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Correlation of Epicardial fat volume with coronary artery calcification and severity of coronary artery disease using multi-slice CT angiography

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Abstract

Background: The degenerative process known as coronary artery disease can present as either non-obstructive or obstructive, but its hallmark is the accumulation of atherosclerotic plaque in the epicardial arteries. The primary cause of atherosclerosis, which is predominantly an inflammatory process involving lipids, is the accumulation of lipoprotein particles in specific regions of the arteries. Epicardial adipose tissue (EAT) has been shown to increase the likelihood of certain cardiovascular complications, including coronary artery disease. Consequently, the utilization of EAT for risk stratification in patients who exhibit respiratory symptoms may prove advantageous.

Aim: The purpose of this study is to determine the association between the amount of epicardial fat, the degree of coronary artery calcification, and the severity of coronary artery disease using multi-slice structural computed tomography (MSCT).

Research Approach: There were 120 participants in the trial; all had been referred for MSCT coronay angiography due to suspicions of coronary artery disease.

Results: According to the results of the MSCT, there is a significant positive association ($p<0.00001$) between the EFV and Ca score. When comparing individuals with normal coronary arteries to those with coronary lesions, the EFV value was considerably greater in the former group ($p>0.00001$), regardless of whether the lesions were caused by single vessel disease or multivessel disease. Also, EFV and the number of sick coronaries did not differ significantly (P=0.441).

Conclusion: In patients suspected of having ischemic heart disease, EFV can be utilized to determine if atheroslerotic coronary artery disease is present or not.

Keywords: Coronary artery disease, Epicardial adipose tissue, MSCT coronary angiography

Introduction

Coronary artery disease (CAD) account for approximately 7.5 million annual deaths globally. It is mostly due to the process of atherosclerosis and subsequent occlusion of the vessel lumen. Acute atherothrombotic events, brought on by plaque rupture or erosion, can cause the condition to become unstable at any moment, even after extended, stable periods [1].

Almost 50% of all fatalities in developed countries are caused by atherosclerosis, a chronic inflammatory process of the arteries. Accumulation of atherogenic particles and low-density lipoprotein in specific parts of arteries, especially in areas of disturbed non-laminar flow at branch sites, initiates the principal lipid-driven process. This process is associated with an active inflammatory process [2].

The CAD process's dynamic structure enables the classification of clinical manifestations as either acute coronary syndromes (ACS) or chronic coronary syndromes (CCS). Diverse clinical presentations are observed [3].

In assessing risk, the distribution of body fat may be as significant as the quantity of body fat, as it varies among individuals. Indeed, coronary heart disease is more likely to occur when there is an excessive accumulation of fat around the upper body, irrespective of the total body fat percentage [4].

Due to its composition of mesothelial cells, the epicardial adipose layer draws its blood supply from the coronary arteries.

This adipose deposit secretes hormones, cytokines, and biomolecules; it functions as an organ in its own right. Furthermore, via paracrine and vasocrine processes, it controls the cardiovascular system and the heart. According to some reports, cardiomyocytes, which get their energy from fatty acid oxidation, have a big energy reserve in the form of EAT [5].

Cardiovascular disease and metabolic syndrome (MS) are increasingly being targeted by primary and secondary prevention strategies as pharmacological targets, despite the fact that EAT is essential for the optimal function of cardiac muscle [6].

Coronary artery disease (CAD) is elevated by epicardial adipose tissue (EAT), which also predicts future cardiovascular events. At this time, it is not known whether a higher Epicardial Fat Volume (EFV) is associated with a longer-term greater risk of atherosclerosis or if a higher EFV is associated with a larger volume of coronary plaque [7].

The noninvasive multi-slice computed tomography (CT) scanner enables the early and precise detection of obstructive and non-obstructive subclinical coronary artery disease, in contrast to invasive angiography. Additionally, it reveals whether coronary artery stenosis is present and how much calcium is in the blood [8].

This technique has recently been used to evaluate coronary atherosclerotic plaques' morphology, composition, and EFV without the need for contrast injection. This information is vital for predicting the likelihood and degree of CAD [9].

2. Patients and Methods

This was a cross-sectional prospective study that was conducted at the Cardiology department of Banha University & Kobri El kobba military hospital and Heliopolis hospital during the period from January 2022 to May 2023.

Patients

The study included 120 patients with suspected coronary artery disease who were referred for multi-slice CTcoronary angiography.

Inclusion criteria

The study encompassed patients who presented with chest pain and a low to intermediate pre-test probability of CAD, as defined by the Diamond and Forrester Pre-Test Probability of Coronary Artery Disease (High: > 90% pre-test probability, Intermediate: between 10% and 90% pre-test probability, Low: between 5% and 10% pre-test probability, very low: < 5% pre-test probability).

