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Correlation of Functional Capacity with Epicardial Adipose Tissue Thickness in Coronary Artery Disease Patients: An Observational Study

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ABSTRACT

Background: Excessive Cardiac adiposity is responsible for coronary atherosclerosis by secreting many active cytokines and regulating insulin sensitivity. Patients experience a downward spiral due to coronary artery disease (CAD), which reduces physical activity and progressively worsens exercise tolerance. Additionally, people with CAD have diminished functional capacities, decreased capacity to carry out everyday activities, and lower quality of life (QOL).
Objective: This study aims to correlate functional capacity and epicardial adipose tissue thickness in CAD patients.
Material and Methods: This study included 22 CAD patients who met the study inclusion criteria using a cross-sectional research design. Data were collected after angiography confirmed the diagnosis of CAD. Demographic data and baseline measures were recorded before starting the examination. Treadmill stress testing and 2D echocardiography were performed.
Result: Mean age group was 54.13±6.76, height (160.5±9.84), weight (66.6±6.542), and Male/Female 13/09. The mean Vo2max was 20.97±6.4 mL/kg/min, and the mean Epicardial adipose tissue thickness (EAT) was 12.72±2.78 mm. Functional capacity and EAT showed a negative correlation (r = -0.05) and found a non-significant result.
Conclusion: The study concludes that CAD patients showed higher EAT than usual and low VO2 max but did not find significant EAT thickness changes in functional capacity.

Keywords: Epicardial adipose tissue thickness, coronary artery disease, functional capacity, treadmill stress testing.

INTRODUCTION

Coronary artery disease (CAD) is a cardiovascular disease caused by reduced blood flow in the coronary arteries and affecting millions of individuals all over the world.[1, 2] The highest rates of coronary artery disease (CAD) are known to occur in Indians. Yet, the usual risk factors are unable to account for this elevated risk. For the Indian subcontinent, there are no systematic data-gathering methods for cardiac mortality and morbidity, and the

bulk of fatalities take place at home without the precise cause of death being known. [3]

India has one of the highest incidences of cardiovascular disease (CVD) worldwide. It is projected that by 2020, there will be 4.77 million CVD deaths in India, up from 2.26 million in 1990. The prevalence of CAD in India has been estimated to have changed over the previous few decades, with numbers increasing from 1.6% to 7.4% in rural areas and from 1% to 13.2% in metropolitan areas. [4]

These illnesses have numerous potentially fatal complications if they remain untreated. Due to inadequate blood supply, various heart disease problems might occur, such as angina, atrial fibrillation, cardiac arrest, heart attacks, heart failure, pulmonary edema, and stroke are some of these disorders. [5] Risk factors for CAD are habits, behaviors, circumstances, or conditions that increase a person's risk of developing CAD. [6]

Excessive cardiac adipose tissue has been associated with CVD. The two distinct depots are epicardial deposition, which is positioned very close to the heart, and the pericardial, an outermost depot, which is located inside and on the pericardium. EAT is hypothesized to have a cardioprotective effect because of its ability to absorb and metabolize enormous amounts of fatty acids, thus inhibiting the formation of atherosclerotic plaques. The release of inflammatory adipokines is expected to increase along with a pathological expansion of epicardial adipose tissue, which is assumed to cause atherosclerosis. [7]

Patients with heart failure experience several functional symptoms, which include fatigue, dyspnea signs, decreased aerobic capacity, decreased muscle strength, low weekly physical activity, and exercise intolerance. Additionally, people with CAD have diminished functional capacities, a decreased capacity to carry out everyday activities, and a lower quality of life. [8]

Cardiopulmonary exercise testing (CPET) offers a comprehensive evaluation of the integrative exercise reactions involving the pulmonary, cardiovascular, hematopoietic, neuropsychological, and skeletal muscle systems, which are not sufficiently reflected by measuring individual organ system function. [9] CPET is becoming increasingly popular in clinical settings, providing physicians with relevant data for various applications. It can evaluate exercise intolerance and exercise-related symptoms that have not yet been diagnosed and objectively determine functional capacity and impairment. [10]

As we know, CAD is one of the most life-threatening diseases in the world and has so many risk factors. Cardiac adipose tissue thickness is an essential marker of patients' cardiac risk. Coronary artery disease reduces the functional capacity. This study was mainly carried out to see if there is any correlation between EAT and functional capacity in patients with CAD.

