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Echocardiographic Parameters of Epicardial Fat Deposition and Its Relation to Severity of Coronary Artery Disease by SYNTAX Score in Zagazig University Hospitals

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ABSTRACT

Background: The thickness of epicardial adipose tissue (EAT) has the potential to act as a novel indicator of cardiac and visceral adiposity and its function in myocardial infarction (MI) diagnosis and therapy. **Objective:** The main aim of the current study was to determine the EAT thickness by echocardiography in chest pain cases, which was suspected to had ischemic heart disease (IHD). We planned to determine EAT association with coronary artery disease (CAD) severity estimated by SYNTAX score and to examine the echocardiographic EAT usage for determining cardiovascular risk in IHD patients. **Patients and Methods:** A case control study was conducted on 148 cases with chest pain suspected to have IHD and referred to Cardiology Department Cath lab for doing coronary angiography (CA). All patients underwent physical examination, lead surface ECG, echocardiographic evaluation, EAT thickness assessment, laboratory investigations and CA. Participants were divided into 2 groups; Group I included 74 ischemic patients who underwent elective CA for evaluation of CAD and Group II included 74 subjects with chest pain referred for CA which reveals normal epicardial coronaries. **Results:** There was a positive correlation among SYNTAX score and age of patients in group I, body mass index (BMI) and waist circumference (WC). There was a positive correlation between SYNTAX score and triglycerides, total cholesterol and LDL in group I while HDL shows significant negative correlation with SYNTAX score. There was a positive correlation between SYNTAX score and EAT, IAS and RVFW. EAT was a significant predictor for CAD severity regarding SYNTAX score. **Conclusions:** The EAT thickness is useful for early detection of individuals with complicated CAD. EAT thickness was significantly correlated with CAD severity. Echocardiography assessment of EAT can be simply predict CAD severity and help in patient's risk stratification.

Keywords: Echocardiographic Parameters, Epicardial Fat, Coronary artery disease, SYNTAX Score.

INTRODUCTION

The epicardial adipose tissue (EAT) is close to the heart both anatomically and functionally and is metabolically active. Consequently, reactions among the heart and its visceral fat depot have been proposed. EAT thickness has the potential to act as a novel indicator of heart and visceral adiposity and its function in myocardial infarction (MI) diagnosis and therapy [1].

In individuals with acute coronary syndrome, elevated EAT thickness may be related with a bad outcome. The visceral fat store of the heart is EAT. It has functional and anatomical proximity to the heart and is metabolically active. Dietary intake has the strongest independent connection with myocardial fat [2].

EAT thickness is an independent hazard indicator for coronary artery disease (CAD) development. Regardless of cardiovascular hazard factors, it causes fatal and nonfatal coronary artery activities. Determination of normal EAT thickness is now crucial for forecasting the development of CAD in the future. It has been shown that EAT has a significant function in CAD pathophysiology [3]. According to our understanding, EAT has both paracrine and endocrine function. It releases cytokines and chemokines that are both proinflammatory and anti-inflammatory. It has been hypothesised that these substances increase coronary artery atherosclerosis [4].

The aim of the current study was to estimate the EAT thickness by echocardiography in chest pain cases which was suspected to had ischemic heart disease (IHD) and to determine its association with CAD severity assessed by SYNAX score and to evaluate the echocardiographic epicardial fat thickness usage for determining cardiovascular risk in ischemic patients.

PATIENTS AND METHODS

A case control study was conducted on 148 cases with chest pain suspected to have IHD and referred to Cardiology Department Cath lab for doing coronary angiography (CA) during the period from May 2014 till fulfilling the sample size.

Exclusion criteria were abnormal myocardial repolarization, left bundle branch block, right bundle branch block, ventricular pacing, previous cardiac surgery, myocarditis, infiltrative disorder of the left ventricle, poor echogenic window, pericardial heart disease, valvular heart disease, congenital heart disease, acute MI, arrhythmias that alter the atrial depolarization and the late ventricular filling phase as complete heart block, atrial fibrillation, and intraventricular conduction disturbances.

Participants were divided into 2 groups; Group I included 74 ischemic patients who underwent elective CA for evaluation of CAD and Group II included 74 subjects with chest pain referred for CA which reveals normal epicardial coronaries.

All participants underwent full demographic data (age, sex, and habits of medical importance especially smoking), a detailed history with particular attention to

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that of myocardial ischemia (symptoms of chest pain, previous MI, previous catheterization, or revascularization), medical history of hypertension (HTN), diabetes mellitus (DM), dyslipidaemia and IHD family history.

