Med. J. Cairo Univ., Vol. 87, No. 1, March: 209-214, 2019
www.medicaljournalofcairouniversity.net

The Relationship between Epicardial Adipose Tissue Thickness and Coronary Artery Disease

AHMED M. MAHFOUZ, M.B.B.Ch.; IBTSAM Kh. IBRAHIM, M.D.; EHAB A. EL-GENDY, M.D. and SEHAM F. BADR, M.D.

The Department of Cardiology, Faculty of Medicine, Tanta University

Abstract

Background: Epicardial adipose tissue (EAT) is a complex endocrine organ that express a variety of inflammatory mediators which may contribute to the pathogenesis of coronary artery disease (CAD).

Aim of Study: To investigate the relation between EAT thickness and presence of coronary artery disease.

Patient and Methods: This study included 100 patients who were candidates for coronary angiography. All patients were subjected to full history taking, and clinical examination. Echocardiographic techniques and calculations of different cardiac dimensions were performed and to measure the EAT. Coronary angiography was performed by standard technique to assess the presence or absence of coronary artery disease and the number of coronary arteries diseased.

Results: EAT equal or more than 0.45cm is related to the presence of coronary artery disease, with a specificity and a sensitivity of 63.6% and 69.2% respectively. Our study revealed a positive correlation between EAT thickness and the presence of CAD.

Conclusions: Epicardial adipose tissue thickness is significantly associated with presence of coronary artery disease.

Key Words: *Epicardial adipose tissue– Atherosclerosis– And coronary artery disease.*

Introduction

CORONARY artery disease is a leading cause of morbidity and mortality worldwide, and its incidence has been gradually increasing. Coronary artery disease is a progressive inflammatory disease in which atherosclerosis plays a major role in its etiology [1].

The obesity epidemic has emerged as one of the most critical public health problems worldwide that are closely associated with the development of a metabolic and cardiovascular disease [2,3].

Correspondence to: Dr. Ahmed M. Mahfouz, The Department of Cardiology, Faculty of Medicine, Tanta University

The epicardial adipose tissue is considered as visceral fat deposited around the heart, particularly around epicardial coronary vessels. Because of its proximity to the myocardium and absence of fascia, epicardial fat may directly affect the coronary arteries and myocardium through paracrine actions of locally secreted adipocytokines and other bioactive molecules, contributing to the development of coronary artery disease [4-6].

EAT is correlated with diastolic blood pressure and, in obese patients, with indexes of insulin resistance and glucose intolerance. EAT could be involved in the pathogenesis of cardiovascular diseases, through an increased ventricular stiffness or secretion of various locally acting substances [7,8].

Epicardial adipose tissue measured by different methods, including echocardiography, CT, and MRI, correlates with the degree of intra-abdominal visceral adiposity. Visualization and measurement of epicardial adipose tissue with two-dimensional (2D) echocardiography were first proposed and validated by Iacobellis, et al., which appeared as the relatively echo-free space between the outer wall of the myocardium, and the visceral layer of pericardium [9,10].

Patients and Methods

This study was done in the Cardiology Department, Tanta University hospitals. The duration of the study was 10 months, started at 1 st of April 2017 to 31 th of January 2018; 100 patients who were candidate for a coronary angiography were included in this study. They were 70 males and 30 females. Their ages ranged from 37 to 74 years with a mean of 55.58±8.649 years. The study population was divided into 5 groups according to the thickness of epicardial adipose tissue, and into two groups according to the presence or absence of CAD.

Exclusion criteria:

Patients with acute coronary syndrome, previous myocardial infarction, heart failure, congenital heart disease, valvular heart disease, patients with atrial fibrillation, previous percutaneous coronary intervention, previous coronary arteries bypass graft surgery, advanced chronic kidney disease, advanced liver disease, and advanced malignancy.

Methods:

All patients in this study were subjected to full history taking with stress on history of risk factors for coronary artery disease.

Standard 12-lead resting electrocardiogram (ECG) was done for all patients, and was analyzed for heart rate, cardiac rhythm, conduction abnormalities, and ST segment and T wave changes.

Epicardial adipose tissue thickness is measured from the echo-lucent area between the right ventricle and parietal pericardium on the parasternal short axis section [11].