MATERIALS & METHODS

We conducted an observational study in the department of cardiology in a tertiary care hospital. The duration of the study was from 2023-24. Ethical clearance was obtained from institutional ethics committee, and written informed consent was obtained from the patients. Our study included a convenient sample size of 22 coronary artery disease patients with angiography reports up to one month. Angiographically documented CAD patients of age 40 to 60 years, diagnosed with single vessel disease / 50-70% stenosis in one or more vessels (not requiring any intervention like angioplasty or CABG) and have LVEF >55%. Patients with heart valve disease, arrhythmia, conduction issues, any neuromuscular diseases, lung pathology, chronic musculoskeletal conditions, and metabolic or any other diagnosed condition impacting CAT thickness were excluded from the study. The outcome measures included assessing the functional capacity by treadmill stress test using modified Bruce protocol and cardiac adipose tissue

thickness measured by 2D echocardiography.

STATISTICAL ANALYSIS

Data was entered in an MS Excel sheet and analysed using Open Epi software instat version 3.06. Quantitative data was expressed in terms of mean and standard deviation. The Pearson correlation test was used to correlate two variables. A p-value of ≤ 0.05 was considered statistically significant.

RESULT

A total of 22 patients were included in this study aged (40 - 60 years). The demographic data of these patients are illustrated in Table 1. Baseline analysis, including the Mean and SD of outcome measures, are shown in Table 2. The correlation between EAT and VO2 max is shown in Table 3.

Table 1: Represents baseline Characteristics of various parameters

Parameter	Mean ± SD
Male %	59.09%
Female %	40.90%
Age (years)	54.13±6.76
Weight (kg)	66.6±6.542
Height (cm)	160.5±9.84
BMI (kg/m^2)	25.58±3.45

Interpretation:

This Table shows baseline characteristics of patients data represented in Mean, SD and percentage of gender, age, weight, height and BMI

Table 2: Represent the mean and SD of the outcomes

Outcome	Mean	Standard deviation
EAT Predicted	4.4	1.2
EAT Performed	12.72	2.78
VO2max Predicted	45.035	7.604
VO2max Performed	20.97	6.402

Interpretation:

This Table shows the Means and SD of predicted and performed EAT and VO2 max.

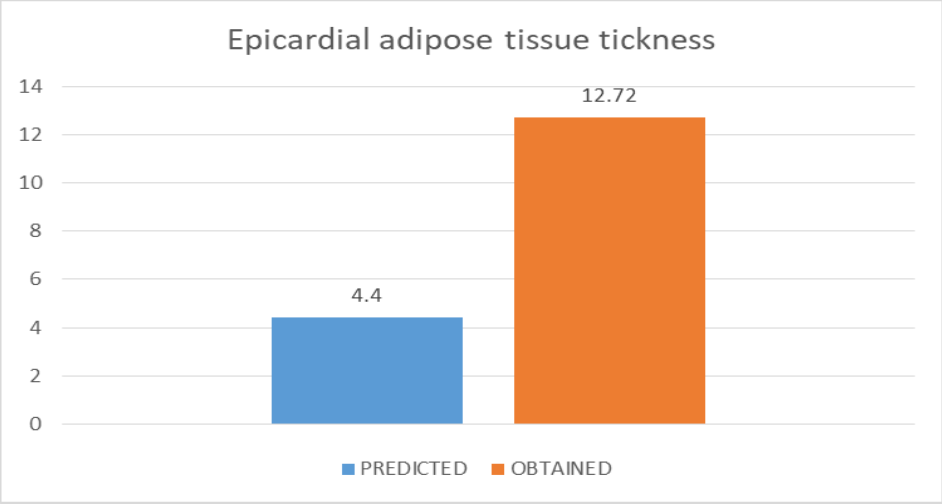

Figure 1 shows the mean of predicted and obtained EAT

Interpretation: This graph compares predicted and obtained EAT.

