Original Research Article

Study of the correlation of epicardial adipose tissue with left ventricular mass and left ventricular mass index in patients with essential hypertension

Sourabh Goswami[1]*, Prakash Keswani[1], Neeraj Chaturvedi[2], Shrikant Sharma[1], Ramji Sharma[1]

[1]Department of Medicine, [2]Department of Cardiology, S.M.S. Medical College and Hospital, Jaipur, Rajasthan, India

*Correspondence:
Dr. Sourabh Goswami,
E-mail: sourabh14goswami14@gmail.com

ABSTRACT

Background: Epicardial adipose tissue (EAT) is recognized to be a cardiovascular risk factor. In addition to providing fuel to heart, it plays a pivotal role in the pathogenesis of atherosclerosis though the secretion of adipokines. This study aims to find the correlation of EAT with left ventricular mass (LVM) and left ventricular mass index (LVMI) in patients with essential hypertension. Increasing LVM and LVMI are predictors of poor cardiovascular outcome. So, if we find a positive correlation, we can say that measurement of epicardial fat in essential hypertension may help us identify high risk hypertensive patients.
Methods: This study was carried out in SMS Hospital, Jaipur, after approval from the Ethics Committee. 100 consecutive eligible patients were included in the study after application of inclusion and exclusion criteria and taking proper informed consent. After history, examination and routine laboratory investigations, all patients underwent transthoracic 2D and Doppler echocardiography. EAT thickness, LVM and LVMI were measured and correlated using Spearman correlation coefficient.
Results: The mean LVM was 139±42.12 g and mean LVMI was 35.76±11.28 g/m$^{2.7}$. The spearman correlation coefficient (r) was calculated to be 0.691 between EAT and LVM and 0.677 between EAT and LVMI, indicating strong positive correlation between EAT and both LVM and LVMI. This implies that as; EAT increases, LVM and LVMI increases significantly.
Conclusions: Thus, we have found that EAT is positively correlated with LVM and LVMI. So, we can say that increase in EAT may lead to adverse cardiovascular outcome in patients with essential hypertension.

Keywords: Epicardial adipose tissue, Essential hypertension, Left ventricular mass, Left ventricular mass index

INTRODUCTION

Hypertension, a "silent killer" is increasingly diagnosed in its quiescent phase, to prevent cardiovascular diseases, which maintains its dignity as being the most common cause of mortality worldwide.[1] Epicardial adipose tissue (EAT) and albuminuria have emerged as newer risk factors to identify high risk hypertensive people.

Epicardial fat, a type of visceral fat, is present between the epicardial surface and the visceral surface of the pericardium covering the heart base, apex, the atrioventricular sulci, the interventricular sulci and the entire surface of the right ventricle.[2,3] It provides free fatty acids (FFA) to meet the myocardial energy demand, protects the myocardium from cardiotoxic effect of FFA by scavenging them, protects heart from hypothermia, provides mechanical protection to the coronary

circulation.[4-6] and secretes adiponectin and other adipokines, which have been found to be anti-atherogenic and anti-inflammatory.[7,8] EAT has also been found to play a pivotal role in the pathogenesis of atherosclerosis by secreting adipokines, which triggers systemic inflammation and oxidative stress, are thought to influence the underlying atherosclerotic plaque development via paracrine and vasocrine actions.[9] Role of epicardial fat has been found in atrial fibrillation, hypertension, increased left ventricular mass (LVM), left ventricular mass index (LVMI) and decreased ejection fraction.[10-12] It has also been found to be associated with metabolic syndrome and insulin resistance.[13] Various imaging methods like 2D echocardiography, cardiac magnetic resonance imaging (cMRI) and CT scan can be used to measure EAT.[2]

The aims and objectives are to study Epicardial Adipose Tissue (EAT) Thickness in patients with essential hypertension by echocardiography and to observe the relationship between EAT and LVM and LVMI in patients with essential hypertension.