Physical examination: Chest, heart, abdomen, and extremity examinations including pulse rate, rhythm, systolic and diastolic blood pressure. HTN was recognized as ≥140 mmHg systolic and/or ≥90 mmHg diastolic on three separate measurements [5]. Signs of heart failure (S3, S4, basal rales and neck veins congestion). Anthropometric measures: body mass index (BMI) and waist circumference (WC) [6].

Lead surface ECG: Searching for ischemic changes, arrhythmia, and conduction defects.

Echocardiographic evaluation: Using commercially accessible technology, the digital ultrasound system (GE) with a 2- to 3-MHz transducer, an echocardiographic examination was performed. All subjects had M-mode, 2-dimensional, and Doppler echocardiographic evaluations. With the left semi-lateral position, left parasternal long axis and short axis views, apical 2, apical 4, and apical 5 chamber images were obtained.

Assessment of systolic function by Modified Simpson's rule: This formula represents the ventricle as a stack of small cylindrical segments. The ventricular volume is estimated as the sum volumes of each individual cylinder. The calculations can be achieved by a light-pen computer system which presumes orthogonal long-axis views of the ventricular chamber. The apical 2 and 4 chamber views fulfil this requirement.

The conventional formula for calculating ejection fraction (EF) is diastolic volume- systolic volume/diastolic volume; EF >55%, normal, EF 35%-55%, moderately impaired and EF <35, severely impaired [7].

Assessment of diastolic function:

Pulsed-wave (PW) Doppler is conducted in the apical 4-chamber view to measure LV filling by obtaining mitral inflow velocity. Mitral inflow measures involve the peak early filling (E-wave) and late diastolic filling (A-wave) speeds, the E/A ratio, the deceleration time (DT) of early filling velocity, and the E/A ratio [8].

Assessment of EAT thickness:

On 2-dimensional echocardiography, epicardial fat was recognized as an echo-free region in the pericardial layers, and its thickness was evaluated perpendicularly on the free wall of the right ventricle at end-diastole for three cardiac cycles. We utilised the aortic annulus as an anatomical reference to standardise the measurement point amongst various observers. The measurement was taken at a position in the midline of the ultrasound beam, perpendicular to the aortic annulus, on the free wall of the right ventricle **(Figures 1 and 2)**. The mean value of three cardiac cycles [9].

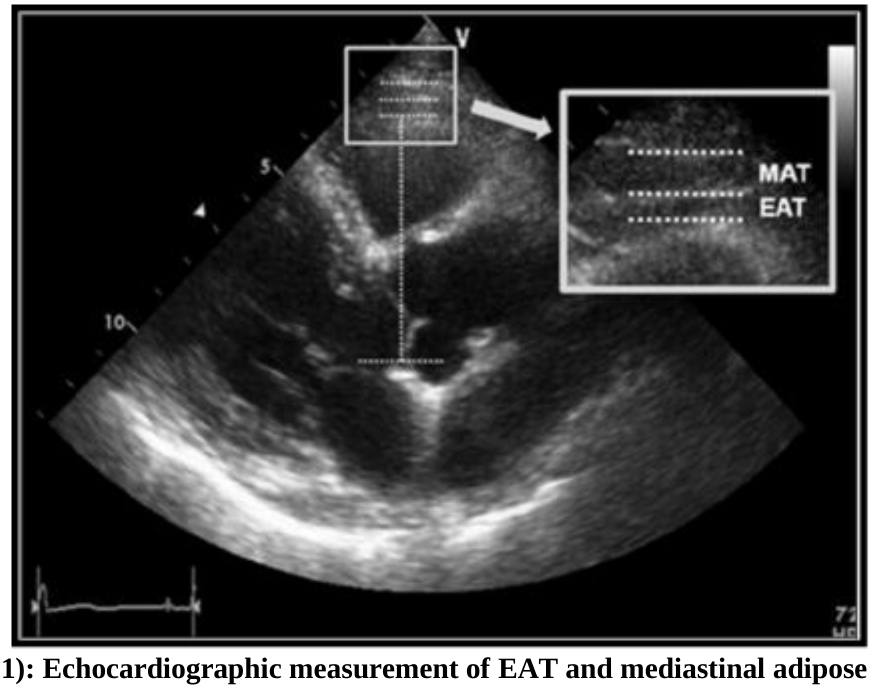


Figure (1): Echocardiographic measurement of EAT and mediastinal adipose tissue [9].

Figure (2): Echocardiographic measurement of epicardial adipose tissue and pericardial adipose tissue [10].

