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CORRELATION OF LEFT ATRIAL VOLUME WITH E/É RATIO AMONG PATIENTS PRESENTING WITH DIASTOLIC DYSFUNCTION

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All the authors contributed significantly to the research that resulted in the submitted manuscript.

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ABSTRACT

Objective: To determine the association between left atrial volume and E/É ratio among patients with diastolic dysfunction.

Methodology: All male and female patients of age > 40years with clinical diagnosis of heart failure were included in the study. Detailed echocardiographic study was performed with Accoson CV 70. Patients with normal ejection fraction and diastolic dysfunction on TDI with E/É>15 were looked for LA volume using modified Simpson method.

Results: Total of 82 patients with a mean age of 60.4 ± 9.916years were included among them 56% (n-46) were male. Using Tissue Doppler Imaging for diastolic function patients were stratified into three groups on the basis of E/É ratio. Group 1 (E/É ratio of 16-18), group 2 (E/É ratio of 19-21) and group 3 (E/É > 21). Overall mean E/E' ratio was 18.45 ± 2.10 while mean LA volume was 69.80 ± 9.16ml. Comparing LA volume men had mean LA volume of 71.9 ± 9ml while women had 67.8 ± 9ml and the mean E/É was 18±5 for men versus 18±3 for women. Mean LA volume in group I, group II and group III were 65.8ml, 72.6ml and 80 ml respectively. There was a significant correlation between E/EI & LA volume using peansm correlation (r= 6.08 & PL< 0.001).

Conclusion: There is a linear association between LA volume and E/E' ratio. LA volume increases progressively with increasing severity of diabetic dysfunction.

Keywords: LV diastolic dysfunction, E/É ratio Echocardiography, Pearson's correlation test, Left atrial volume

INTRODUCTION

Heart failure (HF) is a complex syndrome, resulting from structural or functional cardiac disorders that impair the ability of the cardiac pump to support a physiological circulation.[1] Congestive heart failure affects about 2% of the western population, with prevalence increasing sharply from 1% in 40 years olds to 10% above age 75 years it is the most common cause of hospitalization in patients over 65 years of age.[2] Patients with an ejection fraction of 50 percent or higher were classified as having heart failure with normal ejection fraction (HFNEF), whereas those with an ejection fraction of less than 50 percent were classified as having heart failure with reduced ejection fraction (HFREF).[3] The proportion of patients with HFNEF is about 50% in the general heart failure population.[2] The symptoms of heart failure may be identical whether failure is secondary to systolic or diastolic dysfunction, however, there are differences in the prognosis, characteristics of the patients, pathophysiology and treatment between the two conditions.[4] Compared to patients with a low ejection fraction, those with preserved ejection fraction are older, more often women and are more likely to have a hypertensive aetiology.[5]

Heart failure with preserved ejection fraction is the most common form of heart failure, representing slightly more than half of all cases of heart failure.[6] Its frequency increases dramatically with age, underscoring the importance of this growing public health problem.[6] One study indicates that the prognosis of patients with HFNEF is poor, and just as severe as in patients with reduced ejection fraction.[6] Thus, both conditions have a severe prognosis with 5 years mortality rates of almost 60%.[6]The most useful clinical tools for the assessment of left ventricular diastolic function is Conventional Doppler Echocardiography, not only utilized for diagnostic purposes but also for establishing prognosis and evaluating the effect of treatment.[7] Tissue Doppler imaging (TDI), including the transmitral flow velocity to annular velocity ratio (E/É index), which measures myocardial velocities during the cardiac cycle, is considered more reliable for diagnosing diastolic dysfunction.[8] Left atrial volume determination is an essential part of the diastolic function assessment. Doppler assessment of transmitral inflow provide information related to instantaneous pressure in the left ventricle and atrium. LA volume is a measure of chronicity and severity of diastolic dysfunction and is less load dependent. It has been linked to glycosylated hemoglobin in the assessment of left ventricular filling pressures. Left atrial volume has both diagnostic and prognostic value in the assessment of diastolic function.[9,10]The aim of the study was to evaluate the correlation of the left atrial volume with diastolic function in patient with diastolic dysfunction.