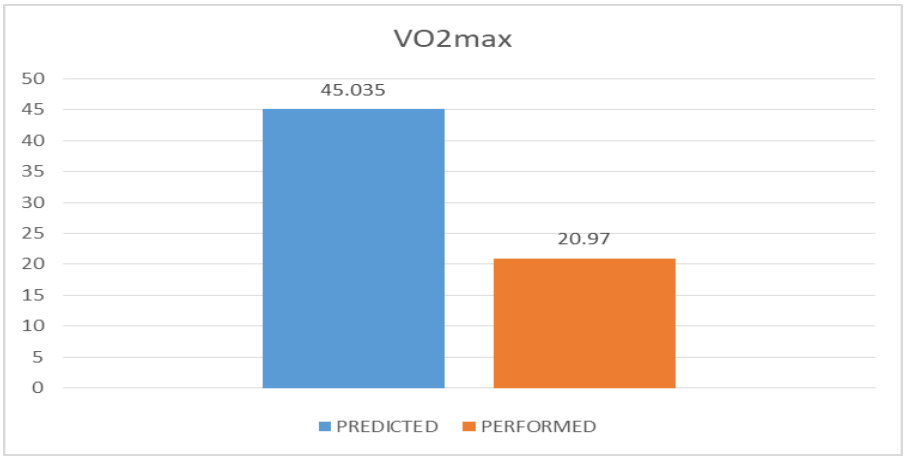

Figure 1 shows the mean of predicted and performed VO2max

Interpretation: This graph shows a comparison of predicted and performed VO2 max.

Table 3: Shows the correlation of EAT with VO2max

Table 3 shows the negative correlation of EAT with Vo2max and found non-significant results.

Correlation	r value	P value	Result
EAT with VO2max	- 0.05341	0.8134	NS

Interpretation:

This Table indicates the correlation between EAT and VO2 max. The data passed the normality test, so to compare these variables, we used the Pearson correlation test and found a non-significance result with an inverse correlation.

DISCUSSION

Coronary artery disease (CAD) is a cardiovascular disease which is occurred due to reduced blood flow in the coronary arteries and affects millions of individuals all over the world. [1, 2] These illnesses have numerous potentially fatal complications if untreated. Excessive cardiac adipose tissue has been associated with cardiovascular disease. [6] Due to its proximity to the coronary artery wall, PCAT may have a more localized and direct impact on atherosclerosis. [11] Additionally, people with CAD have diminished functional capacities, a decreased capacity to carry out everyday activities, and a lower quality of life. [10] Still, there is no evidence about the relation of epicardial adipose tissue with function capacity in CAD patients. Thus, the current study helps determine the correlation of EAT with functional capacity in CAD patients.

In the present study of 22 patients, the mean age group was 54.13±6.76, height (160.5±9.84), weight (66.6±6.542), and Male/Female 13/09. The mean epicardial adipose tissue thickness in the standard group was 4.4 $\pm$1.2 mm, and we found 12.72 $\pm$ 2.78 mm in the CAD group.

The present study showed an increase in epicardial adipose tissue thickness when compared with patients without CAD. K. Meenakshi et al. found a mean thickness value of 6.9 $\pm$ 1.9 mm in CAD patients. [12] Maimaituxun G. et al. reported the highest epicardial thickness around LAD than RCA and LCX in the CAD group. [13] EAT depends upon the presence and severity of CAD and has a strong relationship with it. EAT is also associated with age, gender, obesity, diabetes mellitus, and hypertension.

We found that the mean of VO2max was 20.97 ml/kg/min, i.e., a 53% reduction by predicted value. Van de Veire NR et al. reported that the average Vo2max was 18.5 ± 5.7 mL/kg per minute in their study, which is comparatively lower than the present study. [14] Kalyani MN et.al. reported mean VO2max was 35.2±4.32ml/kg/min in stable CAD patient. [15] Patients living with Heart disease experienced low VO2 max due to abnormal

endothelial function, impaired stroke volume response, ventilatory dysfunction, chronotropic incompetence, and abnormal peripheral oxygen utilization. In the present study, we mainly found the older population who were not adaptive to treadmill walking and speed. Due to the fear of falling, the patient could not walk up to the level, which can be one reason we found low VO2 max.

In our study, we found a negative correlation when we correlated EAT with VO2 max and showed statistically non-significant changes in epicardial adipose tissue thickness on functional capacity in CAD patients. Katlyn E. Koepp et al. (2020) stated that increased myocyte damage, insulin resistance, atrial fibrillation, systemic inflammation, and atrial dysfunction in CAD patients reduce functional capacity. [16]

Limitation

The present study did not compare and correlate BMI with EAT, as obesity affects epicardial fat thickness.

CONCLUSION

Coronary artery disease affects millions of individuals worldwide and significantly impacts cardiac adipose tissue thickness and functional capacity. Our study concludes that patients with coronary artery disease showed higher cardiac adipose tissue thickness than normal and low VO2 max but did not find any effect of epicardial adipose tissue thickness on functional capacity.

Declaration by Authors

Ethical Approval: Approved

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Conflict of Interest: The authors declare no conflict of interest.

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