Epicardial Fat Thickness Obese Patients an Observational Echocardiographic Study

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ABSTRACT:

BACKGROUND:

Obesity currently affects nearly one-third of the population in the industrialized world. Traditionally, anthropometric measures such as body mass index (BMI) or waist circumference have been used to quantify overall adiposity; however, regional fat depots may be of greater importance than overall adiposity. Several studies have highlighted pericardial fat and abdominal visceral adipose tissue (VAT)as unique, pathogenic fat depot.

OBJECTIVE:

Recognize the relation of obesity to increase epicardial fat pad thickness in Iraqi patients.

METHODS:

Epicardial fat thickness was measured in 62 consecutive subjects (28 women 45%, 34 men 55%) mean age of 47.77 years (SD 8.03),using routine transthoracic echocardiogram. Epicardial fat was identified as the echo-free space between the outer wall of the myocardium and the visceral layer of the pericardium, and its thickness was measured perpendicularly on the free wall of the right ventricle at end-systole.

RESULTS:

The results show progressive increase of epicardial fat with increasing BMI which was very significant statistically. High mean epicardial fat is significantly associate with increasing waist circumference. No difference in those below and above 45 years of age in mean epicardial fat and there is gender difference in epicardial fat, where males had more epicardial fat than females.

CONCLUSION:

There is increase in the epicardial fat pad thickness in overweight and obese (BMI≥25) patients if compared to normal persons epicardial fat increase with increasing waist circumference more likely in male obese and independent of age.

KEY WORDS: epicardial fat,obese,echocadiography

INTRODUCTION:

Cardiac adiposity defined as increased epicardial adipose tissue and massive deposits of fat within the atrial septum (lipomatous hypertrophy) is seen in overweight persons and is associated with coronary artery disease (CAD), atrial arrhythmias, and increased risk of left ventricular free wall rupture after acute myocardial infarction. Unlike subcutaneous fat, epicardial fat is metabolically active and produces hormones, cytokines, and other vasoactive substances that work systemically or locally to alter vascular endothelial function and may be implicated in the pathogenesis of CAD (1).

Epicardial fat stores triglyceride to supply free fatty acids for myocardial energy production and produces adipokines. It shares a common embryological origin with mesenteric and omental fat. Like visceral abdominal fat, epicardial fat thickness, measured by echocardiography, is increased in obesity. Epicardial fat could influence coronary atherogenesis and myocardial function because there is no fibrous fascial layer to impede diffusion of free fatty acids and adipokines between it and the underlying vessel wall as well as the myocardium. Segments of coronary arteries lacking epicardial fat or separated from it by a bridge of myocardial tissue are protected against the development of atherosclerosis in those segments (2).

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Epicardial adipose tissue (EAT) is a visceral thoracic fat depot located along the large coronary arteries and on the surface of the ventricles and the apex of the heart, whereas perivascular adipose tissue (PVAT) surrounds the arteries. Both fat depots are not separated by a fascia from the underlying tissue. Therefore, factors secreted from epicardial and PVAT, like free fatty acids and adipokines, can directly affect the function of the heart and blood vessels [(3)].

Epicardial fat covers 80% of the heart's surface and constitutes 20% of total heart weight. There is three- to fourfold more epicardial fat associated with the right than the left ventricle. Putative physiologic functions of epicardial fat are based on observational data and include: buffering coronary arteries against the torsion induced by the arterial pulse wave and cardiac contraction, facilitating coronary artery remodelling, regulating fatty acid homeostasis in the coronary microcirculation and providing fatty acids to cardiac muscle as a local energy source in times of high demand.A number of properties differentiate epicardial fat from other fat depots specifically its smaller adipocytes size; different fatty acid composition, high protein content; high rates of fatty acid incorporation, fatty acid synthesis, insulin-induced lipogenesis or fatty acid breakdown; low rates of glucose utilization, low expression (mRNA) of lipoprotein lipase, stearoyl-CoA desaturase and acetyl-CoA carboxylase-alpha, and slow regression during weight loss. There is a significant direct relationship between the amount of epicardial fat and general body adiposity. Clinical imaging studies have demonstrated a strong direct correlation between epicardial fat and abdominal visceral adiposity [(4)].

AIM OF THE STUDY:

To recognize the relation of obesity to increase epicardial fat pad thickness in Iraqi patients according to gender and age.

PATIENTS AND METHODS:

This was an observational cross-sectional study conducted over a 6-months period from January 2012 till July 2012,in the Obesity research unit in Al-kindy collage of Medicine . Epicardial fat thickness was measured in 62 consecutive subjects underwent routine transthoracic echocardiogram. The patients were referred from all branches of medicine. Profile, BMI, waist circumference was identified and epicardial fat thickness was calculated

1-waist circumference defined as >102 cm (in men) or >88 cm (in women) is central (visceral) obesity (NCEP-ATPIII, national cholesterol education program adult treatment panel 3 at 2001).