Standard laboratory investigations:

Renal function tests involving serum urea and creatinine. The reference normal result range for urea was 15-40 mg/dl, and for creatinine was 0.2-1.2 mg/dl [11]. Lipid profile: Plasma TC, HDL-C and TG were evaluated with standard enzymatic spectrophotometric techniques. LDL-C was estimated from the equation of Friedwald and colleagues [12]:

LDL-C (mg/dl) = TC (mg/dl) – HDL-C (mg/dl) – TG/5 (mg/dl). The reference normal result for TC was (<200 mg/dl), for HDL-C was (>50 mg/dl for females and >40 mg/dl for males), for TG was (<150 mg/dl) and for LDL-C was (<130 mg/dl) [13].

CA: In a condition of fasting, CA was conducted using the Judkins' technique after femoral artery puncture or the radial artery method. In all cases, the coronary atherosclerotic lesions severity was assessed using at least three projections. Significant stenosis was recognized as a 50 percent or larger diameter stenosis. SYNTAX score was utilized to define the angiographic features of the coronary atherosclerotic lesion. Syntax score can be calculated by using the Web-based calculator.

The SYNTAX score algorithm [14]: Dominance, number of lesions, lesion characteristics, segments involved per lesion, total occlusion (number of segments involved, age of the total occlusion (>3 months), bridging collaterals, blunt stump, first segment beyond the occlusion visible by antegrade or retrograde filling, side branch involvement), trifurcation (number of segments diseased), bifurcation (type, angulation between the distal main vessel and side branch <70), sever tortuosity, aorto-ostial lesion, length >20mm, heavy calcification, thrombus and diffuse disease/small vessels (number of segments with diffuse disease/small vessels).

Ethical Approval:This study was ethically approved by the Ethical Committee board of Sharkia Governate, Zagazig University Hospital. Written informed consent was obtained from all participants. This study was executed according to the code of ethics of the World Medical Association (Declaration of Helsinki) for studies on humans.

Statistical analysis

SPSS v27 (IBM, Armonk, NY, USA) was utilized for statistical analysis. Utilizing Shapiro-Wilks test and histograms, the normality of the data distribution was assessed. Parametric quantitative data were given as mean and standard deviation (SD) and analysed utilizing an unpaired student t-test. Non-parametric quantitative data were provided as the median and interquartile range (IQR) and analysed utilizing the Mann Whitney U test. Qualitative variables were given as frequency and percentage (%) and analysed utilizing Chi-square test or Fisher's exact test when applicable. Correlation coefficient(r) is always a number between –1 and +1 and equals zero if the variables are not correlated. The accuracy of a measurement system is the degree of closeness of measurements of a quantity to that quantity's actual (true) value. A two-tailed P value $\leq$0.05 was considered significant.

CASE

Female patient, 59 years old, diabetic, hypertensive and non-smoker with positive family history of IHD complaint of recurrent ischemic chest pain responding to medical treatment. Anthropometric measures: Weight 95Kg, Height 170cm, BMI 32.9 kg/m^2, WC 122cm. Laboratory findings: Lipid profile: Total cholesterol 210mg/dl., Triglycerides 170 mg/dl., LDL 192 mg/dl and HDL 40 mg/dl. Serum creatinine 1.5 mg/dl.

