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ORIGINAL ARTICLE

Coronary Artery Disease Severity has a Strong Association with Epicardial Adipose Tissue Thickness

SADAF SHAHEEN[1], ROSHEENA NABEEL KHAN[2], ABDUL REHMAN[3], IFFAT RAZA [4], SADAF FATIMA[5], SAHRISH MUKHTAR[6]
[1]*Department of Anatomy, Women Medical & Dental College Abbottabad*
[2]*Department of Anatomy, United Medical & Dental College Karachi*
[3]*Department of Anatomy, Liaquat College of Medicine and Dentistry (LCMD) Gulistan-e-Johar, Karachi*
[4]*Department of Anatomy, Karachi Institute of Medical Sciences Karachi*
[5]*Department of Physiology, Jinnah Medical & Dental College Karachi*
[6]*Department of Anatomy, Jinnah Medical & Dental College Karachi*
Correspondence to: Dr Sadaf Shaheen, Email: Drsadi2001@yahoo.com, Cell: 0322-2134772

ABSTRACT

Objective: Measure the EAT thickness by echocardiography in CAD patients and to compare it with healthy adults of Karachi population.

Study Design and setting: It is a case control study. The study was carried out in the radiology (Echocardiography) Department of Ziauddin University Hospital Clifton Campus, Karachi.

Methodology: In this study, there were315 participants among them there were159 cases of coronary artery disease and 156 healthy adults. The participants were selected through non probability convenience sampling technique. After filling the proforma including basic information the echocardiography for EAT thickness calculation was done. The data was analyzed on SPSS version 20. Numerical variables were used to derive means and standard deviations while ANOVA was applied to determine the worth along with coronary artery disease and healthy groups. P- Value less than 0.05 was considered as significant.

Results: EAT mean thickness was found to be 15.45 ± 7.16 mm. Coronary artery disease group had drastically elevated EAT 16.77 ±9.80 mm in contrast to healthy adults group 14.13 ± 4.52 mm (p=0.02). Three vessel disease group had highest EAT thickness value of 18.79mm while one vessel disease group had lowest Epicardial Adipose Tissue value of 13.55mm. A considerable variation (p=0.001) in EAT thickness and CAD severity was found.

Conclusion: Coronary artery diseased CAD group had greater EAT thickness as compared to healthy individuals. Among the CAD patients, the EAT was highest in three vessel disease and was lower in one vessel disease.

Keywords: Adipose tissue, Coronary artery disease, Echocardiography, Epicardial

INTRODUCTION

Adipose tissue has different endocrine functions and it has also some regulatory effects at the cellular, tissue and systemic levels thus it has profound effects on the CVS [1]. Epicardial shows the adipose tissue deposits around the heart[1]. It has unique fats deposit with local and systemic effects[1]. Most of heart surface approximately 80% is covered by EAT and represents 20% of total heart weight. The most common location and allocation of EAT is around coronary arteries, right ventricle especially along the right border, anterior surface and at the apex[2].EAT represents as echo-free space on echocardiography between the outer wall of the myocardium and the visceral layer of pericardium[3].

Visceral fat storage area of the heart is EAT[4]. In regulation of systemic metabolism EAT functions as silent lipid store[2]. EAT play an essential role in storage of large unicellular fat droplet in the form of TGA and its release on demand in the form free fatty acids[2]. In the human myocardial triglyceride content, EAT plays major role as lipotoxic, prothrombotic and pro-inflammatory agent[2]. Pro-inflammatory, anti- inflammatory cytokines and chemokines are released by EAT[5]. These chemicals sanction the process for growth of coronary artery atherosclerosis[5].

CAD is major source of worldwide mortality and morbidity[6].CAD is multifactor condition[6].Visceral obesity is an independent risk factor for CAD[6]. EAT is a visceral fat that has been found to be associated with coronary artery plaques and calcification[6]. Irrespective of cardiovascular risk factors EAT leads to lethal and non-lethal coronary artery events in population[7]. Anatomically and functionally EAT has contiguity to the myocardium therefore it acts as metabolically active organ[1]. It is a known fact that as degree of visceral adiposity increases with increase in epicardial and myocardial fats perhaps play important role for obesity-associated cardiac changes therefore epicardial adipose tissue has the most significant self-determining correlation with myocardial fat[8]. Extreme metabolic activity of EAT and its anatomic and functional propinquity to the myocardium predict some relations between heart and its visceral fat depot[9].

Acute coronary syndrome is significantly correlated with epicardial adipose tissue in its short term prognosis[10]. Continuous exposure to inflammatory stimuli augments EAT to gradually produce augmented amount of inflammatory cytokines. Pro-atherogenic and pro-thrombogenic atmosphere in the coronary arteries is induced by excessive release of cytokines. An involvement of fat adjacent to the coronary arteries for progression of coronary atherosclerosis was reported in studies, this observation was suggestive of strong association of coronary artery diseases with its severity and poor prognosis[10]. In globally done studies association of EAT thickness with CAD has been mentioned but there is limited literature available on this topic in Pakistan. Therefore present study was conducted to measure the thickness of EAT by echocardiography in physically fit &healthy subjects of Karachi population and to compare its results with CAD patients.

