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ABSTRACT

Purpose: Hypertension is known to cause changes in the LV that impact negatively on the LA both structurally and functionally posing clinically significant risk to patients. LA size assessment until recently was limited to determination of LA linear diameter and much has not been elucidated with respect to left atrial volume (indices) and cardiac indices as surrogates for LA and cardiac function. It is therefore important to see how LA indices (size, linear diameter and volume) cardiac indices relate to LV diastolic function among hypertensive subjects. To compare left atria indices with left ventricular function/dysfunction among hypertensive

Methodology: It is an echocardiographic based descriptive cross-sectional study. A total of 200 hypertensive patients were recruited from the cardiology clinics using systematic sampling method.

Results: Majority of the cases had isolated diastolic dysfunction n=149 (74.5%), thirty-six (18%) had normal diastolic and systolic functions while 7.5% had combined systolic and diastolic dysfunction (n=15). Left atrial maximum volume correlated significantly with E/E Prime (P= 0.003) and E/A Ratio (P= 0.003). While Left atrial pre-A wave volume (P=0.025), Left atrial diameter did not correlate with IVRT, E/E', E/A ratio. Among the hypertensive patient's E/E' significantly correlated positively with all phasic LA volumes compared to E/A ratio. LV mass independently predicted all LA phasic volumes

Unique Contribution to Theory, Policy and Practice: This study will create opportunity for clinician and policy markers to adopt measure to prevent progression into overt heart disease or failure

Keywords: *Echicarduigraphy, Left atrium, Systolic dysfunction, Diastolic dysfunction, Hypertension*

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INTRODUCTION

The burden of cardiac diseases is a major problem in the world, with hypertension, ischaemic heart disease and cardiomyopathies as major causes of mortality amongst people. This is particularly worse in developing countries in Africa where there is increased burden of both communicable and non-communicable diseases (for which hypertension and cancers are prevalent). This result in loss of manpower, financial stress on care givers and may also have other socioeconomic implications.[1,2]

Hypertension particularly is found to be more prevalent amongs. Blacks. Patients with hypertension have many targets organ damage for which heart disease is an example. Others include stroke and chronic kidney disease. Hypertension notably causes problems of impaired relaxation of the heart (diastolic dysfunction) and this has been found to impact negatively on the heart chamber size particularly the left atrium and left ventricle.[1]

As our understanding of diastology increases and with availability of non-invasive techniques like echocardiography, this will lead to increase in the early diagnosis of diastolic dysfunction (a notable risk factor for increased cardiovascular morbidity) especially so in patients with systemic hypertension.This study will help increase knowledge base and ultimately improve intervention since most hypertensives are asymptomatic in early stages of the disease.This will create opportunities for clinicians, policy makers and those at decision making levels to adopt solutions towards preventing progression into overt heart failure.

METHODOLOGY

It is an echocardiographic based descriptive cross-sectional study done in DELSUTH (Delta State University Teaching Hospital). A total of 149 hypertensive patiens with diastolic dysfunction were recruited from the cardiology clinics using systematic sampling method. P value less than 0.05 is regarded as significant. **Aims of the Study:** To compare echocardiographic left atrial indices with left ventricular (diastolic,systolic dysfunction and normo function) in hypertensives. Inclusion Criteria: 1) Males and females ≥18years. 2) Hypertensive patients, irrespective of blood pressure control, whether on antihypertensive medications or not and duration of hypertension. Exclusion Criteria; 1) Overt heart failure. 2) Cardiomyopathy, 3) Suboptimal echocardiographic images, 4) Rheumatic valvular heart disease (regurgitation or stenosis), 5) Non consenting patients, 6) Patients with atrial fibrillation. 7) Pregnant women.

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RESULTS

Table 1: Correlation between Cardiac Indices and Left Atrial Dimensions/volume measurements among Cases with Isolated Left Ventricular Diastolic Dysfunction

CARDIAC INDICES	LEFT ATRIAL LINEAR DIMENSIONS/VOLUME MEASUREMENTS			
	Linear diameter	Maximum Volume	Pre A Wave Volume	Minimum Volume
	R (P-Value)	R (P-Value)	R (P-Value)	R (P-Value)
Left Ventricular Ejection Fraction(%)	0.010 (0.908)	0.004 (0.962)	-0.182 (0.026*)	-0.147 (0.073)
Left Ventricular Mass(g)	0.178 (0.030*)	0.187 (0.022*)	0.297 (<0.001*)	0.247 (0.002*)
Left Ventricular Mass Index(g/m^2)	0.116 (0.162)	0.128 (0.122)	0.226 (0.006*)	0.176 (0.032*)
Mitral E Wave Deceleration Time(sec)	0.001 (0.989)	0.029 (0.723)	0.116 (0.160)	0.104 (0.207)
Isovolumetric Relaxation Time(sec)	-0.091 (0.268)	-0.058 (0.484)	-0.030 (0.712)	-0.028 (0.738)
E/E Prime	0.138 (0.094)	0.130 (0.115)	0.073 (0.376)	0.076 (0.357)
E/A Ratio	0.029 (0.724)	0.032 (0.699)	0.087 (0.289)	0.170 (0.038*)
Pulm SV(m/sec)	0.014 (0.865)	-0.049 (0.549)	0.092 (0.265)	-0.022 (0.794)
Pulm DV(m/sec)	0.033 (0.688)	0.010 (0.899)	0.025 (0.764)	-0.012 (0.882)
Pulm A velocity(m/sec)	-0.067 (0.414)	-0.126 (0.126)	-0.010 (0.903)	-0.065 (0.432)
Pulm A duration(sec)	0.201 (0.014*)	0.220 (0.007*)	0.111 (0.177)	0.170 (0.038*)