METHODS

The study protocol was approved by the Ethics Committee of S.M.S. Medical College and Attached hospital, Jaipur, India. This was a hospital based observational study carried out in the Upgraded Department of Medicine, Jaipur, India from April 2017 to March 2018.

Inclusion criteria

- All essential hypertensive patients with or without taking antihypertensive medication.

Exclusion criteria

- Chronic Kidney Disease, Diabetes Mellitus, Previous Stroke, Valvular Heart Defects, Secondary Hypertension, Patients who do not provide consent.

After application of inclusion and exclusion criteria, 100 eligible consecutive patients were included after explaining about the purpose and nature of the study and written informed consent were obtained from all of the subjects. After a complete medical history and physical examination, all patients underwent transthoracic 2D and doppler echocardiography. Patients' height, weight and blood pressure were recorded on the day of echocardiogram.

Blood pressure measurement

The blood pressure (BP) of each patient was twice measured from the left arm after approximately 5 minutes of seated rest. Participants were advised to avoid alcohol, cigarettes, coffee/tea and exercise for at least 30 minutes before BP measurement. Standardized mercury

sphygmomanometers were used, and one of two cuff sizes was chosen on the basis of the circumference of the participant's arm. The Korotkoff phase I (appearance) and phase V (disappearance) were recorded for the SBP and DBP, respectively.

Epicardial fat measurement

All the echocardiographic examinations were performed by using Philips EipQ 7 cardiac ultrasound scanner and 2.5-3.5 MHz transducers by the same cardiologist. Patients were examined in the left lateral position by precordial M-mode, two-dimensional and Doppler echocardiography. Left ventricular internal dimensions, interventricular septum thickness and posterior wall thickness were measured at end-diastole. EAT thickness was measured on the free wall of the right ventricle from the parasternal long-axis views. Epicardial fat was identified as an echo-free space in the pericardial layers on the two-dimensional echocardiography and its thickness was measured perpendicularly on the free wall of the right ventricle at end-diastole for three cardiac cycles.[14] The left ventricular mass (LVM) was calculated according to the Devereux Formula.[15] The LVMI was indexed to height.[2,7]

Statistical analysis

The collected data were transformed into variables, coded and entered in Microsoft Excel sheet. Data were analysed and statistically evaluated using Statistical Package for Social Sciences (SPSS)-PC-17 software (version 17, SPSS, Inc, Chicago, IL, USA). Data are presented as mean and standard deviation (SD) for normally distributed continuous variables, median (minimum-maximum) for skew distributed continuous variables, and as frequencies for categorical variables. Pearson's chi-square test was performed for the comparison of categorical variables, and the means of normally distributed continuous variables were compared by Student's t-test. Correlation was tested with Spearman's analysis, where appropriate. p value of <0.05 was considered to be significant.

RESULTS

Figure 1 show the age and sex distribution of subjects. The age of the subjects included in this study ranged from 42-89 years. 44 subjects were in the 51-60 years group accounting and 34 subjects were in the 61-70 years age group. Only 10% (n=10) subjects were in >70 years age group and only 12 subjects were in ≤50 years age group. The mean age of the subjects was 59.7±9.4 years. Among the female subjects, most were in 51-60 years (45.2%) and 61-70 years (40.5%). Similarly, among the male subjects most were in 51-60 years (43.1%) followed by 61-70 years (29.3%) age group. Overall only 10% subjects were in >70 years age group and only 12 subjects were in ≤50 years age group.
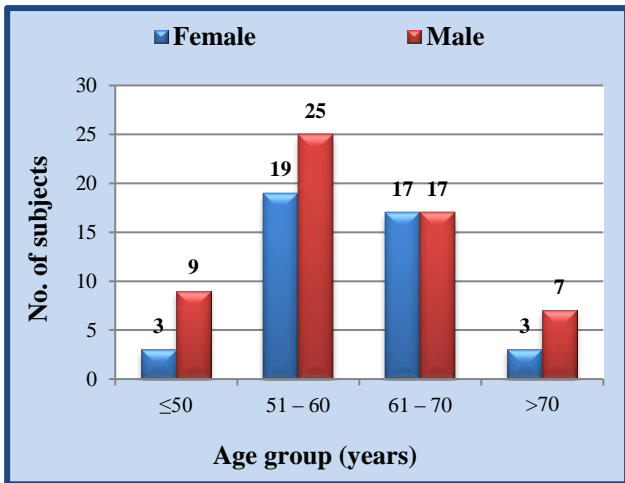
Figure 1: Age and Sex distribution of study subjects.

