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Original article

Correlation between LDL Level and Pericoronary Adipose Tissue Assessed by Multi Slice Computed Tomography Coronary Angiography

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Abstract

Background: Epicardial fat is a metabolically active visceral and perivascular fat depot, surrounding the myocardium and coronary arteries. The aim of this study was to evaluate correlation between low density lipoprotein (LDL) level and pericoronary adipose tissue assessed by multi slice computed tomography coronary angiography. **Methods:** It was a single center, cross sectional, comparative study that was conducted on 200 patients with suspected coronary artery disease were recruited from El-Galaa military outpatient clinic of cardiology underwent computed tomography coronary angiography (CCTA) and they were classified into two equal groups: group (1) included patients with High LDL level (≥130mg/dl) and group (2) included patients with normal LDL level (<130mg/dl). All patients were subjected to full history taking, investigations including ECGs, laboratory investigations, and coronary CT angiography. **Results:** There was a significant positive correlation between LDL level and pericoronary fat thicknesses (PCFT) of left main coronary artery (LM) (r=0.752, P<0.001), PCFT of left anterior descending branch (LAD) (r=0.767, P<0.001), PCFT of left circumflex branch (LCX) (r=0.471, P<0.001), PCFT of right coronary artery (RCA) (r=0.510, P<0.001), and coronary artery calcium (CAC) score (r=0.727, P<0.001). There was an insignificant correlation between LDL level and segment involvement score (SIS). **Conclusions:** PCFT is related to severe coronary atherosclerosis. There was a positive correlation between PCFT, CAC score and LDL cholesterol level.

Keywords: Low density lipoprotein; Pericoronary Adipose Tissue; Multi Slice Computed Tomography Coronary Angiography

Introduction

Epicardial fat is a metabolically active visceral and perivascular fat depot, surrounding the myocardium and coronary arteries., thus allowing a paracrine dialogue between epicardial adipocytes, cardiomyocytes, and cells of the vascular wall [1]. The secretion of bioactive inflammatory molecules by the EAT is now recognized as implicated in the formation of atherosclerotic plaques, and the onset of coronary artery disease [2].

EAT evaluation can be done by (ECHO), (MSCT) and (CMR). The gold standard for assessment of EAT volume is magnetic resonance. EAT volume can be measured by Using MSCT. In addition, information about calcification and coronary stenosis can be assessed [3].

The adipose tissue thickness was measured by MSCT on the basis of multiplane reconstruction (MPR) along the short axis of the left ventricle, at the level of mid-ventricular slices, the EAT thickness at the middle length of the free right ventricle wall, [4].

Pathological studies have identified plaque features of ruptured coronary lesions. These include a large lipid core, spotty calcification, positive remodelling, and inflammatory cell infiltration. Because most of these plaque features can be readily detected on (CTA), multiple studies have evaluated the impact of such lesion characteristics on patient outcome [5].

The severity of luminal diameter stenosis was scored as none (0% luminal stenosis), non-obstructive (luminal stenosis < 50%), or obstructive (luminal stenosis ≥ 50%).

LDL cholesterol is often called the “bad” cholesterol because it collects in the walls of your blood vessels, raising your chances of health problems like a heart attack or stroke **[6].**

The aim of this study was to evaluate correlation between LDL level and pericoronary adipose tissue assessed by multi slice computed tomography coronary angiography.

Patients and Methods

It was a single center, cross sectional, comparative study that was conducted at El-Galaa Military Complex- Cardiology Department during the period from June 2022 to January 2023. The study approved by the ethics committee on research involving human subjects. Informed consent was obtained from the patients before participating in this study.

Inclusion criteria were patients with chronic stable angina with low to intermediate risk.

Exclusion criteria were patients with contraindication to CT, patients with renal insufficiency, Contrast allergy, any types of arrhythmias, patients have difficulties in performing CT, like inadequate breath holding and heart failure and claustrophobia.

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Grouping

(200) patients with suspected coronary artery disease were recruited from El-Galaa military outpatient clinic of

cardiology underwent CCTA and they were classified into two Groups:

- Group (1): 100 Patients with High LDL level (≥130mg/dl).
- Group (2): 100 Patients with normal LDL level (<130mg/dl).

All patients were subjected to full history taking as age, sex and BMI, past history relevant to coronary artery disease, risk factors (smoking, hypertension, dyslipidemia, investigations: ECGs, labs as Serum creatinine, HbA1c & lipid profile, and coronary CT angiography. CCTA was performed with Siemens Somatom definition flash 256 slice (DSCT) scanner.

