Original

Echocardiographic Correlates of Left Atrial Size in Hypertensive Patients

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Abstract
Background: There has been a growing interest in the left atrial structure and function and the vital role it plays in heart diseases. This study set out to access echocardiographic left atrial correlates in hypertensive subjects. This study assessed Echocardiographic Left Atrial Correlates in a hypertensive population attending a tertiary institution.
Method: A Prospective cross-sectional study, which recruited hypertensives, non-diabetic subjects, for which Echocardiography was performed using a predefined imaging protocol in the Rivers State University Teaching Hospital, Echocardiogram laboratory after collecting information on demographics, blood pressure, weight and height by an interviewer. Data collected was processed with Excel and SPSS (25)
Results: Three hundred and sixty-two subjects who had adequate data were evaluated. 182(50.3%) females and 180(49.7%) males, with mean; age of 55.20 ± 13.77yrs, BMI of 28.86 ± 8.77 kg/m^2, systolic and diastolic blood pressures of 143.00 ± 19.08mmHg and 86.34±14.53mmHg respectively. Bivariate correlation using Pearson correlation coefficient showed a significant correlation between Left atrial size/I; LV E/A ratio (.097*), LV internal diameter (.286**), LV relative wall thickness (.129**) and LV Mass/I(241**)
Conclusion: This study found significant correlations between left atrial size and various echocardiographic parameters in hypertensive patients, highlighting its role as a marker for left ventricular remodelling and cardiovascular risk. Notably, left atrial enlargement was associated with abnormal diastolic function, increased left ventricular mass, and reduced systolic function. These findings suggest that monitoring left atrial size could be crucial for assessing cardiovascular risk in hypertensive populations.

Keywords: Left Atrial correlates, Hypertensive Heart Disease

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Introduction

There has been a growing interest in the left atrial structure and function and the vital role it plays in heart diseases.[1] This study set out to assess, echocardiographic left atrial correlates in hypertensive.

There are three main phases of left atrial function namely; reservoir, conduit and pump phases. The sum of these function eventually determines atrial overall function, The afterload of the left atrium is primarily influenced by its elasticity and the pressure it faces downstream. This afterload tends to rise with worsening left ventricular diastolic dysfunction and higher LV filling pressures. Conversely, LA preload is mainly dependent on volume. Research in both animals and humans indicate that as LA volume and pressure increase, so does LA size, initially enhancing its contractile shortening. However, as the LA continues to dilate, reaching a certain fiber length threshold, there's a decrease in atrial shortening and contractility. This pivotal point or threshold effect is akin to the LV's Frank–Starling curve. Once this threshold is crossed, any further increase in size leads to a decline in LA function. [2,3,4]

Different echocardiographic parameters have been used in assessing left atrial function The left atrial (LA) size including left atrial diameter. However, left atrial volume assessment is recommended for evaluating LA geometry in hypertensive patients. Unlike LA dimensions, LA volume assessment using two- or three-dimensional echocardiography offers a more accurate and reproducible estimation of LA size. This method compares with reference standards such as magnetic resonance imaging (MRI), biplane contrast ventriculography, and cine computed tomography (CT).[5]

Tissue Doppler Imaging (TDI) is a valuable tool for assessing left atrial (LA) function. Specifically, the **late diastolic velocity** (Aa or A') of the **mitral annulus** has been studied in relation to LA function. Aa Correlates with left atrial (LA) function and decreases as atrial function deteriorates Aann represents the average of peak atrial systolic mitral annular velocities measured at the septal, lateral, anterior, and inferior annulus. This measures the left atrial systolic function or the contractile function of the left atrium This have been shown to corelate with left atrial fractional area change (FAC) and fractional volume change (FVC) during atrial systole, and can be used to assess left atrial systolic function or contractile function.[6]

The left atrial (LA) size is an important marker in hypertensive patients, indicating hypertensive heart disease [7]. Studies have shown that LA enlargement can be related to systolic blood pressure and left ventricular (LV) hypertrophy, particularly in older patients with isolated systolic hypertension.[8] Other factors such as age, obesity, and race have also been suggested as important covariates of LA size.[9] Studies have also affirmed the role of LVH and left atrial dilatation as markers of diastolic dysfunction.