ECG: Old Inferior wall MI and anterolateral ischemia **(Figure 3).**

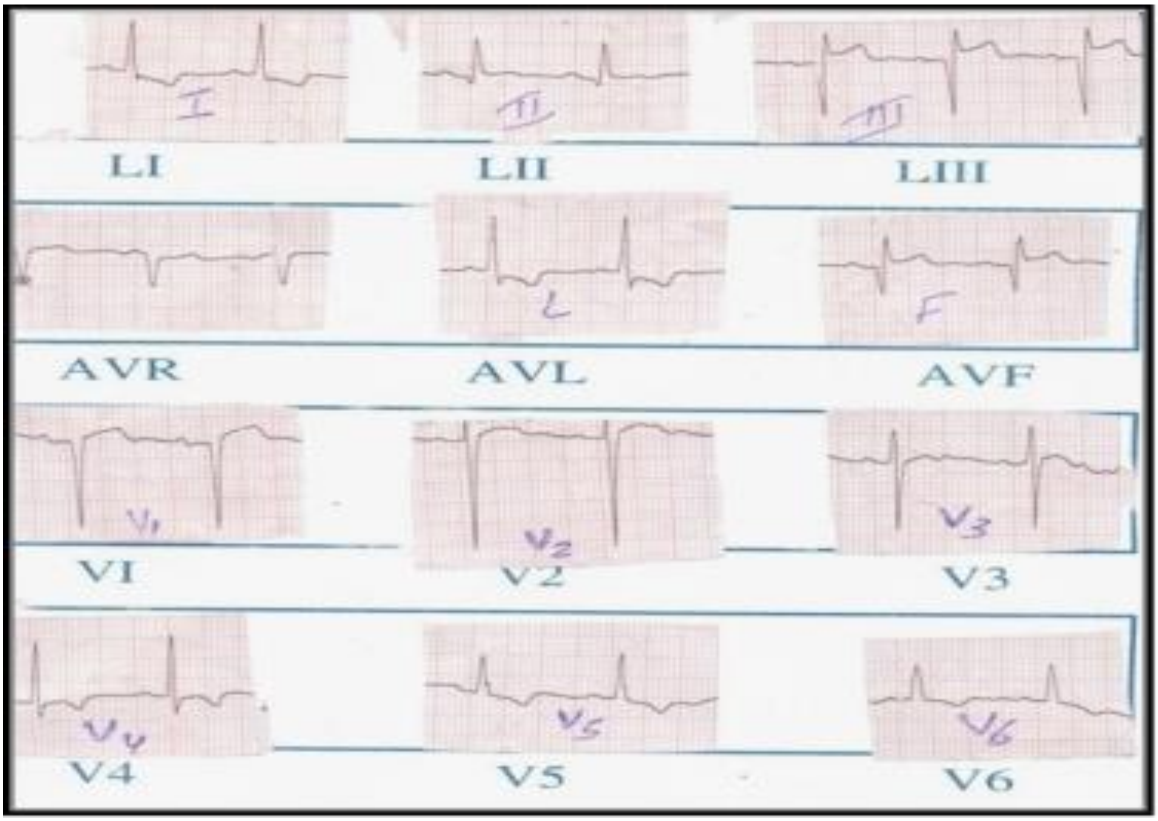


Figure (3): ECG of Female patient, 59 years old, hypertensive, diabetic with Inferior wall MI and anterolateral ischemia.

Echocardiography: Normal left ventricular dimension and good LV systolic function with EF 52%, left ventricular diastolic dysfunction grade II with resting wall motion abnormalities. EAT thickness: 9mm (**Figure 4).**

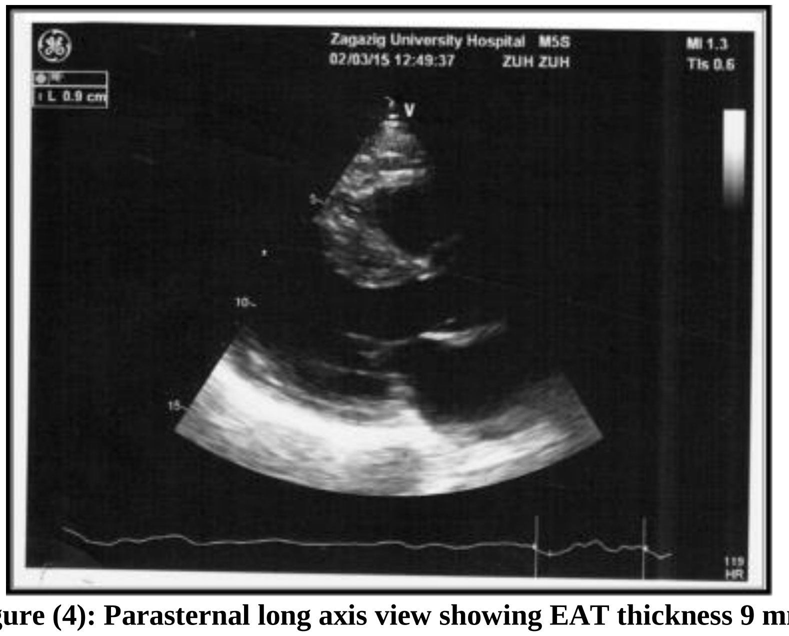
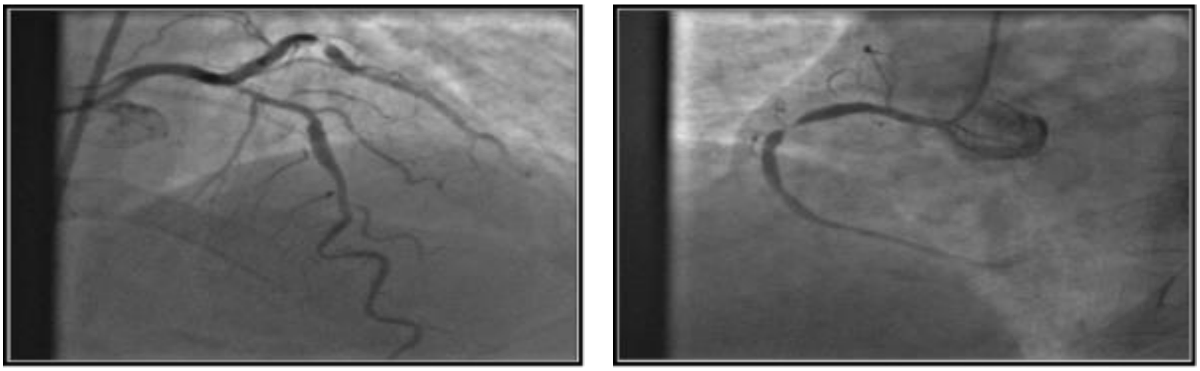


Figure (4): Parasternal long axis view showing EAT thickness 9 mm.