Making the measurements in at least three cardiac cycles, calculating the mean value, and not being satisfied with a single measurement would be convenient for accurate measurement. Performing epicardial adipose tissue measurement during end-diastole, just before the R-wave on the ECG was done [11].

Coronary angiography was done using Seldinger femoral technique, by introducing 6F femoral sheath in the right femoral artery, engagement of left and right systems, angiogram in multiple projections was done to completely visualize both systems [12].

Coronary angiography was performed during the indexed period. Hemodynamically, significant stenosis was defined as a diameter stenosis of ≥50% in the left main coronary artery and ≥50% in vessels other than the left main coronary artery and non-obstructive coronary artery disease was defined ≤50% [13].

Results

Neither age nor gender nor body mass index had an impact on epicardial adipose tissue thickness, (Tables 1,2,3).

Table (1): Epicardial adipose tissue thickness in relation to gender.

Gender	EAT thickness				
	2–2.9 mm	3–3.9 mm	4–4.9 mm	5–5.9 mm	>6mm
Male	6	17	7	7	28
Female	2	6	3	3	16
Total	8	23	10	10	44
	Chi-square 1.826			*p*-value 0.767	

Table (2): Epicardial adipose tissue thickness in relation to the age.

Age	EAT thickness				
	2–2.9 mm	3–3.9 mm	4–4.9 mm	5–5.9 mm	>6mm
30–39 yrs.	0	0	0	1	0
40–49 yrs.	1	6	1	3	6
50–59 yrs.	1	6	4	4	15
≥ 60 yrs.	1	5	3	3	18
Total	3	17	8	11	39
	Chi–square 10.59			*p*-value 0.563	

Table (3): Epicardial adipose tissue thickness in relation to body mass index.

BMI	EAT thickness				
	2–2.9 mm	3–3.9 mm	4–4.9 mm	5–5.9 mm	>6mm
<30Kg/m^2	4	13	6	11	18
≥30Kg/m^2	4	10	4	4	26
Total	8	23	10	15	44
	Chi–square 5.361			*p*-value 0.252	

Also, none of cardiovascular risk factors showed statistically significant impact, (Table 4).

Patients were classified according to the presence of CAD into two groups; non-coronary artery disease group included 22 individuals and coronary artery disease group consisted of 78 patients. There is a statistically significant difference between the two groups as regard epicardial adipose tissue thickness, (*p*-value=0.0284), (Table 5).

ROC curve shows the specificity and sensitivity of epicardial adipose tissue thickness to coronary artery disease which are 63.6% and 69.2% respectively. The best cut off point value is ≥4.5mm, (Fig. 1).

Table (4): Epicardial adipose tissue thickness in relation to cardiovascular risk factors.

Adipose Tissue Thickness	Risk Factors								
	HTN			DM			Smoking		
	HTN	Non-HTN	Total	DM	Non-DM	Total	Smoker	Non-Smoker	Total
2–2.9mm	4	4	8	4	4	8	4	4	8
3–3.9mm	13	10	23	6	17	23	10	13	23
4–4.9mm	6	4	10	6	4	10	5	5	10
5–5.9mm	12	3	15	6	9	15	7	8	15
>6mm	31	13	44	23	21	44	13	31	44
Result	Chi–square 3.693	*p*-value 0.449		Chi–square 0.248	*p*-value 5.406		Chi–square 0.535	*p*-value 3.133	

Table (5): Comparison between epicardial adipose tissue thickness and coronary artery disease group and non-coronary artery disease group.

	Non–CAD	CAD	*p*-value
EAT	0.48±0.3	0.63±0.25	0.0248*

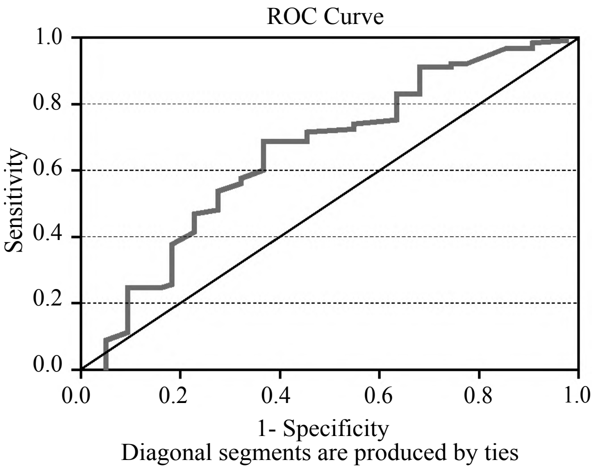

Fig. (1): ROC curve.