* *= Pearsons Correlation Significant = P <0.05*

Key: Pulm- Pulmonary, SV Systolic Velocity, DV- Diastolic velocity, STVI- Systolic Time Velocity Integral, DTVI- Diastolic Time Velocity Integral

Multivariate analysis of increased LA linear diameter show that the independent predictors of left atrial linear diameter in patients with isolated diastolic dysfunction were Left ventricular mass (Beta; 0.188, P; 0.020, CI; 0.001-0.012), pulmonary A wave duration (Beta; 0.210, P; 0.009, CI; 3.190-22.31).

Multivariate analysis of increased LA pre A wave volume show that the independent predictor of LA pre A wave volume in patients with isolated diastolic dysfunction were LV mass (Beta; 1.320, P; <0.001, CI; 0.049-0.144) and LV mass index (Beta; 1.100, P; 0.001, CI; 0.247-0.063).

Multivariate analysis of increased LA minimum volume show the independent predictors of LA minimum volume in patients with isolated LV diastolic dysfunction were LV mass (Beta 0.987, P-0.003, CI; 0.021-0.104), LV mass index (Beta; 0.835, P; 0.012, CI; 0.181-0.023) pulmonary a wave duration (Beta; 0.289, P; <0.001, CI; 45.026- 145.32) and E/A ratio (Beta; 0.149, P; 0.047, CI; 0.460- 6.340).

Multivariate analysis of increased LA maximum volume show the independent predictors of LA maximum volume in patients with isolated LV diastolic dysfunction were LV mass (Beta 0.008, P; 0.013, CI; 0.002-0.014), Pulmonary A duration (Beta; 15.36, P; 0.004, CI; 4.891-25.82)

Table 2: Correlation between Cardiac Indices and Left Atrial Dimensions in Cases with Left Ventricular Systolic and Diastolic Dysfunction

CARDIAC INDICES	LEFT ATRIAL LINEAR DIMENSIONS/VOLUME MEASUREMENTS			
	linear diameter	Maximum Volume	Pre A Wave Volume	Minimum Volume
	R (P-Value)	R (P-Value)	R (P-Value)	R (P-Value)
Left Ventricular EF(%)	0.078 (0.783)	0.058 (0.836)	0.092 (0.744)	-0.167 (0.552)
Left Ventricular Mass(g)	0.487 (0.066)	0.503 (0.056)	0.553 (0.033*)	0.202 (0.471)
Left Ventricular Mass Index(g/m^2)	0.346 (0.207)	0.366 (0.180)	0.379 (0.164)	0.025 (0.930)
Mitral E WaveDeceleration Time(m/sec)	-0.454 (0.089)	-0.452 (0.091)	-0.440 (0.101)	-0.357 (0.191)
Isovolumetric Relaxation Time(sec)	0.124 (0.659)	0.092 (0.745)	-0.127 (0.652)	0.135 (0.632)
E/E Prime	0.411 (0.128)	0.460 (0.084)	0.302 (0.274)	0.204 (0.465)
E/A Ratio	0.371 (0.173)	0.423 (0.116)	0.191 (0.494)	0.267 (0.337)
Pulm SV(m/sec)	-0.647 (0.009*)	-0.663 (0.007*)	-0.259 (0.351)	-0.012 (0.967)
Pulm DV(m/sec)	-0.706 (0.003*)	-0.725 (0.002*)	-0.258 (0.354)	0.025 (0.928)
Pulm STVI(mm)	-0.604 (0.017*)	-0.629 (0.012*)	0.219 (0.433)	-0.216 (0.440)
pulm DTVI(mm)	-0.439 (0.101)	-0.476 (0.073)	-0.031 (0.914)	-0.448 (0.094)
pulm A velocity(m/sec)	0.509 (0.053)	0.508 (0.053)	0.244 (0.380)	-0.074 (0.795)
pulm A duration(sec)	0.316 (0.252)	0.298 (0.281)	0.117 (0.678)	0.001 (0.998)

** = Pearsons Correlation Significant = P <0.05*

Key: EF – Ejection Fraction, Pulm- Pulmonary, SV - Systolic Velocity, DV- Diastolic velocity, STVI- Systolic Time Velocity Integral, DTVI- Time Velocity Integral