CA: Left main: Normal, LAD: Atherosclerotic vessel with Proximal 70% significant lesion, LCX: mid-segment subtotal lesion, RCA: mid-segment subtotal occlusion.



(A) (B)

Figure (5): Angiographic analysis, (A) AP cranial view: Show LAD Proximal 70% significant lesion and LCX mid-segment subtotal lesion. (B) AP cranial view: show RCA mid-segment subtotal occlusion [SYNTAX score= 23].

RESULTS

Table 1 summarized patients' baseline characteristics. The mean of dyslipidaemia parameters and serum creatinine between both Groups I and II. There was a highly significant difference among TG, TC, LDL, HDL, and serum creatinine of the two groups.

About 12.1% of group I present with LVSD and the differences among both groups were significant. There was a highly significant variance among Group I and Group II as regard adipose tissue parameters.

Table (1): Demographic data anthropometric measures, risk factors, and Echo-Doppler parameters of the studied groups.

Variable	Mean ± SD				T-test	P-value
	Group I= 74		Group II= 74			
Age (years)	57.987±8.35		57.554±7.98		0.322	0.748
BMI (kg/m^2)	31.56±7.151		29.15±5.702		2.260	**0.025***
WC	106.68±11.603		109.8±14.168		1.466	0.145
Gender and risk factors	**N**	**%**	**N**	**%**	**X2**	**---**
Male	56	75.7	52	70.3	0.548	0.579
Female	18	24.3	22	29.7		
Hypertensive	52	70.3	18	24.3	31.335	**0.0001****
Diabetic	43	58.1	15	20.3	22.228	**0.0001****
Smoker	48	64.9	28	37.8	12.745	**0.002****
Not smoker	21	28.4	46	62.2		
Ex-smoker	5	6.7	0	0.0		
Family history of IHD	61	82.4	7	9.5	79.3	**0.0001****
TG (ng/mL)	136.53±15.788		163.96±8.932		13.009	**0.0001****
TC (mg/dL)	156.53±18.318		133.11±11.725		9.263	**0.0001****
LDL (mg/dL)	128.2±25.97		108.3±12.56		5.93	**0.0001**
HDL (mg/dL)	52.446±5.083		55.824±3.597		4.667	**0.0001****
Serum creatinine (mg/dl)	1.168±0.221		0.973±0.161		4.703	**0.0001****
ECHO						
WMA	21	28.4	0	0	**17.295**	**0.001****
LVDD	42	56.7	73	98.6		
Con.LVH	2	2.8	1	1.4		
LVSD	9	12.1	0	0		
EAT	9.789±2.503		4.489±0.674		9.396	0.001
IAS	10.603±1.417		9.096±1.827		5.606	0.001
RVF	6.587±1.495		4.981±0.518		8.728	0.001

Body mass index (BMI), Waist circumference (WC). Ischemic heart disease (IHD), Wall motion abnormalities (WMA), left ventricular diastolic dysfunction (LVDD), concentric left ventricular hypertrophy (con LVH),), left ventricular systolic dysfunction, epicardial adipose tissue thickness (EAT) (mm) (N=5mm),interatrial septum thickness (IAS) (mm) (N=10mm), right ventricular free wall thickness (RVFW) (mm) (N=5mm),**p-value<0.001 (highly significant). *p-value<0.05 (significant).

Table 2 indicates highly significant positive correlation among EAT thickness and parameters indicate adipose tissue presence (RVFW and IAS) in patients of group I. A positive significant correlation among EAT thickness and age in group I; it also shows a significant positive correlation among EAT thickness and BMI, while it is highly significant with WC. There was a highly significant positive correlation among EAT thickness and parameters of dyslipidaemia (TG, TC and LDL) in group I. While HDL shows highly significant negative correlation with EAT. There was positive correlation among syntax score and age of patients in group I which is highly significant; it also shows a significant positive correlation among syntax score, BMI and WC. This table shows positive correlation among syntax score and parameters of dyslipidaemia (TG, TC and LDL) in group I which is highly statistically significant. HDL showed significant negative correlation with SYNTAX score. The table shows positive correlations among syntax score and parameters that indicate the presence of adipose tissue (EAT, IAS and RVFW), which is highly significant.