2- BMI categories as groups of : normal weight (BMI 18.5–24.9 kg/m2); overweight (BMI 25–29.9 kg/m2); obesity (BMI≥30kg/m2) (WHO criteria).

The study had ethical approval of Alkindy college scientific and ethical committee.

Procedures

Weight and height were measured while the subjects were fasting and wearing only their undergarments. BMI was calculated as body weight divided by height squared. Minimum waist circumference (in centimeters; minimum circumference between the lower rib margin and the iliac crest, mid waist) was measured while the subjects were standing with their heels together (normal value<88cm for female and <102cm for male-NCEP ATP3). Each subject underwent transthoracic, two-dimensional guided M-mode echocardiogram using commercially available equipment (Vivid), and the images were digitized.

Standard parasternal and apical views were obtained in the left lateral decubitus position. Epicardial fat was identified as the echo-free space between the outer wall of the myocardium and the visceral layer of the pericardium, and its thickness was measured perpendicularly on the free wall of the right ventricle at end-systole (Figure 1a). Because it is compressed during diastole, maximum epicardial fat thickness was measured in end systole. (Figure 1b). Parasternal long- and short-axis views allow the most accurate measurement of epicardial adipose tissue on the right ventricle, with optimal cursor beam orientation in each view. Maximum epicardial fat thickness was measured at the point on the free wall of the right ventricle along the midline of the ultrasound beam, perpendicular to the aortic annulus, used as anatomical landmark for this view. For the mid ventricular parasternal short-axis assessment, maximum epicardial fat thickness was measured on the right ventricular free wall along the midline of the ultrasound beam, perpendicular to the interventricular septum at mid chordal and tip of the papillary muscles level, as anatomic landmark. The average value of three cardiac cycles from each echocardiographic view was considered.

Figure 1: a-parasternal view shows ventricle during systole, with thickness of epicardial fat b-subcostal view display epicardiasl fat thickness

Statistical analysis

Are performed using minitab version 13, in addition to descriptive statistics ,percentage, frequency, mean, SD were calculated with inferential statistics , T test for two means and ANOVA test for three means were used to find the level of significance. P value less than 0.05 was considered statistically significant.

RESULTS:

Table 1 show that our sample patients are of middle age group (mean 47years SD 8),male patients are slightly more (55% M and 45%F).

Table 1: Distribution of study groups according to gender.

Demographic variable		No.%	Mean age (years)	Standard deviation
age		62(100%)	47.77	8.03
gender	male	34(55%)	47.41	8.96
	female	28(45%)	48.21	6.87

Table 2 show the percentage of BMI through studied sample 20% normal (BMI<25), 32% are overweight (B MI≥25%) and 42% are obese (BMI≥30), the results show progressive increase of epicardial fat with increasing BMI which was very significant statistically.

Table 2: Difference in Epicardial fat mean in three groups according to Body mass index.

Body mass index	NO.(%)	Mean epicardial fat (mm)	Standard deviation	P value
Normal weight	12 (19.35%)	3.40	0.809	0.0001
Overweight	20(32.25%)	6.35	1.ooo	
Obese	30(48.30%)	8.82	1.824	
Total	62(100%)	6.70	1.23	

Table 3 show the relation of waist circumference (>88cm in female and >102cm in male) to mean epicardial fat where high mean epicardial fat is significantly associate increasing waist circumference

Table 3: Differences in epicardial fat means in two groups according to Waist circumference

Waist circumference	No.(%)	Mean epicardial fat(mm)	Standard deviation	P value
Normal	15 (24.19%)	3.687	0.937	0.0001
Abnormal increase	47(75.81%)	7.72	1.72	
Total	62(100%)	6.70	1.23	

Table 4: Show that there is no significant difference between those below and above 45 years of age in mean epicardial fat.

Table 4: Distribution of epicardial fat according to age group.

Age(years)	No.(%)	Mean epicardial fat(mm)	Standard deviation	P value
<45	24(39%)	6.71	2.70	0.891
≥45	38(61%)	6.70	2.08	
Total	62(100%)	6,70	1,23	

Table 5: Show significant gender difference in epicardial fat , where males had more epicardial fat than females.