METHODOLOGY

This was a case control study. The study was conducted from September 2014 to February 2015 at Ziauddin Hospital, Clifton campus. It was done after endorsement from the Ethics Review Committee (Reference # 0180814SSANA) and Board of Advance Studies and Research (BASR) of Ziauddin University. This study included 159diagnosed cases of coronary artery disease and 156 healthy adults. The participants were selected through non probability convenience sampling, after explaining objectives and rationale of the study all participants did signed the written consent. All information gathered during this study was kept confidential. The individuals full filing the exclusion criteria were excluded from study.

A proforma was filled for each patient and healthy individual. The proforma included information regarding age, gender, history of hypertension, diabetes and history of any known cardiac disease. In our sample population EAT thickness was determined by using Toshiba model Echo Machine NemioXG with cardiac probe frequency of 3.5 MHz at Echo Cardiology Department of Ziauddin Hospital Clifton, Karachi. All participants were examined in supine position and a cushion was placed below their shoulders to make them relaxed. Quantification of EAT thickness was done by subcostal view, parasternal short as well as long axis views was taken &then mean EAT values were calculated.

Statistical analysis done by Microsoft Excel and SPSS version 20. Quantitative variables were presented as mean and standard deviation and qualitative as frequency and percentage. For comparison between case and control, age was analyzed by independent t test and cross tabulation was done for gender and age group. Means and standard deviations were calculated for numerical variables and for the significance among age groups ANOVA was applied. The comparison in dissimilarity of EAT with severity of CAD was measured by pooled t test while independent t-test was applied to analyze significance between EAT thickness with severity of coronary artery disease. P- Value of <0.05 was considered noteworthy.

RESULTS

A total of 315 participants were recruited in the study. The mean age of study applicants was found to be 55.16 ± 13.79 years. The age limit of each subject was from 35 to 85 years. Out of 315, the males were 159&females were 156 as shown in table 1.Out of total 315 participants, there were 79 (25.1%) males, 77 females (24.4%) in coronary artery disease group and 79 (25.1%) males and 77 (24.4%) females in control group as shown in figure 1.The mean age of males was found to be 54.36±14.54 and females was 55.96±12.98 years respectively.

Figure 1: The gender distribution in CAD and Control groups. Out of 315, in CAD group males were (25.4%) and females were (25.1%) while in Control group males were (25.1%) and females were (24.4%).

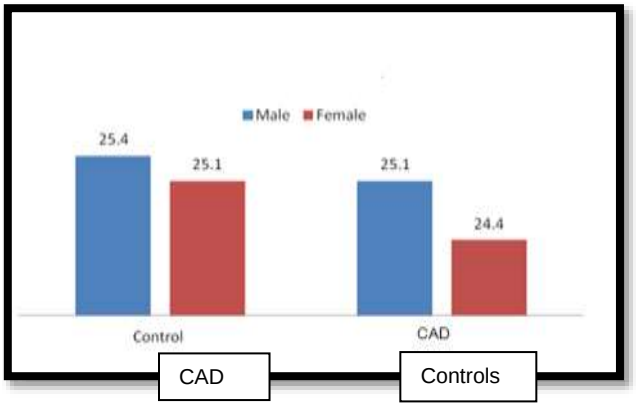

Table 1 show the age and gender distribution of the study participants. The highest percentage of participants (28.9%) was found in the age group of 45-54 years. This is followed by (24.1%) in 35-44 years, (19%) in 55-64 years, (17.8%) in 65-74 years and (10.2%) in 75-85 years. The percentage of males (50.5%) was higher as compared to females (49.5%).

Table 1: Baseline Characteristics.

Variables		Total N (%)	Case N (%)	Control N (%)	P-value
Age	Less than 34	2 (0.6)	0	2 (0.6)	0.001
	35-44	74 (23.5)	13 (4.1)	61 (19.4)	
	45-54	91 (28.9)	44 (14)	47 (14.9)	
	55-64	60 (19)	41 (13)	19 (6)	
	65-74	56 (17.8)	39 (12.4)	17 (6)	
	More than 75	32 (10.2)	19 (6)	13 (4.1)	
	Mean ± SD	55.2 ± 13.8	59.7±11.7	50.7±14.3	0.001
Gender	Male	158 (50.2)	78 (27.8)	80 (25.4)	0.523
	Female	157 (49.9)	78 (24.8)	79 (25.1)	

Table 2 show that out of 159 coronary artery disease cases there were 43.4% of cases with one vessel disease, 36.5% of cases with two vessel diseases while 20.1% of cases with three vessel disease. A significant difference (p=0.001) in EAT and the severity of CAD was found as shown in table 2. In one vessel disease the EAT thickness was 13.55 mm, in two vessel disease the EAT thickness was 17.66mm while in three vessel disease EAT thickness was found to be 18.79mm. The highest value of EAT 18.79mm was found in three vessel disease while the lowest EAT value of 13.55mm was in one vessel disease (table 2).