Table (2): Pearson correlation between EAT thickness, RVFW thickness IAS thickness, age, BMI, WC and parameters of dyslipidaemia. Pearson correlation between syntax score and age, BMI, WC, parameters of dyslipidaemia, EAT thickness, IAS thickness, and RVFW thickness of group I.

Variable	**EAT thickness**	
	r	**P-value**
RVFW	**0.841**	**0.0001**
IAS	**0.662**	**0.0001**
Age (years)	**0.311**	**0.01***
BMI (kg/m^2)	**0.255**	**0. 03***
WC	**0.362**	**0.002***
TG (ng/mL)	**0.417**	**0.001****
TC (mg/dL)	**0.479**	**0.001****
LDL (mg/dL)	**0.473**	**0.001****
HDL (mg/dL)	**-0.439**	**0.001****
Variable	**SYNTAX score**	
	r	**P-value**
Age (years)	**0.375**	**0.001****
BMI (kg/m^2)	**0.340**	**0. 003****
WC	**0.282**	**0.01***
TG (ng/mL)	**0.409**	**0.001****
TC (mg/dL)	**0.342**	**0.001****
LDL (mg/dL)	**0.616**	**0.001****
HDL (mg/dL)	**-0.637**	**0.001****
EAT	**0.762**	**0.001****
IAS	**0.646**	**0.001****
RVFW	**0.666**	**0.001****

Epicardial adipose tissue thickness (EAT), right ventricular free wall thickness (RVFW) and inter-atrial septum thickness (IAS), Body mass index (BMI), waist circumference (WC), test of significance MW (Mann Whitney), triglycerides (TG), total cholesterol (TC), low density lipoprotein cholesterol (LDL), high density lipoprotein cholesterol (HDL).

There were no significant differences among HTN cases, and those not having the diseases as regards EAT thickness in group I. Also, there was no significant variance among smokers and non-smokers, moreover no significant difference among cases with positive family history and those with negative family history of IHD regarding EAT thickness. However, there was significant difference among diabetics with mean value 7.1 (SD 1.4) of EAT thickness in contrast to non-diabetic cases 6.4 (SD 1.6). There was no significant variance among males and females regarding mean values of EAT thickness in patients of group I **(Table 3).**

Table (3): Comparison of mean values of EAT thickness and risk factors in group I.

Variable	EAT Mean ± SD	T-test	P-value
Hypertension			
Yes (N= 52)	6.8±1.4	0.162	0.872
No (N= 22)	6.7±1.8		
Diabetes			
Yes (N= 43)	7.1±1.4	2.13	**0.04***
No (N= 31)	6.4±1.6		
Smoking			
Yes (N= 48)	6.8±1.5	0.171	**0.864**
No (N= 26)	6.7±1.4		
Family history of IHD			
Yes (N= 61)	6.8±1.5	0.173	**0.863**
No (N= 13)	6.7±1.4		
Gender			
Male (N= 56)	6.7±1.5	**1.05**	**0.3**
Female (N= 18)	7.1±1.5		

Table 4 shows that there were 33 cases with one vessel diseased and syntax score was 7 (SD 6.8), while 15 cases with two vessel disease and syntax score was 16.7 (SD 5.8) and 26 cases with multi- vessels disease and syntax score was 32.1 (SD 7.3). The difference between cases was highly statistically significant. There was no significant variance among males and females regarding syntax score in group I. This table shows statistically significant differences between cases with HTN and DM, and those not having the diseases as regards syntax score in group I. However, there was highly significant difference among smokers and those do not smoke as regards syntax score in group I. Also, there was highly significant variance among cases with positive family history and those with negative IHD family history regarding syntax score in group I.

Table (4): Comparison of mean values of syntax score and number of affected vessels affected, gender and risk factors in group I.

Variable	N of cases	Syntax score Mean ± SD	U-test	P-value
N of affected vessels One vessel Two vessels Multi-vessels	33 15 26	7±6.8 16.7±5.8 32.1±7.3	**99.8**	**0.001****
Gender Male (N= 56) Female (N= 18)	16.848±13.315 12.876±11.13		**1.320**	**0.187**
Hypertension				
Yes (N= 52)	20.682±12.655		**3.186**	**0.001**
No (N= 22)	10.954±11.663			
Diabetes				
Yes (N= 43)	21.407±12.736		**3.106**	**0.002**
No (N= 31)	12.774±11.018			
Smoking				
Yes (N= 48)	25±10.3		**88**	**0.001****
No (N= 26)	4.4±3.4			
Family history of IHD				
Yes (N= 61)	20.4±12.7		**88**	**0.001****
No (N= 13)	4.3±3.1			

Table 5 shows descriptive statistics of SYNTAX score in group I.

Table (5): The mean value and descriptive of SYNTAX score and EAT thickness in patients of group I.