The mean BMI was 23.7 ± 3.3 kg/m^2. In this study, the mean systolic blood pressure (SBP), diastolic blood pressure (DBP) and mid BP were 158.3 ± 16.6 mmHg, 87.78 ± 10.68 mmHg and 123.06 ± 12.82 mmHg respectively.

In this study, the epicardial adipose tissue (EAT) thickness ranged from a minimum of 2 mm to a maximum of 10.4 mm in patients with essential hypertension (Table 1). The mean epicardial adipose tissue thickness in patients with essential hypertension was 5.42 ± 2.22 mm with a median of 5.3 mm.

Table 1: Epicardial adipose tissue (EAT) thickness in patients with essential hypertension.

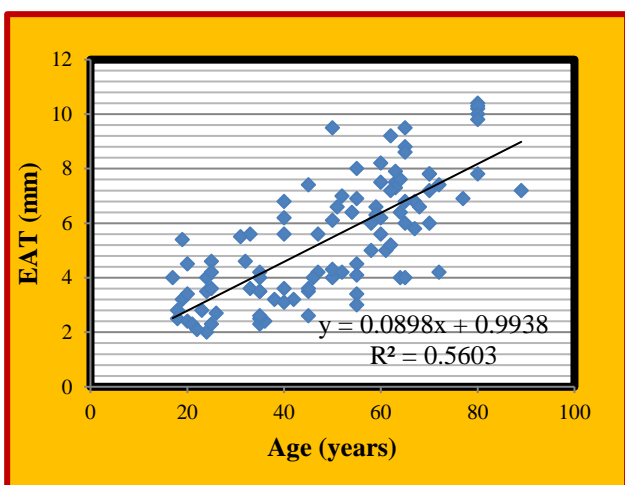| Range (minimum - maximum)	2 - 10.4 mm
Mean±SD	5.42±2.22 mm
Median	5.3 mm

Figure 2: Correlation between age and EAT.

Figure 2 depicts the correlation between EAT and age of study subjects. The spearman correlation coefficient (r) was

calculated to be 0.749 indicating strong positive correlation between EAT and age of subjects and this correlation was found to be statistically significant (p<0.001) which suggests that as age increases, the EAT also increases.

The correlation between serum creatinine and EAT of study subjects is shown in Figure 3. The spearman correlation coefficient (r) was calculated to be 0.244 which did not show a strong positive correlation between serum creatinine and EAT of subjects and although this correlation was also found to be statistically significant (p=0.014) but it has no relevance as the patients with renal dysfunction have been excluded from the study.
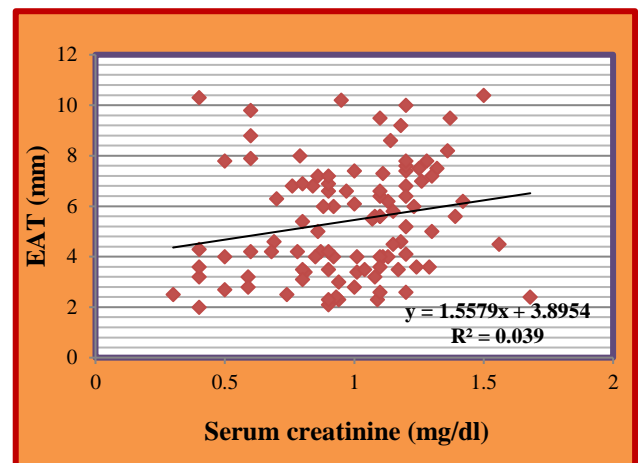

Figure 3: Correlation between serum creatinine and EAT.