Epicardial adipose tissue thickness in relation to the number of coronary arteries diseased which shows there was no relation between increasing the number of coronary arteries diseased and increasing the epicardial adipose tissue thickness (*p*-value=0.312), (Table 6).

Table (6): Epicardial adipose tissue thickness in relation to the number of coronary arteries diseased.

Number of coronary arteries diseased	EAT thickness				
	2–2.9 mm	3–3.9 mm	4–4.9 mm	5–5.9 mm	>6mm
One V.D	1	8	2	2	9
Two V.D	0	3	1	3	16
Multi V.D	2	6	5	6	14
Total	3	17	8	11	39
	Chi–square 5.361			*p*-value 0.252	

According to epicardial adipose tissue thickness and the number of coronary arteries diseased, there was no correlation between increasing the epicardial adipose tissue thickness and increasing the number of coronary arteries diseased (*p*-value=0.769), (Table 7).

Table (7): Correlation between epicardial adipose tissue thickness and the number of coronary arteries diseased.

Variable	Epicardial adipose tissue thickness	
	r	*p*-value
The number of coronary arteries diseased	0.034	0.769

Discussion

The concept of cardiac adiposity as a novel CV risk factor is rapidly emerging. EAT has been proposed as a reliable predictor of visceral adiposity and unfavorable metabolic profile [14]. The role of EAT in the pathogenesis of coronary atherosclerosis has received recently increasing attention. [15-17].

In our study, we found that there is a relationship between increasing epicardial adipose tissue thickness equal or more than 4.5mm with specificity and sensitivity 63.6% and 69.2% respectively and presence of coronary artery disease, (*p*-value= 0.024).

The present study showed no significant difference between male and female gender regarding the values of EAT thickness (*p*-value=0.767), this was in concordance with Juan Valiente Mustelier, et al., 2011 and Ahn SG, et al., 2008 [14,15]. revealed that no difference in epicardial fat thickness between men and women (5.85±2.8mm vs 6.25± 2.8mm, *p*=0.283). On the contrary this was discordant with Iacobellis G, et al., 2007 & 2008 and Flüchter S, et al., 2007 [16-18] as they pointed out that EAT is thicker in men than in women. This discrepancy may be explained by different sample size and different patient selection criteria.

Our study revealed no relationship between EAT thickness and age of patients (p-value=0.563), Bénédicte Gaborit, et al., 2015 and Gianluca Iacobellis, et al., 2003 [19,20] revealed that no significant relation to age of patients with epicardial adipose tissue measured by echocardiography, (p-value= 0.71 and 0.14).

Our study revealed no relationship between EAT and BMI (p-value=0.252), Bénédicte Gaborit, et al. 2015 and Alina Cristina Silaghi, et al., 2011 [19,21] also noticed that the EAT not correlated with BMI, (p-value=0.82 and 0.315).

Our study revealed no relationship between traditional risk factors as HTN, DM and smoking and EAT (p-value=0.449 for HTN), (p-value= 0.284 for DM) and (p-value=0.449 for smoking), Bénédicte Gaborit, et al., 2015 and Alexander M. de Vos, et al., 2007 [19,22] had similar results reporting no relation between traditional cardiovascular risk factors as hypertension, DM, and smoking and increasing the thickness of EAT, (p-value=0.93, 0.97, and 0.51).

In our study we found that there was a relationship between increasing epicardial adipose tissue thickness equal or more than 4.5mm with increasing the probability of presence of coronary artery disease with specificity and sensitivity 63.6% and 69.2% respectively, (p-value=0.024). Ahn SG, et al., 2008 [15]. showed that echocardiographic EAT thickness values >3.0mm were associated with the presence of coronary artery disease in a Korean population of men and women, Miroslav Sram and Zvonimir Vrselja, et al., 2015 [23] found significant relationship between EAT thickness measured by 2D echocardiography and CAD, and Sinha SK, et al., 2016 [24] reported that EAT thickness measured by using transthoracic echocardiography significantly correlates with the presence of CAD.