METHODOLOGY

A Cross Sectional (Co-relation) study was conducted at Cardiology Department of from March 2012 to September 2012.Both gender of age more than 40 years with diagnosis of diastolic dysfunction of left ventricle and normal ejection fractions on echo were included, using Consecutive Non probability sampling. Patients with Valvular heart diseases, Congenital heart disease, Arrhythmias (AF, SVT), Constrictive pericarditis, Atrial myxom Systolic dysfunction (EF <50%) were excluded. Diagnostic criterion was shortness of breath with raised JVP, S4 sound on auscultation and EF >50% on 2D echo and E/É of >15. An informed written consent was obtained. History of and general physical examination for signs of heart failure was performed. Electrocardiogram was taken to exclude any arrhythmia. Patients were subjected to Echocardiography with Accoson CV 70 in Echocardiography lab of Cardiology Department, where ejection fraction (EF) and Fractional Shortening (FS) for systolic function and E to É ratio for diastolic dysfunction was calculated. Patient with normal ejection fraction and diastolic dysfunction were looked for LA volume using modified Simpson method. Pearson's correlation coefficient was calculated to see the relationship between LA volume & E/É ratio. P value of < 0.05 was considered significant.

RESULTS

The study was conducted from March 2012 to September 2012.Total of 82 patients with mean age of 60.4±9.916 years (range 42-80) were included. Of them male were 56% (46) while female were 44% (36) (Table 1).

Patients were divided into three groups on the basis of age. Group A included patients from 41-55years,group B included patients with age from 56-70 years while in group C included patients with age of >70years. Using Tissue Doppler Imaging (TDI) for diastolic function E/É ratio was calculated. Patients were stratified into three groups on the basis of E/É ratio. Group 1 included patient with E/É ratio of 16-18, group 2 included patients with E/E' ratio of 19-21and group 3 with E/É > 21. LA volume was calculated using modified Simpson method. Overall mean E/É ratio was 18.45 ± 2.10 while mean LA volume in the study population was 69.80 ± 9.16ml. In male mean E/E' was 18±5 and mean LA volume was 71.7±9ml while in female the mean E/E' was 18±3 and mean LA volume was 67.8±9ml (Table 2).

E/E' increased with advance age (Table 3).

Mean LA volume was 66.8±7.9ml, 69.8±8.4ml and 78.6±10.3ml respectively in group A, B and C (Table 4).

There was a tendency fan increase in LA volume with age, with smaller left atrial size in Group A compared with other

Table 1: Baseline Characteristic of Study Population (n=82)

Sex of the Patient	Frequency	Percent	Mean Age±SD
Male	46	56.1	62.72(9.25)
Female	36	43.9	57.47(10.07)
Total	82	100.0	60.41(9.91)

Table 2: Mean E/É Ratio And LA Volume In Male Versus Female Patients (n=82)

Gender	E/É ratio	Mean E/É±SD	LA Volume (ml)	Mean LA Volume (ml)±SD
Male	16-23	18.5±2	58-98	71.7±9
Female	16-22	18.3±2	56-94	67.8±9

Table 3: Mean E/É In Different Age Group

Group	Age (Years)	Mean E/É±SD
A	41-55	17.6±2.0
B	56-70	18.6±1.9
C	>70	20±1.6

Table 4: Mean LA Volume in Different Age Group

Groups	E/É	Mean LA Volume (ml)	No of Patients
I	16-18	65.8±5.8	45 (55%)
II	19-21	72.6±8.8	27 (33%)
III	>21	80±12	10(12%)

Table 5: Mean LA Volume in Different Groups Of Diastolic Dysfunction

Age Groups (Years)	Mean Age (Years)± SD	Mean LA Volume (ml)±SD	No of Patients (%)
A (41-55)	49.7±4	66.8±7.9	30 (36.5%)
B (56-70)	64±4	69.8±8.4	42 (51.5%)
C(>70)	>77± 2	78.6±10.3	10(12%)

Table 6: Correlation Between E/E'ratio And LA Volume In Diastolic Dysfunction

		E/É ratio	La Volume
E/É ratio	Pearson Correlation	1	.608''
	Sig (2-Tailed)		.000
	N	82	82
LA Volume	Pearson Correlation	.608''	1
	Sig (2 Tailed)	.000	
	N	82	82

**. Correlation is Significant at the 0.01 Level (2-tailed).
Pearson's Correlation Coefficient (ɣ): + 0.608
P: < 0.0001

groups. Mean LA volume was 65.8ml, 72.6ml and 80 ml in group I, group II and group III respectively (Table 5).