Figure 4 reveal the correlation between Left Ventricular Mass (LVM) and EAT thickness of study subjects. The spearman correlation coefficient (r) was calculated to be 0.691 indicating strong positive correlation between LVM and EAT thickness of subjects and this correlation was found to be statistically significant (p<0.001) which indicate that EAT thickness increases significantly as LVM increases.
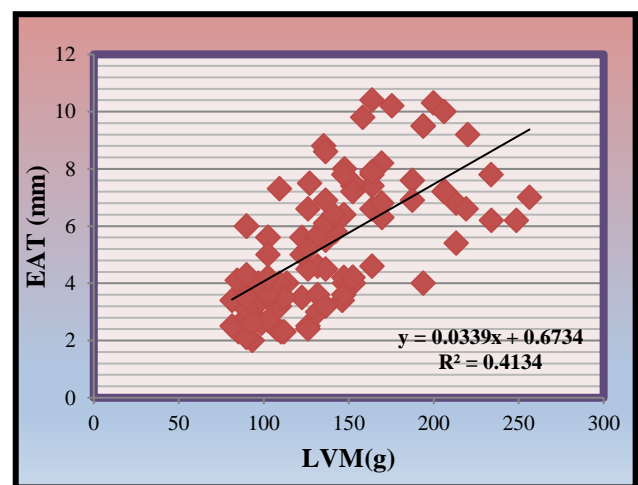

Figure 4: Correlation between LVM and EAT.

The correlation between Left Ventricular Mass Index (LVMI) and EAT of study subjects is depicted in Figure 5. The spearman correlation coefficient (r) was calculated to be 0.677 indicating strong positive correlation between LVMI and EAT of the subjects (p<0.001) which implies that with increase in LVMI, EAT also increases significantly.
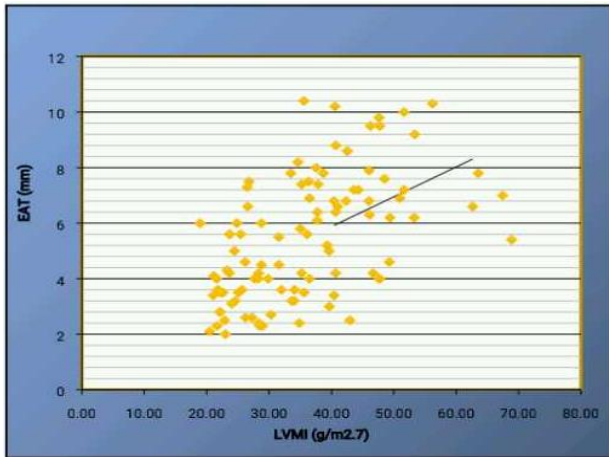

Figure 5: Correlation between LVMI and EAT.

Figure 6 show the correlation between LVM/BSA and EAT of study subjects. The spearman correlation coefficient (r) was calculated to be 0.553 indicating strong positive correlation between LVM/BSA and EAT of subjects (p<0.001) which suggests that with the increase in EAT; LVM/BSA also increases significantly.
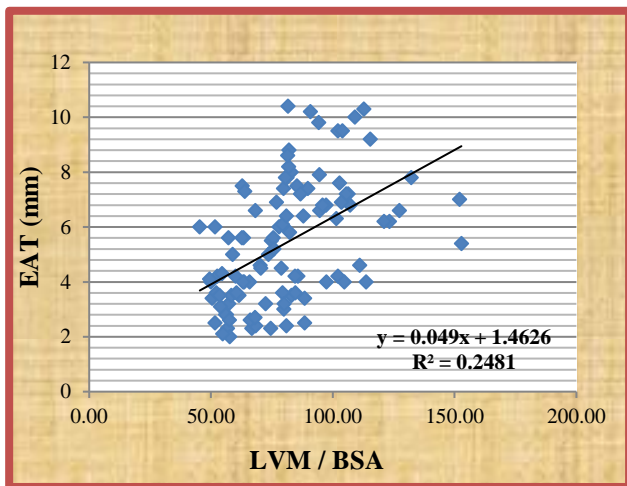

Figure 6: Correlation between LVM/ BSA ratio and EAT.