The mean EAT thickness in CAD group was 5.10± 1.06mm and in non-CAD group was 4.36± 1.01mm which was significant, (p=0.003). Significant correlation was demonstrated between EAT thickness and presence of CAD (p<0.003), A. Baragettia, et al., 2016 [25]. found that EAT is associated with subclinical atherosclerosis and also CAD.

Our study showed that EAT was insignificantly correlated with increasing the number of coronary arteries diseased as an indicator for the severity of coronary artery disease with (p-value=0.769), Teresa G Yañez-Rivera, et al., 2014 [26]. Observed the same result as epicardial fat thickness measured by echocardiography with atherosclerotic CAD, but not correlated with the degree of severity of the disease.

Conclusion:

Epicardial adipose tissue thickness is an independent factor related to the presence of CAD.

References

1- GIFFORD R.W.J., KIRKENDALL W., O'CONNOR D.T. and WEIDMAN W.: Office evaluation of hypertension. A statement for health professionals by a writing group of the Council for High Blood Pressure Research. American Heart Association. Circulation, 79: 721-731, 1989.

2- NAKAMURA K., FUSTER J.J. and WALSH K.: Adipokines a link between obesity and cardiovascular disease. J. Cardiol., 63: 250-259, 2014.

3- CORRADI D., MAESTRI R., CALLEGARI S., PASTORI P., GOLDONI M., LUONG T.V. and BORDI C.: The ventricular epicardial fat is related to the myocardial mass in normal, ischemic and hypertrophic hearts. Cardiovasc Pathol., 13 (6): 313-316, 2004.

4- MAZUREK T., ZHANG L., ZALEWSKI A., MANNION J.D., DIEHL J.T., ARAFAT H., SAROV-BLAT L., O'BRIEN S., KEIPER E.A., JOHNSON A.G., MARTIN J., GOLDSTEIN B.J. and SHI Y.: Human epicardial adipose tissue is a source of inflammatory mediators. Circulation, 108: 2460-2466, 2003.

5- BAKER A., da SILVA N., QUINN D., HARTE A., PAGANO D., BONSER R., KUMAR S. and MCTERNAN P.: Human epicardial adipose tissue expresses a pathogenic profile of adipocytokines in patients with cardiovascular disease. Cardiovasc Diabetol., 5: 1-10, 2006.

6- CHALDAKOV G.N., STANKULOV I.S. and ALOE L.: Subepicardial adipose tissue in human coronary atherosclerosis: Another neglected phenomenon. Atherosclerosis. 154: 237-238, 2001.

7- IACOBELLIS G., RIBAUDO M.C., ASSAEL F., VECCI E., TIBERTI C., ZAPPATERRENO A., DI MARIO U. and LEONETTI F.: Echocardiographic epicardial adipose tissue is related to anthropometric and clinical parameters of metabolic syndrome: A new indicator of cardiovascular risk. J. Clin. Endocrinol. Metab., 88: 5163-5168, 2003.

8- MONTANI J.P., CARROLL J.F., DWYER T.M., ANTIC V., YANG Z. and DULLOO A.G.: Ectopic fat storage in heart, blood vessels and kidneys in the pathogenesis of cardiovascular diseases. Int. J. Obes. Relat. Metab. Disord., 28 (Suppl 4): S58-S65, 2004.

9- IACOBELLIS G., CORRADI D. and SHARMA A.M.: Epicardial adipose tissue: Anatomic, biomolecular and clinical relationships with the heart. Nat. Clin. Pract. Cardiovasc. Med., 2 (10): 536-543, 2005.

10- IACOBELLIS G.: Epicardial and pericardial fat: CLOse, but very different. Obesity (Silver Spring), 17 (4): 62, 2009.

11- BERTASO A.G., BERTOL D., DUNCAN B.B. and FOPPA M.: Epicardial fat definition, measurements and systematic review of main outcomes. Arq. Bras. Cardiol., 101: e18-28, 2013.

12- DONALD S. BIAM and WILLIAM GROSSMAN.: Coronary angiography. In: Donald S. Biam., William Grossman. (eds). Cardiac catheterization, angiography, and intervention, 5 th edt. USA: Lippincott William and Wilkins, 183-216, 1996.