LA volume increased with advanced group of DD. Correlation between E/É ratio and LA volume was measured using Pearson's correlation coefficient that showed a moderate correlations between the E/É ratio and LA volume($r=0.608$ $p < 0.0001$). (Table 6)

DISCUSSION

Diastolic dysfunction refers to an abnormality of diastolic distensibility, filling, or relaxation of the left ventricle regardless of the ejection fraction and symptomats. Currently, the most sensitive echocardiographic technique for the assessment of LV diastolic function is that of tissue Doppler imaging. Tissue Doppler-derived intramyocardial velocities continuously decline from normal to advanced LV diastolic dysfunction. As a consequence, É decreases and the E/É ratio continuously increases with advanced and worsening of LV diastolic dysfunction.[22] The volume of the left atrium is an important biomarker of the heart function. Doppler assessment of transmitral inflow provides information related to instantaneous pressure in left ventricle and atrium.LA volume is a measure of chronicity and severity of diastolic dysfunction and is less load-dependant.Our findings that E/E' increases similarly in both gender with age and this correlates with previous epidemiology-based studies.[11, 12] We found a positive correlation between age and LA volume ($r = + 0.414$, $P<0.0001$) One study by Ploumen MA et al" and Pritchett AM et al".[13,14] Similarly a previous ANOVA analysis revealed that LA volume indices were significantly correlated with age ($r = 0.366$, $P <0.0001$).[16] The effect of normal aging on LAV volume in different studies is controversial. It has been

shown that advancing age alone does not independently contribute to LA enlargement.[17]

In our study a larger LA volume was found in men. When comparing men and women of all ages, the mean LA volume for men was 71.7 ± 9ml versus 67.8 ± 9ml .Women seem to be less prone to an enlarged LA volume than men. The impact of gender on LA volume can largely be accounted for by the differences in body surface area between men and women.[14,15] that might be the reason for enlarged LA volume in male compared with female.

In a previous bivariate analyses, age, and DD grade were positively associated, whereas female gender were inversely associated with LAV ($p < 0.001$ for all).[14]

LA volume significantly increased in case of deteriorating diastolic function. We found a moderate correlations between the E/É ratio and LA volume. Tsang et al had previously also demonstrated that LA volume reflects the severity of LV diastolic dysfunction.[18]LA volume was found to correlate positively with age, body surface area, diastolic function grade, tissue Doppler E/É, and negatively with LV ejection fraction (all $p < 0.006$).[18] In multivariate models, LA volume showed strongly associated with E/($\beta = 0.45$, $p < 0.001$).[19]Yue at al reported a significant positive correlation between Left Atrial volume and E/É ratio (correlation coefficient= 0.4544, $P < 0.01$).[20] The correlation coefficient is higher in our study than the previous study. The reason might be that in our study only those patients with diastolic dysfunction and E/E' ratio >15 were included, which shows that they had advanced diastolic dysfunction.

Thus, LA volume as a reflection of severity and chronicity of diastolic dysfunction. We found a strong relation between LA and LV diastolic function. The utility of LA volume and function for monitoring cardiovascular risk and for guiding therapy is an evolving science and may prove to have a very important public health impact. There is little evidence for the benefit of any methods to treat patients with LA dysfunction, whether prognostic or symptomatic.[21] However, early diagnosis of LA dysfunction by echocardiography might result in timely treatment of the underlying pathology preventing its progression to LA dysfunction and the development of thrombotic complications or atrial fibrillation.[14], Antihypertensive medication (e.g. ACE inhibitors and thiazide diuretics) could normalize LA function and regress LV hypertrophy. LA volume is a valuable tool for clinical and prognostic implications. It should be routinely incorporated in clinical practice.

There were certain study limitations. This was small single centre study. Patients having diastolic dysfunction with E/É of less than [15] were not included in the study. The left atrial volume index was not measured as body surface area. Indexed to BSA largely eliminate the gender difference in LA volume. Three-dimensional echocardiography can improve the accuracy of the assessment of LA volume, but are not widely available. In addition the number of patients enrolled in the study was small; therefore larger studies are needed to validate the study findings.

CONCLUSION

There is a linear association between LA volume and E/E' ratio. LA volume increases progressively with increasing severity of Left ventricular diastolic dysfunction and thus reflects the seriousness of diastolic heart failure.

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