Exclusion criteria

Dye allergy, irregular heart rhythm (such as atrial fibrillation) or a heart rate exceeding 80 beats per minute, severe coronary calcification (ca score>1000), inadequate breath holding during CT, acute coronary syndrome diagnosis, prior coronary intervention (PCI or CABG), or myocardial infarction or heart failure (EF < 35%) are all reasons why CT coronary angiography should not be performed.

Methodology

a) **Complete history taking including the following data:** Sex, hypertension, Age family history of ischemic heart disease and smoking.

b) **Complete clinical examination including:** Body mass index, waist circumference and waist to hip ratio.

c) **Standard ECG including the following data:** Rhythm, heart rate and presence of ischemic changes.

d) **Routine laboratory investigations including:** Complete Blood Count (CBC), random blood glucose level, serum creatinine and complete lipid profile.

e) **Transthoracic echocardiography:** Ejection fraction (EF), regional wall motion abnormalities (RWMA), valvular lesions and LV diameters.

f) **Multi-slice CT angiography:** Dual-source scanners (Som atom Definition Flash, Siemens) were employed to perform CT angiography on all patients. The slice configuration was 128 × 0. 625 mm, and the gantry rotation duration was 330 Ms.

3. Results

With a mean age of 51.9± 12.1 years, 59.2% of the patients surveyed were male and 40.8% were female. When it came to the factors that put patients at risk for atherosclerosis, 65.8% had hypertension, 51.7% had diabetes, 40.8% smoked cigarettes regularly, and 33.3% had a family history of coronary artery disease (Table 1).

Table 1: Prevalence of qualitative risk factors for atherosclerosis among the study group

		Number	%
Sex	**M**	71	59.2%
	F	49	40.8%
HTN		79	65.8%
DM		62	51.7%
Smoking		49	40.8%
Family history of CAD		40	33.3%

Among the patients analyzed, 24.2% had healthy coronaries, 45.8% had disease affecting just one artery, and nearly 30% had damage affecting many vessels, according to the results of the MSCT and the distribution of damaged coronary arteries. Around 41.7% of patients in the study group had their left anterior descending artery (LAD) affected, 18.3% had their right coronary artery (RCA) affected, 15.8% had their left circumflex artery (LCX) affected, and 5% had their left main trunk (LM) affected, making these three major coronary arteries the most common sites of injury (Table 2).

Table 2: MSCT findings that measure the extent and severity of CAD and EFV of the study group

EFV (Mean ± SD/cm^3)	128.4 ± 34.1
Ca score (Mean ± SD)	251.9 ± 398.6.
Normal vessels (n%)	29 (24.2)
Single vessel D (n%)	55 (45.8)
Multi vessel D (n%)	36 (30)
LM (n%)	6 (5)
LAD (n%)	50 (41.7)
LCX (n%)	19 (15.8)
RCA (n%)	22 (18.3)

As regard the quantitative risk factors for atherosclerosis, Table 3 shows highly significant positive correlation between EFV and age, body mass index, serum cholesterol, LDL-C, serum triglycerides ($p<0.00001$), and significant negative correlation between EFV and HDL-C ($p<0.00001$).

Table 3: Relationship between epicardial fat volume and quantitative risk factors for atherosclerosis

Risk Factors (quantitative factors)	EFV (cm3)	
	P value	**R score**
Age (years)	<0.00001	0.8869
Body mass Index ((Kg/m^2)	<0.00001	0.8841
Total cholesterol (mg/dl)	<0.00001	0.9063
LDL-C (mg/dl)	<0.00001	0.9626
S. Triglycerides (mg/dl)	<0.00001	0.9439
HDL-C (mg/dl)	<0.00001	-0.7061

Patients with normal coronary arteries were noted to have a significantly lower EFV value than those patients with coronary lesions either single vessel disease or multivessel disease ($p<.00001$), but there is no significant difference between EFV and the number of diseased coronaries either single vessel disease or multivessel disease (P=0.441) Table (4).

Table 4: Relationship between epicardial fat volume and number of affected coronary arteries assessed by MSCT

	EFV (Cm3)			
	Mean	**Standard deviation**	**Minimum value**	**Maximum value**
Normal coronaries	91.55	17.87	47.9	117.2
Single vessel D	138.24	28.36	98.3	221.1
Multi vessel D	143.11	30.85	89.7	220.4

4. Discussion

In an effort to ascertain whether there was a correlation between the severity of coronary artery disease and the proportion of epicardial fat, as well as the presence or absence of coronary artery calcification, the present study was conducted, Coronary angiography with multiline CT.

In agreement with our results, Ding J, *et al.* in 2009 conducted a study that found a strong correlation between the thickness and volume of epicardial fat as measured by cardiac CT and risk factors for vascular atherosclerosis and coronary calcification in postmenopausal women. Epicardial fat may be a useful quantitative marker for CAD risk stratification due to the positive correlation between it and metabolic impairments and systemic atherosclerosis [10].