13- WINDECKER S., KOLH P., ALFONSO F., COLLET J-P., CREMER J., FALK V., FILIPPATOS G., HAMM C., HEAD S.J., JUNI P., KAPPETEIN A.P., KASTRATI A., KNUUTI J., LANDMESSER U., LAUFER G., NEUMANN F-J., RICHTER D.J., SCHAUERTE P., SOUSA UVA M., STEFANINI G.G., TAGGART D.P., TORRACCA L., VALGIMIGLI M. and WIJNS W.: ESC/EACTS Guidelines on myocardial revascularization: The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS). Developed with the special contribution of the European Association of Percutaneous Cardiovascular Interventions (EAP-CI). Eur. Heart J., 35: 2541-2619, 2014.

14- JUAN VALIENTE MUSTELIER, JULIO OSCAR CABRERA REGO, ANGELA GALA GONZÁLEZ, JÚLIO CÉSAR GANDARILLA SARMIENTO and BEATRIZ VEGA RIVERÓN: National Cardiology and Cardiovascular Surgery Institute1; Institute of Tropical Medicine ´Pedro Kourí´ 2-Havana-Cuba, Arq. Bras. Cardiol., 97 (2): 122-129, 2011.

15- AHN S.G., LIM H.S., JOE D.Y., KANG S.J., CHOI B.J., CHOI S.Y., YOON M.H., HWANG G.S., TAHK S.J. and SHIN J.H.: Relationship of epicardial adipose tissue by echocardiography to coronary artery disease. Heart, 94: e7, 2008.

16- IACOBELLIS G., SINGH N. and SHARMA A.M.: Cardiac adiposity and cardiovascular risk: potential role of epicardial adipose tissue. Curr. Cardiol. Rev., 3: 11-14, 2007.

17- IACOBELLIS G. and BARBARO G.: The double role of epicardial adipose tissue as pro- and anti-inflammatory organ. Horm. Metab. Res., 40 (7): 442-5, 2008.

18- FLÜCHTER S., HAGHI D., DINTER D., HEBERLEIN W., KÜHL H.P., NEFF W., SUESELBECK T., BORGGREFE M. and PAPAVASSILIU T.: Volumetric assessment of epicardial adipose tissue with cardiovascular magnetic resonance imaging. Obesity, 15 (4): 870-8, 2007.

19- BÉNÉDICTE GABORIT, NICOLAS VENTECLEF, PATRICIA ANCEL, VÉRONIQUE PELLOUX, VLAD GARIBOLDI, PASCAL LEPRINCE, JULIEN AMOUR, STÉPHANE N. HATEM, ELISABETH JOUVE, ANNE DUTOUR and KARINE CLÉMENT: Human epicardial adipose tissue has a specific transcriptomic signature depending on its anatomical peri-atrial, peri-ventricular, or peri-coronary location, Cardiovascular Research, 1 October Volume 108, Issue 1, Pages 62-73. https://doi.org/10.1093/cvr/cvv208, 2015.

20- GIANLUCA IACOBELLIS, MARIA CRISTINA RIBAUDO, FILIPPO ASSAEL, ELIO VECCI, CLAUDIO TIBERTI, ALESSANDRA ZAPPATERRENO, UMBERTO DI MARIO and FRIDA LEONETTI: Echocardiographic epicardial adipose tissue is related to anthropometric and clinical parameters of metabolic syndrome: A new indicator of cardiovascular risk. The Journal of Clinical Endocrinology & Metabolism, 88.11: 5163-5168, 2003.

21- ALINA CRISTINA SILAGHI, LAURA POANTĂ, ANA VALEA, RALUCA PAIS, and HORAŢIU SILAGHI: Is epicardial adipose tissue, assessed by echocardiography, a reliable method for visceral adipose tissue prediction? Medical Ultrasonography, 13.1: 15-20, 2011.

22- ALEXANDER M. de VOS, MATHIAS PROKOP, CORNELIS J. ROOS, MATTHIJS F.L. MEIJS, YVONNE T. VAN DER SCHOUW, ANNEMARIEKE RUTTEN, PETRA M. GORTER, MAARTEN-JAN CRAMER, PIETER A. DOEVENDANS, BENNO J. RENSING MARIE-LOUISE BARTELINK, BIRGITTA K. VELTHUIS, AREND MOSTERD and MICHIEL L. BOTS: Pericoronary epicardial adipose tissue is related to cardiovascular risk factors and coronary artery calcification in postmenopausal women. European Heart Journal, 29 (6), 777-783, 2007.