The correlation between ejection fraction (EF) and EAT of study subjects is shown in Figure 7. The spearman correlation coefficient (r) was calculated to be -0.599 indicating strong negative correlation between ejection fraction and EAT of subjects (p<0.001) which indicate that as the EAT increases ejection fraction decreases significantly.
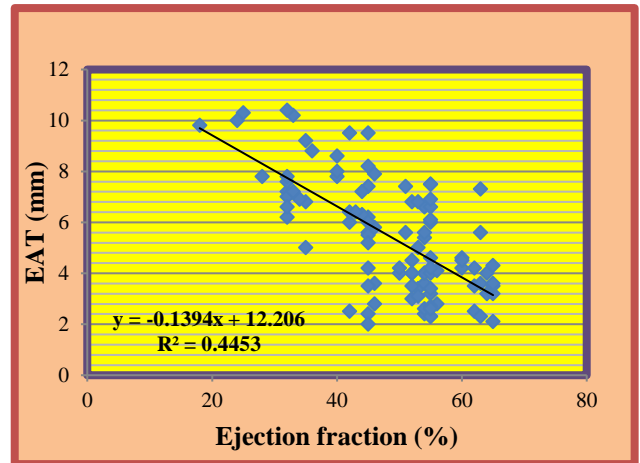

Figure 7: Correlation between Ejection fraction and EAT.

DISCUSSION

Authors studied the correlation of epicardial adipose tissue thickness and left ventricular mass and left ventricular mass index in patients with essential hypertension. Authors observed a strong positive correlation between EAT and both LVM and LVMI. Increased epicardial fat leads to additional mass on both ventricles that can increase the work demands on the heart and result in left ventricular hypertrophy.[16] Iacobellis G et al, showed that LVM and LVM/height$^{2.7}$ correlated with the amount of epicardial fat and the correlation appeared to be independent of BMI and age.[16] Similarly, Mookadam et al, also observed that epicardial fat more than 5 mm was associated with increased left ventricular mass.[17] Likewise, Erdogan et al, concluded that EAT was related to increased LVM independent of BMI, waist circumference, weight, and diastolic blood pressure and other risk parameters, in patients with hypertension.[11] This findings are also in concordance with these previous works.

EAT and its role in coronary artery disease (CAD) has been extensively evaluated in various studies.[18-20] The increased proinflammatory effect and reduced expression of anti-inflammatory adipokines promotes the atherosclerotic process and leads to development of CAD.[18,21-23] Goeller M et al, observed that lower EAT and increased EAT volume were associated with coronary calcification, serum levels of plaque inflammatory markers and adverse cardiovascular events, suggesting that dysfunctional EAT may be linked to early plaque formation and inflammation.[24] Several studies suggest the association of epicardial fat with CAD.[25,26] Mahabadi AA et al, nconcluded that epicardial fat is associated with fatal and nonfatal coronary events in the general population independent of traditional cardiovascular risk factors and complements information from cardiac computed tomography above the CAC score.[27] Kamal et al, found that epicardial fat thickness was significantly correlated with severity of CAD.[28]

Thus, epicardial fat leads to structural changes in the heart and also predisposes to CAD. So, measurement of epicardial fat may be useful to identify high risk hypertensive patients.

CONCLUSION

Epicardial fat is a cardiometabolic risk factor. Echocardiography which is a very non-invasive, easy to do, reproducible, and cost- effective method can be used to estimate it. Epicardial fat estimation can identify high risk hypertensive patients and also will give an idea of structural changes in the heart. However, for a better generalisation of this concept, a larger study is required to be done.

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