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Association between Epicardial Fat, Metabolic Syndrome and Obesity

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Abstract

Epicardial fat is true visceral fat deposited around sub epicardial coronary vessels; it has been implicated in the development of coronary atherosclerosis. Epicardial fat has been also associated with insulin resistance.
Transthoracic echocardiography provides a reliable measurement of epicardial fat thickness.

Objective: To evaluate the association between epicardial fat thickness with metabolic syndrome and anthropometric parameters of adiposity.

Methods: We assessed 70 patients who underwent echocardiography; the epicardial fat thickness on the free wall of the right ventricle was measured at end-diastole from the parasternal long-axis views of 3 cardiac cycles with Aloka Alfa 6 equipment (Japan), by 2 cardiologists who were unaware of the clinical data. Metabolic syndrome was defined according with the International Diabetes Federation criteria.

The association between epicardial fat thicknesses with metabolic syndrome was evaluated with the fisher exact test, whereas its correlation with body mass index, and waist circumference was evaluated with the Pearson coefficient.

Results: We found a significant association between epicardial fat thickness and metabolic syndrome ($p = 0.0076$), we also found a significant correlation between epicardial fat and body mass index ($r = 0.51$, $p = 0.00001$) and with waist circumference ($r = 0.472$, $p = 0.0004$).

Conclusion: Epicardial fat thickness is associated with metabolic syndrome and anthropometric parameters related with adiposity, and may contribute to the cardiovascular risk of these patients.

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Keywords: Epicardial fat thickness; Echocardiography; Metabolic syndrome; Adiposity; Cardiovascular risk

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Introduction

Obesity is recognized as an important risk factor for metabolic syndrome, coronary heart disease and increased mortality, then, the detection of the fat deposited around the internal organs might be important for the risk stratification of cardiovascular disease and metabolic syndrome[1].

Epicardial adipose tissue is a true visceral fat tissue deposited around the heart, between the myocardium and the pericardium; physiological functions of epicardial fat includes mechanical protection to myocardium, and to be a source of energy and antiatherogenic adipokines. It is important to say that as the myocardium and the epicardial fat share the same microcirculation, both tissues interact through the secretion of adipokines[2].

Excess of epicardial fat has been associated with increased left ventricular mass, with the release of pro inflammatory and proatherogenic adipokines, and with the development of atherosclerosis[3]. Although the normal amount of epicardial fat has not been established, an epicardial fat thickness ≥ 3 mm has been related with an increased risk of coronary heart disease[4].

Magnetic Resonance Imaging (MRI) has been accepted as a gold standard for measuring Epicardial Fat Thickness (EFT).

However, Iacobellis et al reported that the echocardiographic measurement of epicardial fat thickness has good correlation with MRI epicardial fat measurements[5,6].

The measurement of EFT thickness on the free wall of the right ventricle from the parasternal long-axis view has been recommended as the adequate procedure because this zone has been reported as the highest absolute epicardial fat layer thickness, and also the parasternal long axis view allows the most accurate measurement of epicardial fat on the right ventricle[5,6]. The aim of this work is to evaluate if there is an association between epicardial fat thickness greater than 3 mm with the coexistence of metabolic syndrome and markers of adiposity.

Methods

We included 70 patients that underwent an echo cardio graphic study in our facility, in whom the measurement of epicardial fat thickness on the free wall of the right ventricle at end-diastole from the parasternal long-axis views of 3 cardiac cycles, as described by Iacobellis[6] ,with an Aloka Alfa 6 equipment (Japan), by 2 cardiologists who were unaware of the clinical data, was added to the regular procedure.

In all subjects, serum glucose (glucose oxidase), creatinine (JAFFE), lipid profile (CHODPAP) and triglycerides (Triglyceride-PAP) were performed too, all venous samples were collected in the morning, after 12 h overnight fast. The determinations were performed by personnel blinded to the study.

Body mass index was calculated with the formula:

Weight (in Kilograms) / Height (in meters)^2

Waist circumference was measured on broadest area between the edge of lower ribs and the iliac crest in standing position. Systolic and diastolic blood pressures were recorded in triplicate with a mercurial sphygmomanometer in the sitting position after a 5-minute rest and at 3-minute intervals; an average of the three measurements was recorded.

The presence of metabolic syndrome was assessed in accordance with the 2009 International Diabetes Federation criteria[7].

Patients with any of the following diagnoses were excluded from the study

Decompensated Diabetes mellitus (glucose ≥ 250 mg/ml); heart, hepatic, or renal failure (Serum Creatinine > 1.5 mg/dl); acute heart block or cardiac arrhythmia; acute coronary syndrome or cerebro vascular disease six months before the study's initiation; hypertensive emergency, alcohol abuse and/or psychotropic drugs.

The study was conducted with the approval of the Research and Medical Ethics Committee of our hospital, in accordance with the Helsinki declaration. Participants gave informed consent before their inclusion in the study protocol.

Statistical analysis

The association between epicardial fat thicknesses with metabolic syndrome was evaluated with the Fisher exact test, whereas its correlation with body mass index, and waist circumference was evaluated with the Pearson coefficient, a $P < 0.05$ was considered to be significant.