While some studies view left atrial changes as an aftermath of left ventricular changes, others view left atrial changes as a prelude to LV changes.[10]

A local study from Ibadan examined early changes in the left atrium in hypertensive patients and their relation to left ventricular geometry. It involved 100 hypertensive patients and 50 normal individuals, using echocardiography for measurements. Hypertensive patients showed a higher percentage of increased left ventricular mass and larger left atrial dimensions. The study concluded that left ventricular changes occur early in hypertension, preceding left ventricular systolic function deterioration, with marginal corresponding left atrial changes.[11]

Another study by Zhou D et al [12] aimed to compare left atrial function in patients with hypertrophic cardiomyopathy and hypertension using cardiovascular magnetic resonance feature tracking. The study recruited 60 patients from each group and 60 controls, all with normal left atrial size. Results showed both patient groups had impaired left atrial reservoir and conduit function, with left atrial strain being more sensitive than left ventricular longitudinal strain for evaluating the primary endpoint. The study concluded that left atrial dysfunction, quantified by CMR-FT-derived strain, could be a promising metric for assessing clinical implications and predicting prognosis at an early stage.

A study that examined the influence of arterial hypertension on the left atrium's size and function in a group of 100 patients without any heart disease or atrial fibrillation. The findings showed that a small portion of patients had an enlarged left atrium, a majority exhibited an increase in reservoir and pump functions, and a large number had a decrease in conduit function. Influential factors causing these changes were identified as diabetes,

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obesity, and the use of antihypertensive drugs. The study concluded that arterial hypertension has a considerable effect on the left atrium's size and function, indicating a need for more research to determine the predictive value of left atrial remodeling in hypertensive patients.[13]

Another local study investigated the prevalence and correlates of left atrial enlargement (LAE) among hypertensive subjects in Nigeria. It found that LAE was present in over half of the subjects, and those with LAE were typically older, had a higher waist circumference, and a higher frequency of left ventricular hypertrophy. The left atrial dimension was also significantly higher in those with left ventricular hypertrophy. The study concluded that LAE is common in Nigerian hypertensive subjects, with age, waist circumference, and left ventricular dimensions being key correlates.[14]

There has been conflicting evidence on relationship between blood pressure, pulse pressures and left atrial size in a large, population-based cohort study, systolic and pulse pressures were identified as statistically significant determinants of left atrial size after adjusting for age and body mass index (BMI). However, the magnitudes of these relations were quite modest. While factors predisposing to increased left atrial size are clinically relevant, few studies systematically analyze the determinants of left atrial enlargement. Common factors associated with left atrial enlargement include aging, increased body size, and mitral valve disease.[15]

While there are differing views on whether left atrial changes precede or follow left ventricular changes, our study seeks to define the relationship that left atrial size has with other echocardiographic parameters in hypertensive patients. Future research should focus on longitudinal studies to better understand the predictive value of left atrial remodeling in hypertensive patients and to explore potential therapeutic interventions aimed at improving left atrial function and overall cardiac health in this population. This study investigated the association between left atrial size and various clinical and echocardiographic parameters in hypertensive patients.

Method

Study Design: This study adopted a prospective cross-sectional design.

Setting: It was a hospital setting. The research was conducted at the Echocardiogram Laboratory of the Rivers State University Teaching Hospital, Port Harcourt, Nigeria.

Study Duration: The study was carried out over a period of one year, from March 2023 to March 2024.

Participants: Eligible participants were hypertensive non-diabetic patients. Patients with diabetes, valvular heart diseases, and congenital heart diseases were excluded from the study. Participants were selected from those attending the Echocardiogram Laboratory during the study period.

Variables:
Clinical Parameters: Weight, Height, Sex, Blood pressures.