Table 3: Correlation between Cardiac Indices and Left Atrial Linear Dimensions/ Volume measurements among Cases with Normal Left Ventricular Function

CARDIAC INDICES	LEFT ATRAL LINEAR DIMENSIONS / VOLUME MEASUREMENTS			
	Linear Diameter r(p-value)	Maximum Volume r(p-value)	Pre A Wave Volume r(p-value)	Minimum Volume r(p-value)
Left Ventricular Ejection Fraction (%)	-0.03 (0.912)	-0.14 (0.413)	0.03 (0.847)	-0.01 (0.943)
Left Ventricular Mass(g)	0.28 (0.097)	0.17 (0.315)	-0.24 (0.142)	0.29 (0.082)
Left Ventricular Index (g/m^2)	0.14 (0.405)	0.11 (0.516)	0.14 (0.415)	0.16 (0.347)
Mitral E Wave Deceleration Time (sec)	-0.08 (0.645)	0.01 (0.962)	0.08 (0.644)	-0.01 (0.981)
Isovolumetric Relaxation Time (sec)	0.21 (0.219)	0.20 (0.242)	0.03 (0.842)	0.15 (0.387)
E/E Prime	0.11 (0.511)	0.12 (0.487)	0.12 (0.481)	0.18 (0.290)
E/A Ratio	0.04 (0.802)	0.10 (0.549)	0.07 (0.695)	0.05 (0.785)

Pulm SV (m/sec)	-0.27 (0.109)	-0.24 (0.160)	-0.23 (0.170)	-0.29 (0.084)
Pulm DV (m/sec)	-0.08 (0.629)	-0.26 (0.126)	0.08 (0.642)	0.03 (0.642)
Pulm A Velocity (m/sec)	-0.29 (0.088)	-0.18 (0.291)	-0.02 (0.932)	-0.02 (0.932)
Pulm A duration (sec)	-0.19 (0.281)	-0.10 (0.548)	-0.15 (0.376)	-0.15 (0.376)

** = Pearsons Correlation Significant = P <0.05*

Key: EF – Ejection Fraction, Pulm- Pulmonary, SV - Systolic Velocity, DV- Diastolic velocity

There was no significant correlation found with Left atrial maximum volume and left atrial pre A wave volume. All other correlations were also non-significant (As shown in Table 3)

DISCUSSION

The pulmonary vein Doppler waves have being known to represent diastolic function variables and are also related to left atrial function. The pulmonary vein A wave reversal duration (which is the time during which some LA blood returns to the pulmonary vein during left atrial contraction) showed a positive correlation with left atrial linear dimension, LA maximum volume and LA minimum volume among hypertensives with isolated diastolic dysfunction. This is indirectly supported by the findings of Bukachia et al [3] which showed that increasing age (which could cause increase in the size of the left atrium) correlated positively with pulmonary A wave duration reversal. This may be as a result of the fact that reduced left ventricular compliance results in backward flow of blood into the pulmonary veins. However, some other works [4,5] have also shown that though correlation may exist between left atrial dimensions and pulmonary A wave reversal duration, it is not statistically significant.

This study found significant association between LA maximum volume and pulmonary vein Systolic velocity, Diastolic velocity, Systolic time velocity integral in the subgroup with both systolic and diastolic dysfunction; however they were not found to be predictors of LA maximum volume on regression analysis. This is in agreement with the study done by Yang et al [6]. Bamikole et al [7] also showed correlation between LAVI and pulmonary vein systolic velocity. Impaired compliance

of the left atrium occurs with progressive enlargement of the left atrial chamber from volume distension and this in turn transmits pressure back into the pulmonary venous bed. Progressive increase in the pulmonary venous pressure can lead to the feeling of dyspnea consequent on increased left atrial afterload.

LA volume was highest in the group with both systolic and diastolic dysfunction, followed by those with isolated diastolic dysfunction and those without systolic and diastolic dysfunction in descending order; these findings were statistically significant. This is in keeping with Valocik et al [8] who compared LA volumes in subgroups of patients (isolated systolic dysfunction, isolated diastolic dysfunction and patients with normal systolic and diastolic functions) and showed that LA volumes were lowest in the subgroup without systolic or diastolic dysfunction compared to the other groups. It is worthy of note that they did not include hypertensive subjects with combined diastolic and systolic dysfunction in their analysis. This study included this subgroup (combined systolic and diastolic dysfunction) in its analysis and showed that LA volumes were highest in them compared to the others subgroups. These findings show that several factors play a role in increasing left atrial size (systolic and diastolic factors).

CONCLUSION

LA volumes correlated significantly with cardiac indices among hypertensive patients with isolated diastolic dysfunction but not with hypertensive patient with isolated systolic dysfunction. Among the hypertensive patients LV mass and Pulmonary a wave duration are predictors of left ventricular dysfunction

RECOMMENDATION

There is need for echocardiographic assessments and monitoring of hypertensives with early increase in left ventricular mass.

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