has the direct impact on the severity of CAD. Aim of the study was to determine the correlation between epicardial fat thickness and severity of coronary artery disease in diabetic patients using syntax scoring system. The references used in this review were identified through PubMed and Google Schlor searches of articles published for the last 20 years. Search terms included CAD, correlation of EFT in CAD, syntax scoring system , Gensini scoring system, 2D-ECHO, diabetes in CAD. We reviewed 50 articles done on only humans. We reviewed relevant review articles also. It can be concluded that Epicardial fat thickness has significant correlation with severity of coronary artery disease.

Keywords: Adipose tissue, Coronary artery disease, Diabetes mellitus, Epicardial fat thickness, Syntax score

INTRODUCTION

Coronary artery disease (CAD) remains the major cause of death and disability in developing countries.[1] In India 20% deaths are due to CAD. The sudden increase in load of CAD is due to cultural modification in lifestyle, food habits which accounts for the increase in frequency of risk factors such as diabetes, hypertension, obesity, metabolic syndrome and dyslipidaemia.[2]

Epicardial fat thickness (EFT) is identified as the marker for CAD, this review exhibits the epicardial fat measurement, determinants, clinical association and its pathophysiological role in CAD.[3]

Authors performed a narrative review of literature finding association between epicardial fat thickness and severity of CAD.

REVIEW OF LITERATURE

Epicardial fat (epicardial adipose tissue)

Epicardial fat (EF) is the visceral fat deposits surrounding the heart which accumulated between the visceral pericardium and the myocardium, which does not has any separate layer to distinguish from the myocardium and the epicardial vessels. Epicardial fat thickness can be measured using echocardiography, computed tomography and magnetic resonance imaging.[4]

Physiological roles of epicardial fat

It can regulate the coronary vascular supply and its distribution over the myocardium by vasocrine mechanisms.[5] It acts as an immune barrier and offers protection to myocardium and coronary vessels from toxic substances.[6] It provides space for the coronary

arterial wall to expand in the initial phase of atherosclerosis. During myocardial stress it releases fatty acid to provide the energy to the injured myocardium for function.[7]

Epicardial fat has the potential to influence the process of lipogenesis and lipolysis which helps to store the excess fatty acid and release them when the underlying myocardium is under stress and also serve as the energy supply of heart and surrounding tissues. Epicardial fat has the ability to secrete hormones like lectin, adiponectin, omentin and PGI2, it also act as the source for the pro-inflammatory cytokines. In diseased state, EF releases these inflammatory products which contributes to the progression of coronary artery disease.

Measurement and imaging methods

Iacobellis et al used 2D-ECHO, Computed tomography (CT) and magnetic resonance imaging (MRI).[8]

In 2D-ECHO, EFT is recognized as a hypoechoic space superior to the right ventricular wall and its thickness is measured by the sliding between the epicardium and parietal pericardium. EFT should be measured on the right ventricular free wall in at least two locations, from both parasternal long and short axis, for three consecutive beats. These measurements show good correlation with the values found on MRI.[8]

Determinants of epicardial fat

Obesity: volume of epicardial fat has been reduced in patient who undergoes weight reduction as well as bariatric surgery and it's been reports as reduction in EFT from 5.3±2.4 mm to 4.0±1.6 mm.[9]

Age: Epicardial fat seems to increase with age.[10-12] It is 22% thicker in individuals older than 65 years.[13] During the aging process, there is a decrease in lean body mass and increase in fat accumulation. The distribution of the fat, rate and intensity of this distribution will vary between male and females due to their body fat composition. But, it produce no clinical significance.

Gender: Based on the data from the Framingham cohort, Rosito et al suggest that EF is more associated with risk factors in women than in men.[14] There is no role in gender predominance on epicardial fat thickness.

Clinical associations

Diabetes: DM has moderate association with epicardial fat and with the prevalence of type 2 diabetes mellitus.[15,16]

Metabolic syndrome: Studies suggest that higher amount of EFT in individuals with metabolic syndrome. Obesity and insulin resistance is responsible for increase in epicardial fat in metabolic syndrome and diabetes.