	N	Range	Minimum	Maximum	Mean	SD
Syntax score	74	32.5	7	39.5	21.3	9.77
EAT	74	5.5	4.5	10	6.79	1.5

Table 6 shows highly significant difference concerning mean and SD of syntax score among two groups of cases divided by the mean value of EAT. EAT thickness >6.79 associated with SYNTAX score of mean value 29.6 while EAT thickness ≤6.79 associated with SYNTAX score of mean value 9.3. The difference between three grades of syntax score regarding EAT was highly significant.

Table (6): Summary of SYNTAX score among studied cases in group I regarding EAT.

SYNTAX score				**MW**	**P-value**
EAT	**N**	**Mean ± SD**	**Range**		
> 6.79 ≤ 6.79	31 43	29.6±9.4 9.3±2.4	(6.8-10) (4.5-6.5)	83.5	**0.001****
EAT				**F - test**	**P-value**
Syntax score	**N**	**Mean ± SD**	**Range**	**42.2**	**0.001****
Low <21	47	6.05±1.02	(4.5-9)		
Intermediate 22-32	8	6.8±1.13	(5.5-8.4)		
High >32	19	8.6 ±1.003	(7.5-10)		

Table 7 shows Sensitivity and specificity of EAT in predicting the severity of CAD regarding SYNTAX score.

Table (7): Reliability data of EAT as a predictor tool for the severity of CAD.

Cutoff	**AUC**	**Sensitivity**	**Specificity**	**PPV**	**NPV**	**ACC**	**P-value**
6.8	1.00	92.8	93.5	89.7	95.5	89.1	**0.000**

DISCUSSION

Epicardial fat volume is an independent indicator not only of the existence and CAD severity at the time of the baseline scan, but also of the development of CAD in subsequent scans [15]. **Fu-Zong *et al.*** [3] found that determining the typical EAT thickness is increasingly critical for predicting the development of CAD.

Regarding clinical and demographic data, our research showed that hypertension, DM, smoking and positive IHD family history were elevated in group I and this was suspected as the mentioned variables were considered as risk factors for CAD and also this was in line with **Iacobellis *et al.*** [16]**, Mendis *et al.*** [17]**, and Lin *et al.*** [18]**,** who found similar results. Our research showed significant positive correlation among EAT thickness and age of cases and this was concordant with **Iacobellis *et al.*** [16] **and Silaghi *et al.*** [19]. **Mendis *et al.*** [17] showed that CVD becomes increasingly common with advancing age and this was concordant with our study that showed positive correlation between syntax score (reflecting severity of CAD) and age of cases.

Regarding anthropometric measures: our research was concordant with studies revealed strong association of WC with EAT thickness [20-22]. This research was disagreed with **Shaheen *et al.*** [23] who observed no significant difference among EAT thickness and BMI. On the other hand, we observed a significant positive correlation among EAT thickness and BMI. The discrepancy between the two studies may be attributed to the difference between BMI of studied groups.

In this research, there were significant differences regarding BMI which means that obesity was significant in CAD group, and this is concordant with **Mendis *et al.*** [17] who found that obesity is strongly related to major cardiovascular risk factors. This research shows a significant positive correlation among syntax score (a surrogate of complexity of CAD) and BMI and WC (a surrogate for obesity) this is concordant with **Yusuf *et al.*** [24] who observed that the most prominent risk factor for CAD is obesity.

Klop *et al.* [25] concluded that obesity elevates cardiovascular hazard through factors like elevated fasting plasma TG, elevated LDL-C, decreased HDL-C, high blood glucose and insulin and elevated blood pressure and this is concordant with our study as we found increased BMI and WC (as markers of obesity) in group I ,also increased TG,LDL and low HDL in the same group. In addition, the numbers of diabetic and hypertensive patients were higher in that group**.**

Regarding laboratory data: there is a highly significant difference among TG, TC, LDL and HDL of the two groups and this is concordant with **Mendis *et al.*** [17] **and Varbo *et al.*** [26] who found that dyslipidaemia is related to elevated risk for IHD. **Wannamethee *et al.*** [27] found that in the normal range, a high blood creatinine concentration is indicative of an elevated hazard of cardiovascular disease and this is concordant with our study as we found serum creatinine was normal in both groups with significantly elevated in group I. This study showed positive correlation between EAT and parameters of dyslipidaemia (TG, TC and LDL) of cases which is concordant with **Iacobellis *et al.*** [16]**,** who found that EAT is directly related to increased LDL cholesterol. In this research, there was positive correlation among syntax score and parameters of dyslipidaemia (TG, TC and LDL) which is in agreement with **Mendis *et al.*** [17] who found the same results.