Table 2: EAT Thickness with Severity of CAD by one Way Anova

No of Coronary Artery Involvement	N (%)	EAT thickness(mm) Mean ± SD	P value
1 vessel	69(43.4)	13.55 ± 5.03	0.001
2 vessel	58(36.5)	17.66 ± 4.56	
3 vessel	32(20.1)	18.79 ± 6.13	

DISCUSSION

EAT is a white type of adipose tissue[11]. Visceral layer of the pericardium has EAT therefore it has a directly contact with coronary arteries[12], because of its anatomical location it plays an important role in the physiological and biochemical regulation of cardiac homeostasis[13].Vicinity of EAT to the coronary arteries gives rise to the pathophysiological consequences[12].EAT play an essential role for maturation of CAD as endocrine and paracrine tissue due to release of pro-inflammatory and anti-inflammatory cytokines and chemokines[14]. Pro-inflammatory mediators secreted by epicardial fat have been worsening endothelial dysfunction, eventually leading to coronary artery disease[13]. It predicts the incidence of CAD independent of traditional cardiovascular risk factors[12].

Several studies done worldwide for measurement of EAT thickness in healthy adults. Cardiovascular diseases associated death rates of nearly 80% is reported in low and middle income countries[15]. There is strong association for development of CAD and EAT thicknes[12]. EAT thickness can be easily &non-invasively access by transthoracic echocardiography, & it can be used as a marker for prediction of CAD[16].EAT may be introduced as a latest measure of cardiac and visceral adiposity for diagnosis and therapeutics in myocardial infarction. In acute coronary syndrome its gradual increase may be associated with poor prognosis[10].The association of EAT mass and severity of coronary artery disease depends on left ventricular function[17]. Shaheen[18] et al. studied the correlation of EAT thickness with age and gender in CAD patients and healthy adults. In this study, the comparison of EAT thickness with severity of CAD was studied.

In our study, the mean EAT thickness of 16.77+ 9.80mm in CAD group was considerably higher as compared to non disease participants ((p=<0.002). Our study had the similar results as found in previous studies done in South Korea[16], Turkey[16], Croatia[19], and USA[20]. All these studies shown that EAT thickness increased in CAD patients. In our study unexpectedly elevated results of EAT thickness (16.77 ±9.80 mm) in CAD patients were found as compared to studies done by Rivera[21] et al. (5.39±1.75mm) and Eroglu[16]et al. (5.9±1.5mm).Mookadam[20] et al. mentioned that EAT>5mm is associated with cardiac abnormalities on echocardiography. The previous studies showed a significant association between excessive visceral adipose tissue and abnormal lipid profile, enhanced systemic inflammation, diabetes and cardiovascular diseases[22].

The data of our study showed that highest percentage of patients had one vessel disease (43.4%), followed by two vessel disease (36.5%) and three vessel disease (20.1%). Rivera et al also mentioned the same data[20]. in which the highest percentage of participants had one vessel disease (31.4%) then two vessel disease (23.5%) and the lowest had three vessel disease (22.9%). In contrast to our study, Doesch[17] et al. reported that highest percentage of patients had three vessel disease (46%),then 2 vessel disease (32%) and lowest had one vessel disease (22%).Highest value of EAT thickness was found in three vessel disease (18.79mm) while lowest value of the EAT thickness was observed in one vessel disease (13.55mm). Eroglu[16]et al. reported that EAT thickness was 5.7±1.7mm in single vessel disease as compared to 7.4±1.2mm in multi vessel disease. Strong correlation of EAT thickness with the severity of CAD was also mentioned by

Wu[23] et al. and Shambu[24] et al . Our results are consistent with these studies.

To the best of our knowledge, this is the first study done on EAT thickness and severity of CAD in Pakistan. Our study results recommend that future incidence of CAD progression can be indicated by an augment in EAT thickness. Therefore EAT thickness could be used as diagnostic tool for cardiac and visceral adiposity. Cardiovascular risk can be evaluated by measuring the epicardial adipose tissue thickness as it is inexpensive and easy to calculate.

The limitations of this study were small sample size. The future recommendations are that this study should be done on 3 dimensional echocardiography as it gives better results and also it needs to be done on large scale from different parts of Pakistan and would give more accurate results.

CONCLUSION

Higher value of EAT thickness was found in coronary artery disease patients as compared to healthy individuals. Among the CAD patients, the EAT was higher in 3 vessel disease and was lower in 1 vessel disease.

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