As regard the relationship between EFV and MSCT findings and in agreement with our results, Bhattarika, *et al.* in 2010 involuntary coronary angiography and multi-slice computed tomography (MSCT) were used to assess around fifty people for possible coronary artery disease. In order to evaluate calcium score and quantify EAT, we acquired MSCT images. On conventional coronary angiography, the Gemini score was employed to grade coronary stenosis. The volumetric estimate of EAT was shown to be significantly correlated with the Gemini score, coronary artery calcification, and body mass index. Using automated volumetry, we found that EAT volumes were significantly different between patients with and without significant coronary artery steno sis [11].

Moreover, Oakdale in 2014 analyzed the correlation between Epicardial Fat Volume (EAT) and coronary artery disease severity as measured by magnetic resonance angiography (MSCT) in non-obese individuals, and speculated on the potential effects of EAT on the shape and expansion of coronary plaques. Despite the absence of visceral fat accumulation, patients with elevated EFV were found to have more severe coronary artery lesions. Additional evidence that dense epicardial fat increases the likelihood of coronary atherosclerotic disease has been found [12].

However, that was disconcerting with some previous studies that used echocardiography instead of MSCT to assess the epicardial fat and CAD. This disparity is believed to have multiple causes. To start, these studies don't all use the same measurement tools or have the same sample sizes. Also, echocardiography can only measure the free wall of the right ventricle, therefore it can't correctly and dependably assess the entire volume of pericardial fat. Furthermore, MSCT coronary angiography offers superior temporal and spatial resolution compared to echocardiography, which means that the latter may not accurately measure epicardial fat. Last but not least, some patients may have trouble having the epicardial fat delineated during echocardiographic evaluation [13].

5. Conclusion

Patients suspected of having ischemic heart disease can have their atherosclerotic coronary artery disease (CAD) predicted using EFV.

Conflict of Interest

Not available.

Financial Support

Not available.

6. References

1. Porsch F, Mallat Z, Binder CJ. Humoral immunity in atherosclerosis and myocardial infarction: from B cells to antibodies. Cardiovasc Res. 2021;117:2544-2562.
2. Dichgans M, Pulit SL, Rosand J. Stroke genetics: discovery, biology, and clinical applications. Lancet Neurol. 2019;18:587-599.
3. Knuuti J, Wijns W, Saraste A, Capodanno D, Barbato E, Funck-Brentano C, Prescott E, Storey RF, Deaton C, Cuisset T, *et al.* 2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes. Eur Heart J. 2020;41:407-477.
4. Pirillo A, Casula M, Mastroeni E, Morata GD, Catapano AL. Global epidemiology of dyslipidaemia. Nat Rev Cardiol. 2021;18:689-700.
5. Koepp KE, Obokata M, Reddy YNV, Olson TP, Borlaug BA. Hemodynamic and functional impact of epicardial adipose tissue in heart failure with preserved ejection fraction. JACC Heart Fail. 2020;8:657-666.
6. Du Z, Qin Y. Dyslipidemia and cardiovascular disease: current knowledge, existing challenges, and new opportunities for management strategies. J Clin Med. 2023;12(1):363.
7. Domanski MJ, Tian X, Wu CO, Reis JP, Dey AK, Gu Y, *et al*. Time course of LDL cholesterol exposure and cardiovascular disease event risk. J Am Coll Cardiol. 2020;76:1507-16.
8. Kim J, Hwang BH, *et al*. Impact of diabetes duration on the extent and severity of coronary atheroma burden and long-term clinical outcome in asymptomatic type 2 diabetic patients: evaluation by coronary CT angiography. Eur Heart J Cardiovasc Imaging. 2015;16:1065-1073.
9. Kolossváry M, Szilveszter B, Merkely B, Maurovich-Horvat P. Plaque imaging with CT: a comprehensive

review on coronary CT angiography-based risk assessment. Cardiovasc Diagn Ther. 2017;7(5):489-506.
10. Ding J, Hsu FC, Harris TB, Liu Y, Kritchevsky SB, Szklo M, *et al*. The association of pericardial fat with incident coronary heart disease: the Multi-Ethnic Study of Atherosclerosis (MESA). Am J Clin Nutr. 2009;90(3):499-504.
11. Bastarrika G, Broncano J, Schoepf U, *et al*. Relationship between coronary artery disease and epicardial adipose tissue quantification at cardiac CT: comparison between automatic volumetric measurement and manual bidimensional estimation. Acad Radiol. 2010;17:727-734.
12. Okada K, Ohshima S, Isobe S, *et al*. Epicardial fat volume correlates with severity of coronary artery disease in non-obese patients. J Cardiovasc Med. 2014;15(5):384-390.
13. Wheeler GL, Shi R, Beck SR, Langefeld CD, Lenchik L, Wagenknecht LE, *et al*. Pericardial and visceral adipose tissues measured volumetrically with computed tomography are highly associated in type 2 diabetic families. Invest Radiol. 2005;40(2):97-101.

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