If heart rate was ≥ 65 bpm, the patient was orally administered 40 mg of oral beta blocker propranolol hydrochloride except those with contraindications to beta-blockers. A 0.5 mg sublingual dose of nitroglycerin was administered just before the scan. [7].

Statistical analysis:

Statistical analysis was done by SPSS v28 (IBM©, Armonk, NY, USA). The Shapiro-Wilks test and histograms were used to evaluate the normality of the distribution of data. Quantitative parametric data were presented as mean and standard deviation (SD) and were analysed by unpaired student t-test. Qualitative variables were presented as frequency and percentage (%), analysed by Chi-square test. Pearson correlation was done to estimate the degree of correlation between two quantitative variables. P value < 0.05 was considered statistically significant.

Results

There was an insignificant difference between both groups regarding baseline characteristics including age, sex, weight, height and BMI. The risk factors including HTN, DM, smoking and family history were insignificantly different between both groups.

Regarding the lipid profile, total cholesterol, triglycerides and LDL were significantly higher in group 1 compared to group 2, with no significant difference regarding HDL. **Table 1**

The number of vessels was significantly different between both groups (P<0.001). **Table 2**

CAC and SIS scores were significantly higher in group 1 compared to group 2 (P<0.001, 0.039). The stenosis of LM, LAD and LCX was significantly different higher in group 1 compared to group 2 (P=0.003, 0.001, 0.011 respectively), with no significant difference between both groups regrading RCA stenosis. The PCFT of LM, LAD, LCX and RCA was significantly higher in group 1 compared to group 2 (P<0.05). The R.I LM, LCX and RCA was insignificantly different, while R.I LAD was significantly higher in group 1 compared to group 2 (P=0.002). **Table 3**

There was a significant positive correlation between LDL level and PCFT of LM (r=0.752, P<0.001), PCFT of LAD (r=0.767, P<0.001), PCFT of LCX (r=0.471, P<0.001), PCFT of RCA (r=0.510, P<0.001), and CAC score (r=0.727, P<0.001). There was an insignificant correlation between LDL level and SIS. **Table 4**

Table 1: Lipid profile of the studied groups

	Group 1 (n=100)	Group 2 (n=100)	P value
Total cholesterol (mg/dL)	209.7 ± 35.52	129.9 ± 21.96	**<0.001***
Triglycerides (mg/dL)	219.5 ± 36.71	110.6 ± 18.45	**<0.001***
HDL (mg/dL)	51.99 ± 6.12	53.03 ± 4.73	0.180
LDL (mg/dL)	173.96 ± 19.95	93.7 ± 13.96	**<0.001***

HDL: high density lipoprotein, LDL: low density lipoprotein, *: statistically significant as p value <0.05.

Table 2: Number of affected vessels by coronary angiography of the studied groups

		Group 1 (n=100)	Group 2 (n=100)	P value
Number of vessels	**0**	45 (45%)	25 (25%)	**<0.001***
	1	12 (12%)	31 (31%)	
	2	18 (18%)	30 (30%)	
	3	17 (17%)	6 (6%)	
	4	8 (8%)	8 (8%)	

Table 3: MSCT evaluation of the affected vessels of the studied groups

			Group 1 (n=100)	Group 2 (n=100)	P value
CAC score		**Mean± SD**	254.5 ± 94.74	54.1 ± 46.5	**<0.001***
SIS score		**Mean± SD**	2.01 ± 2.46	1.4 ± 1.09	**0.039***
LM	**Stenosis**	**No**	71 (71%)	84 (84%)	**0.003***
		Mild	19 (19%)	16 (16%)	
		Moderate	10 (10%)	0 (0%)	
	PCFT	**Mean± SD**	13.1 ± 2.76	7.5 ± 1.21	**<0.001***
	RI		7 (7%)	9 (9%)	0.602
LAD	**Stenosis**	**No**	49 (49%)	73 (73%)	**0.001***
		Mild	28 (28%)	20 (20%)	
		Moderate	8 (8%)	5 (5%)	
		Severe	15 (15%)	2 (2%)	
	PCFT	**Mean± SD**	14 ± 3.09	5.9 ± 1.39	**<0.001***
	RI		40 (40%)	20 (20%)	**0.002***
LCX	**Stenosis**	**No**	64 (64%)	80 (80%)	**0.011***
		Mild	26 (26%)	11 (11%)	
		Moderate	3 (3%)	6 (6%)	
		Severe	7 (7%)	3 (3%)	
	PCFT	**Mean± SD**	9.6 ± 2.33	7.3 ± 1.2	**<0.001***
	RI		20 (20%)	18 (18%)	0.718
RCA	**Stenosis**	**No**	64 (64%)	71 (71%)	0.750
		Mild	26 (26%)	20 (20%)	
		Moderate	2 (2%)	2 (2%)	
		Severe	8 (8%)	7 (7%)	
	PCFT	**Mean± SD**	14.8 ± 3.5	10.9 ± 1.39	**<0.001***
	RI		27 (27%)	19 (19%)	0.179