Table 5: Distribution in epicardial fat mean according to gender.

gender	No.(%)	Mean epicardial fat(mm)	Standard deviation	P value
Female	28(45%)	5.84	1.68	0.005
Male	34(55%)	7.41	2.54	
Total	62(100%)	6.70	1.23	

DISCUSSION:

Waist circumference is widely accepted as a good predictor of intra-abdominal fat mass [(5)]. Sagittal diameter assessed by magnetic resonance imaging (MRI) shows advantages over waist circumference, but its ability to predict visceral adipose tissue(VAT) is limited in obese subjects[(6)].Computed tomography (CT) and especially MRI, the gold standard technique, provide methods to estimate visceral adipose tissue(VAT) safely and accurately. Unfortunately, both MRI and CT are quite high-cost methods, and CT requires radiation exposure[(7)]. We think that there is close correlation between visceral obesity , waist circumference, and epicardial fat thickness and that noninvasive echocardiogram is easy available method for predicting epicardial fat and increasing cardiovascular risk.

Our study show significant association (P value0.0001) between BMI and increasing thickness of epicardial fat measured by transthoracic echocardiography and that was also seen by torres et al. [(8)]

In addition this study also showed a close relation to waist circumference significantly (P value0.0001) where increasing waist circumference associate with increased epicardial fat which is also confirmed by Iacobellis et al. Epicardial fat thickness in subjects with metabolic syndrome is significantly higher than that observed in subjects without metabolic syndrome.[(9)]

Park et al [(10)] document age difference in epicardial fat thickness, which is increasing with age but our results show no significant difference. This result may be explained by difference in mean age in both studies.

Unlike our study mookadam et al[(11)] did not support our findings of gender difference in epicardial fat pad, as we found that males had thicker fat pad than females significantly (Pvalue0.005) while most studies (Iacobellis)[(12)] support that males usually had thicker epicardial fat pad than female.

CONCLUSION AND RECOMMENDATIONS:

Echocardiographic epicardial fat is an inexpensive, reproducible, and direct measure of visceral fat. It may have an important role in predicting and stratifying cardiovascular risk in clinical care.

In this study, there is increase in the epicardial fat pad thickness in overweight and obese patients if compared to normal persons, epicardial fat increase with increasing waist circumference more likely in male obese and independent of age.

Further studies is recommended to know the prevalence of increasing epicardial fat in Iraqi patients and the relation to weight loss.

REFERENCES:

1. Sarin S, Wenger C, Marwaha A, Qureshi A, Go BD, Woomert CA, Clark K, Nassef LA, Shirani J., Clinical significance of epicardial fat measured using cardiac multislice computed tomography..Am J Cardiol. 2008;102:767-71.
2. Sacks HS, Fain JN. Human epicardial adipose tissue: a review.Am Heart J. 2007 ;153:907-17.
3. Ouwens DM, Sell H, Greulich S, Eckel J.The role of epicardial and perivascular adipose tissue in the pathophysiology of cardiovascular disease. J Cell Mol Med. 2010;14:2223-34.
4. Rabkin SW. Epicardial fat: properties, function and relationship to obesity.Obes Rev. 2007; 8:253-61.
5. Wei, M., Gaskill, S. P., Haffner, S. M., Stern, M. P. Waist circumference as the best predictor of noninsulin dependent diabetes mellitus (NIDDM) compared to body mass index, waist/hip ratio and other anthropometric measurements in Mexican Americans: a 7-year prospective study. Obes Res .1997;5:16–23.
6. Van der Kooy, K., Leenen, R., Seidell, J. C., Deurenberg, P., Visser, M. Abdominal diameters as indicators of visceral fat: comparison between magnetic resonance imaging and anthropometry. Br J Nutr ,1993;70: 47–58.
7. Ross, R., Shaw, K. D., Martel, Y., de Guise, J., Avruch, L. Adipose tissue distribution measured by magnetic resonance imaging in obese women. Am J ClinNutr 1993;57:470–75.
8. Christopher Torres et al, Epicardial adipose tissue and its association to plasma adrenomedullin levels in patients with metabolic syndrome, ENDOCRINOLOGÍA Y NUTRICIÓN accepted 6 June 2011
9. Iacobellis G, Assael F, Ribaudo MC et al. Epicardial fat fromechocardiography: a new method for visceral adipose tissue prediction.Obes Res 2003;11:304-10.
10. EunMi Park et al, Echocardiographic Epicardial Fat Thicknesson Short Term Prognosis in Patients withAcute Coronary Syndrome J Cardiovasc Ultrasound 2008;16:42-47.
11. Farouk Mookadam, RamilGoel, Mohsen S. Alharthi, PanupongJiamsripong, and Stephen ChaEpicardial Fat and Its Association with Cardiovascular Risk: A Cross-Sectional Observational StudyHeart Views. 2010;11:103–8.
12. GianlucaIacobellis, MD, PhD and Howard J. Willens, MD, Hamilton, Ontario, Canada; Miami, FloridaEchocardiographicEpicardial Fat: A Review ofResearch and Clinical Applications.J Am SocEchocardiogr. 2009;22:1311-19.