Echocardiographic and angiographic data: **Panza *et al.*** [28] found that CAD associated with severe LV dysfunction, and this was in agreement with our study. In this research, we evaluated the hypothesis that a thicker EAT identifies individuals with higher complicated CAD and that a thicker EAT predicts significant lesions presence which may need interventional therapy.

In our study The EAT thickness in group II was observed to be 4.49 (SD 0.674) mm while the mean EAT thickness in group I was observed to be 9.79 (SD 2.5) mm. This was disagreed with a study found that the mean EAT thickness in control group was observed to be 14.13 (SD 4.5) mm while mean EAT thickness in CAD was observed to be 16.77 (SD 9.80) mm which was much higher than our study.

Our research showed significant difference among group I and group II as regard EAT thickness and this was concordant with **Šram *et al.*** [29] who found significant EAT thickness in CAD group. **Park *et al.*** [30] found that EAT thickness has the potential to act as a novel factor of thickness of cardiac and visceral adiposity with therapeutic and diagnostic applications in MI. Our investigation confirms that elevated EAT thickness is related with a worse outcome in individuals with acute coronary syndrome.

In our research we observed that EAT thickness >6.79 associated with SYNTAX score of mean value 29.6 (SD 9.4) while EAT thickness ≤6.79 associated with SYNTAX score of mean value 9.3 (SD 2.4). A previous meta-analysis demonstrated that EAT may serve as a reliable coronary heart disease predictor and this is also concordant with our results that showed positive correlations between syntax score and EAT thickness.

Mustelier *et al.* [31] concluded that right ventricle epicardial fat and fat infiltration of it had significant relation with CAD presence and this was concordant with our study. Due to EAT uneven regional distribution around the heart, particularly in interventricular (IV) groove and the atrioventricular (AV) groove, with fat infiltration of the right ventricular free wall, there is a growing focus on the place EAT thickness as a predictor for cardiometabolic illness.

Rosito *et al.* [32] stated that EAT was related to cardiovascular activities and was able to predict myocardial ischemia, consistent with our findings.

Our study was disagreed with **Yanez-Rivera *et al.*** [33] who stated no significant association among CAD angiographic severity and echocardiographic EAT thickness. This disparity may have stemmed from the approach employed to assess CAD severity. Instead of utilising the stenotic main coronary arteries number as a proxy for CAD severity, we assessed CAD complexity by applying Syntax scores and correlated these measures with EAT thickness.

Gökdeniz *et al.* [34] revealed there is a substantial correlation among EAT thickness and SYNTAX score. They also assessed a cut-off value of 5 mm EAT thickness to predict an intermediate-to-high Syntax score at a specificity of 92.2% and a sensitivity of 77.4%.

On the other hand, we found cut-off value of 6.8 mm EAT thickness to predict an intermediate-to-high SYNTAX score at a specificity of 93.5% and a sensitivity of 92.8%. However, those researchers only examined nondiabetic individuals, while we found a correlation among CAD complexity and EAT thickness in both diabetic and nondiabetic patients. **Wang *et al.*** [35] determined EAT thickness was larger in higher score than lower one. As we revealed that EAT thickness was positively and strongly linked with SYNTAX score, although only acute MI patients were examined in this study. We recognized a similar relation among CAD complexity and EAT thickness which expressed with the entire CAD clinical spectrum, involving stable and unstable angina pectoris. In our research, EAT thickness was elevated in higher score than intermediate and lower one.

LIMITATIONS

Firstly, modest number of patients is a potential limitation of this study which warrants the necessity of large prospective research to establish the relationship among EAT and CAD. We assessed EAT thickness by transthoracic echocardiography. However, Unlike MR and CT imaging, echocardiographic EAT measurements may not accurately represent the overall epicardial fat volume. But echocardiography is easier, accurate, and less expensive than MR and CT. Since a linear measurement at a single place, echocardiography might not be the optimum approach for quantifying epicardial fat; therefore it might not accurately reveal the variation in fat thickness or total epicardial fat volume. When assessing the thickness of fat in the deeper epicardial fat layers, multi-detector computed tomography had higher sensitivity and specificity than echocardiography. Recent data shows that the quantity of epicardial fat, as opposed to its thickness, may be the most accurate risk indicator. However, we feel the agreement's restrictions are sufficient for screening purposes. Calculating EAT through echocardiogram requires expertise, since echo-free spaces might be misconstrued for pericardial fluid.

CONCLUSION

The thickness of the EAT is useful for the early detection of individuals with complicated CAD. This information may motivate doctors to select more forceful preventative and therapeutic options, or to send these cases for diagnosis the cardiac catheterization sooner. In individuals with known CAD, EAT thickness was significantly linked with CAD severity. Echocardiography EAT assessment can be simply predict CAD severity and so, help in patient risk stratification.

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