CAC: coronary artery calcium, SIS: segment involvement score, LM: left main, LAD: left anterior descending, LCX: left circumflex, RCA: right coronary artery, PCFT: Pericoronary fat thicknesses, R I: remodeling index, *: statistically significant as p value <0.05.

Table 4: Correlation between LDL level and PCFT and MSCT scores

	LDL (mg/dL)	
	r	**P**
PCFT of LM	0.752	**<0.001***
PCFT of LAD	0.767	**<0.001***
PCFT of LCX	0.471	**<0.001***
PCFT of RCA	0.510	**<0.001***
CAC score	0.727	**<0.001***
SIS score	0.103	0.146

Discussion

Despite the rather short period of intervention trials (usually < 5years),, a 10% reduction in LDL-C is associated with a 25% reduction of the incidence of coronary artery disease [8].

EAT has effect in surrounding tissues such as the myocardium and coronary arteries and may act as a local transducer of systemic inflammation in obese or diabetic patients **[9]**.

There was an insignificant difference between both groups regarding the baseline characteristics including age, sex, weight, height and BMI.

In agreement with our findings, a study was conducted aiming to evaluate relationship between BMI, Sex and smoking with LDL-C in 12,273 males and females and reported that there was insignificant difference among patients **[10]**.

In the present study, total cholesterol, triglycerides and LDL were significantly higher in group 1 compared to group 2, with no significant difference regarding HDL.

In contrast with us it was reported that total cholesterol, triglycerides, LDL and HDL were insignificantly different among patients **[11]**.

In parallel with our findings, a study was conducted to evaluate CAC scoring for risk assessment in 1,904 patients with severe hypercholesterolemia. They reported that patients with LDL-C ≥190 mg100 ml, CAC was associated with a higher risk for ASCVD events (CAC ≥100 vs CAC <100, hazard ratio 3.57 [1.81 to 7.04], p <0.001) **[12]**.

The number of vessels in our study was significantly different between both groups (P<0.001).

In alignment with our findings, a study was done including 116,419 individuals. They reported that high LDL-C was observationally and genetically associated with high risks of PAD and CKD, suggesting the more LDL level increase, the more blood vessels affected **[13]**

Regarding the CT findings in our study, the stenosis of LM, LAD and LCX was significantly higher in group 1 compared to group 2 (P=0.003, 0.001, 0.011), with no significant difference between both groups regarding (RCA) stenosis. PCFT of LM, LAD, LCX and RCA was significantly higher in group 1 compared to group 2 (P<0.05). The remodelling index of LM, LCX and RCA was insignificantly different between both groups, while in LAD was significantly higher in group 1 compared to group 2 (P=0.002)

In agreement with us, a cross-sectional study was performed including 210 patients referred for CT angiography to study the correlation between EAT, PCFT, and PCFD with the existence and severity of CAD. They reported that EATT and PCFT showed that the obstructive group had significantly higher mean EATT and PCFT values than the non-obstructive and non-atherosclerotic groups **[14]**

In contrast, a study was done on 139 patients who were referred for coronary angiography did not show a significant correlation between EAT thickness and number of atherosclerotic coronary segments **[15]**

In the current study, there was a significant positive correlation between LDL level and PCFT of LM, LAD, LCX, RCA (P<0.001), and CAC score (P<0.001). There was an insignificant correlation between LDL level and SIS.

In parallel with us, study including 496 patients with CAD, who underwent CCTA; was conducted. They concluded that periplaque FAI values quantified by CCTA were strongly correlated with lipid and calcification component volume fractions **[16]**

Conclusions:

PCFT is related to severe coronary atherosclerosis. There was a positive correlation between PCFT, CAC score and LDL cholesterol level.

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