23- MIROSLAV ŠRAM, ZVONIMIR VRSELJA, IGOR LEKSAN, GORAN ëURIë, KRISTINA SELTHOFER-RELATIC and RADIVOJE RADIë: Epicardial adipose tissue is nonlinearly related to anthropometric measures and sub-cutaneous adipose tissue. International Journal of Endocrinology. 4562-93, 2015.

24- SINHA S.K., THAKUR R., JHA M.J., GOEL A., KUMAR V. and KUMAR A: Epicardial Adipose Tissue Thickness and Its Association With the Presence and Severity of Coronary Artery Disease in Clinical Setting: A Cross-Sectional Observational Study. Journal of Clinical Medicine Research, 8 (5): 410-9, 2016.

25- A. BARAGETTIA, G. PISANOC, C. BERTELLIC, K. GARLASCHELLIA, L. GRIGOREA, A.L. FRACANZANIC, S. FARGIONC, G.D. NORATABD and A.L. CATAPANOBE: Subclinical atherosclerosis is associated with Epicardial Fat Thickness and hepatic steatosis in the general population. Nutrition, Metabolism and Cardiovascular Diseases, 26 (2): 141-153, 2016.

26- TERESA G. YAÑEZ-RIVERA, MANUEL A. BAÑOS-GONZALEZ, JORGE L. BLE-CASTILLOEMAIL AUTHOR, MANUEL E. TORRES-HERNANDEZ, JORGE E. TORRES-LOPEZ and GABRIELA BORRAYO-SANCHEZ: Relationship between epicardial adipose tissue, coronary artery disease and adiponectin in a Mexican population. Cardiovascular Ultrasound, 12 (1): 35, 2014.

العلاقة بين سماكة النسيج الدهنى النخابى وقصور الشريان التاجى

قصور الشريان التاجى هو السبب الرئيسى للوفيات فى جميع أنحاء العالم. تصلب الشرايين هو أحد العوامل الرئيسية المؤدية إلى الإصابة بقصور الشريان التاجى. يعتبر النسيج الدهنى الناخبى جزء من الدهون الحشوية المتجمعة حول القلب وخصوصاً حول الشرايين التاجية ولقرب تلك الدهون من عضلة القلب وعدم وجود فاصل بينهما فيؤثر ذلك مباشرة على الشرايين التاجية مما يؤدى ذلك إلى حدوث قصور الشريان التاجى. الدهون النخابية يمكن قياسها بطرق مختلفة فيمكن قياسها عن طريق الموجات فوق الصوتية على القلب والأشعة المقطعية والرنين المغناطيسى وقياس الدهون النخابية عن طريق الموجات الصوتية ثنائية الأبعاد على القلب هو الطريقة المقبولة والمعتمدة لدى الكثير.

الهدف من البحث: تقييم سمك النسيج الدهنى النخابى وعلاقته بوجود مرض قصور الشرايين التاجية.

المرضى وطرق البحث: تم إجراء تصوير للشرايين التاجية لعدد ١٠٠مريض بقسم القلب والأوعية الدموية بمستشفى طنطا الجامعى خلال الفترة من ٢٠١٧/٤/١ حتى ٢٠١٨/١/٣١.

النتائج: جنس وعمر المرضى لا يؤثرا فى حجم النسيج الدهنى النخابى. عوامل الخطورة التقليدية كأرتفاع ضغط الدم والداء السكرى والتدخين لا تؤثر فى حجم النسيج الدهنى النخابى. سمك النسيج الدهنى النخابى أكثر من ٠.٤٥ سم يزيد من إصابة الشرايين التاجية بمرض قصور الشريان التاجى. زيادة سمك النسيج الدهنى النخابى أكثر من ٠.٤٥ سم لا يؤدى بالضرورة إلى زيادة عدد الشرايين التاجية المصابة بمرض قصور الشريان التاجى.

الأستنتاج: النسيج الدهنى النخابى هو عامل مستقل يتعلق بوجود مرض قصور الشريان التاجى وزيادة سمكه يؤدى إلى زيادة نسبة الإصابة بمرض قصور الشريان التاجى.