Coronary artery disease: A direct association between the amount of EF and the presence/severity of coronary artery disease (CAD) is identified in observational studies in patients undergoing coronary angiography.[4]

Various studies says that, the epicardial fat is a visceral fat deposit. It partially shares its systemic, metabolic and inflammatory effects. Also, there is a rationale for the local atherosclerotic effect of EF on the coronary artery walls. Under the influence of stress to underlying myocardium like in CAD, EAT undergoes hypertrophy and fails to release the vasoprotective agents like nitric oxide, adiponectin and PGI2.[17-19] These effects leads to reduce in vasodilatory action of underlying coronary artery. So this proves, increase in size of EFT has the deleterious effect on myocardium by interfering with diastolic relaxation, affecting the cardiac conduction system predisposing to atrial fibrillation.[20,21]

Verma et al did a cross sectional observational study among 500 patients finds that the mean systolic and diastolic EFT thickness in the CAD group was significantly higher than the non-CAD group. EFT thickness showed a significant positive correlation with waist circumference, LDL-C levels, Gensini score, and SYNTAX score. Systolic and diastolic EFT thicknesses are increased in CAD patients and related to both presence and severity of CAD.

Various studies demonstrates significant correlation between echographic EFT and severity of CAD using syntax and gensini scoring system in diabetic patients. In addition to it they found positive relationship between CAD and obesity.[22] however, they also established syntax score is more complete than the modified Gensini score.[23]

Similar study done on 2008 showed EFT is thicker in CAD patient when compared to normal individuals and they consider EFT is an independent factor of CAD ($p<0.001$) and it provides valuable information on assessing CAD risk as well foreseeing the range and action of CAD.[24]

Nakazato et al studied 92 patients states that there is increased EFT and elevated coronary calcium score in CAD group when compared to non- CAD group.[25] Similar follow up studies states that EFT on CT is independently predicting the development of non-calcium coronary plague in asymptomatic patients especially in type II diabetes.[17,26]

In contrast to previous study Meenakshi K et al showed no significant difference in EFT among male and female patients with matched BMI in both gender and gender is not affecting the correlation between EFT and CAD.[18]

Ng et al used 3D echocardiography in 130 patients and found that EFT affects the systolic function of left ventricle despite of preserved ejection fraction and absence of significant CAD.[27] Lately, in type II diabetic

patients a strong association between epicardial fat and cystatin C is proved and also signifies that accumulation of epicardial fat play an important role in secretion of cystatin C which contributes to risk of atherosclerosis in diabetic patients.[28-30]

DISCUSSION

Epicardial fat has been recognized as a vital tool in early diagnosis and predicting outcome in coronary artery disease.[5] The results of this study builds the existing evidence that the severity of CAD significantly correlates with the increase in thickness of epicardial fat. The subjects with severe CAD had increased EFT when compared to mild CAD which is consistent with similar worldwide studies.[1,6,7] 2D-ECHO was used for the measurement of EFT which has its own advantage over CT/MRI imaging, which is easy accessibility, cost effective and reproducible.[8] Moreover, drawbacks like observers variation, difficulty to measure the EFT in morbidly obese subjects and women with dense breast tissues could be overcome by measuring the EF by same cardiologist and positioning the patient in left lateral decubitus position. This adaptation helps in standardization of measurement.[19,31]

CONCLUSION

Epicardial fat is a visceral adipose tissue sourrounds the heart which can be measured by 2D-ECHO, which shares the local inflammatory and systemic effect. Epicardial fat thickness increases in patients with metabolic syndrome, CAD and diabetes, in addition reduction in weight reduces the EFT. There is significant correlation between EFT and severity of CAD which is assessed by various angiographic tools like gensini and syntax scoring system. Despite the availability of various new technology, simple non-invasive 2D-ECHO can be used to identify the presence of cardiovascular disease even before the onset of symptoms especially in high risk populations.

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