Results

Basal characteristics of patients are shown in Table # 1. We found epicardial fat thickness ≥ 3 mm in 48 subjects (68.5%)

Table 1: Basal characteristics of patients

Age (years)	58.7 ± 13
Gender M/F	26/44
Epicardial fat thickness	3.87 ± 1.6
Blood Pressure (mm Hg)	132 ± 16 / 78 ± 12
Waist Circumference (cm)	97.1 ± 10.5
Body Mass Index	30.5 ± 7.2
Fasting Glucose (mg/dl)	101 ± 9
Uric Acid (mg/dl)	5.74 ± 3
Total Cholesterol (mg/dl)	103.4 ± 26
High Density lipoproteins (mg/dl)	35.1 ± 9.9
Triglycerides (mg/dl)	184 ± 47

We diagnosed metabolic syndrome in 56 patients, 43 of them had epicardial fat thickness ≥ 3 mm, interestingly, and only five patients without metabolic syndrome had an EFT greater than 3 mm. We found a significant association between epicardial fat thickness ≥ 3 mm, and metabolic syndrome ($p = 0.0076$).

When we correlated epicardial fat thickness with the anthropometric parameters of adiposity, we found a significant correlation between epicardial fat and both, body mass index ($r = 0.51$, $p = 0.00001$, figure # 1) and with waist circumference ($r = 0.472$, $p = 0.0004$, Figure # 2).

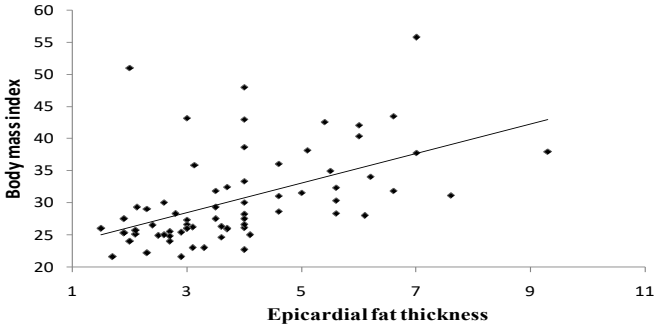

Figure # 1 Correlation between body mass index and epicardial fat thickness.

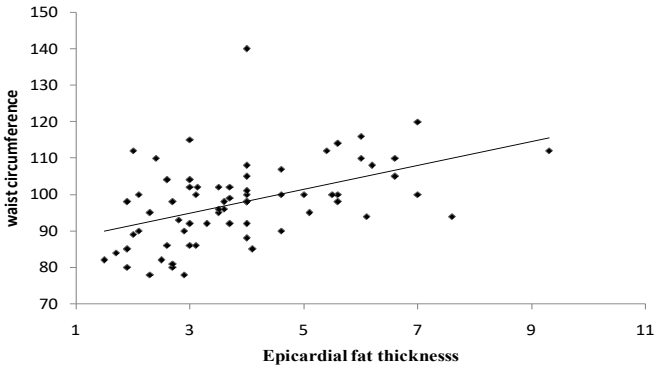

Figure # 2 Correlation between waist circumference and epicardial fat thickness.

Discussion

Epicardial fat secretes adipokines that are able to reach the myocardium throw several pathways, and although its pathophysiological roles are not well understood, EFT has been emerged as a new risk factor that perhaps plays a role in the development of metabolic diseases, and may be useful as a marker of visceral adiposity[8]. Iacobellis described that echo cardio graphic epicardial fat thickness is a marker of visceral fat, and an independent predictor of visceral fat[9], and that is associated with intra myocardial and intra hepatic fat accumulation[8]. Our findings seems to be in accordance with his results, since in our paper, EFT correlates with both, body mass index and waist circumference,and also, EFT has a significantly association with metabolic syndrome.

Pierdomenico et al, found that EFT was thicker in patients with metabolic syndrome, but when his patients were analyzed by ethnicity, the difference was mayor in Caucasian subjects[10], whereas Iacobellis found than in Caucasians, an epicardial adipose tissue ≥ 9 mm in men and ≥ 7.5 mm in women is associated with metabolic syndrome. Lima-Martinez et al[11], reported that epicardial fat thickness ≥ 5 mm predicts metabolic syndrome in Venezuelan patients. We evaluated only Mexican subjects (Hispanics), and in our paper, the association between epicardial fat thickness and metabolic syndrome was found at lower values than those found by Lima-Martinez, we do not have an explanation for this difference. However no data is available about a cut-off point that associates epicardial adipose tissue with anthropometric parameters of metabolic risk in Mexico, our results suggest that epicardial fat thickness ≥ 3 mm is associated with metabolic syndrome and adiposity in our country.

Echo cardio graphic measurement of epicardial fat tissue is a non invasive, cost-effective and objective way to evaluate adiposity, besides EFT adds information about cardiovascular risk; as echo cardio graphic studies are usually performed in patients with high cardiovascular risk, the evaluation of epicardial fat tissue should be included in the procedure, our results support this recommendation, and an echocardiogram with evaluation of EFT should be performed in those subjects that suffer metabolic syndrome and/or obesity, but if epicardial adipose tissue should be a therapeutic target in those patients, requires further investigation.

Our study has some limitations, as a transversal study, it is difficult to establish a causal relation between metabolic syndrome and epicardial fat thickness, we only describe an association.

In Conclusion

Epicardial fat thickness is associated with metabolic syndrome and anthropometric parameters related with adiposity, and may contribute to the cardiovascular risk of these patients.

An EFT ≥ 3 mm seems to be useful for the risk stratification of cardiovascular disease and metabolic syndrome.

Echocardiographic measurement of epicardial fat tissue should be part of the global evaluation of cardiovascular risk in patients with metabolic syndrome and obesity, and perhaps, in the future, a therapeutic target.

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