Echocardiographic Parameters: Left Atrial Area indexed for height (LAD/l), Left Ventricular Ejection Fraction (LVEF), Left Ventricular Deceleration Time (LV Dect), LV E/A ratio, LV internal Diameter in Diastole, Left Ventricular Posterior Wall (LVPW) thickness, Interventricular Septal Thickness in Diastole.

Data Sources/Measurement: Data was collected using a data entry proforma. The sources of data included clinical examinations and echocardiographic measurements. All measurements were performed using standardized procedures to ensure comparability.

Bias: Efforts to address potential sources of bias included the exclusion of patients with conditions that could confound the results, such as diabetes, valvular heart diseases, and congenital heart diseases. Data collection was standardized to minimize measurement bias.

Study Size: Required sample size for a study on hypertension in Port Harcourt with a hypertension prevalence of 25%, was computed using the following formula:
$n = \frac{{z^2 \cdot p \cdot (1 - p)}}{{e^2}}$[12]
Where:

- (n) is the sample size.
- (z) is the standard normal distribution value corresponding to the desired confidence level. For a **95% confidence level**, (z = 1.96).

- (p) is the prevalence of hypertension (expressed as a decimal). Given that the prevalence is 25%, (p = 0.25).
- (e) is the margin of error. Let's assume a margin of error of **5%**, so (e = 0.05).

Inserting the values:
n = \frac{{1.96^2 \cdot 0.25 \cdot (1 - 0.25)}}{{0.05^2}} \approx 288
Therefore, the minimum required sample size for the study on hypertension in Port Harcourt is approximately 288.
362 subjects were recruited.
Echocardiogram was performed using the GE VIVID IQ,

Data Analysis:
Data was collected into an Excel Spreadsheet. Descriptive Statistics: Mean, Median, and Standard Deviation was deployed for continuous variables like age, weight, height, blood pressure, and echocardiographic parameters. While frequency and percentage was used for categorical variables like sex.

Bivariate Analysis: Chi-square Test: was used to assess the association between categorical variables, such as sex and the presence of enlarged left atrium. The T-test was used to compare the means of two groups, for example, comparing echocardiographic parameters between male and female participants.

Correlation Analysis: - Pearson Correlation: was used to examine the relationship between continuous variables, such as the correlation between left atrial size and blood pressure or other echocardiographic parameters. Pearson is used for normally distributed data, while Spearman is used for non-normally distributed data.

Results

Three hundred and sixty-two, were evaluated who had Echocardiography done over a period of one year. 182(50.3%) females and 180 (49.7%) males, with mean; age of 55.20 ± 13.77yrs, BMI of 28.86 ± 8.77 kg/m², systolic and diastolic blood pressures of 143.00 ± 19.08mmHg and 86.34±14.53mmHg respectively, with means of other echocardiographic parameters as shown in table 1and 2.

Table 1: Cardiovascular Parameters**:**

Parameter	Mean ± SD
Age (Years)	55.20 ± 13.77
Body Mass Index (Bmi) (Kg/M²)	28.86 ± 8.77
Systolic Blood Pressure (Bp) (mmHg)	143.00 ± 19.04
Diastolic Blood Pressure (Dbp) (mmHg)	86.34 ± 14.53
Heart Rate (Hr) (Beats/Min)	77.21 ± 19.06

Table 2: Echocardiographic Parameters:

Parameter	Mean ± SD
Left Atrial Diameter (Lad) (Cm)	4.01 ± 0.76
Left Atrial Diameter/I(cm²/m)	2.43cm²/m
Interventricular Septal Thickness (IVSD) (Cm)	1.12 ± 0.36
Left Ventricular Internal Diameter (LVIDD) (Cm)	5.11 ± 1.03
Left Ventricular Posterior Wall Thickness (LVPWD) (Cm)	1.23 ± 0.32
End-Diastolic Volume (EDV) (Mls)	128.84 ± 58.76
Stroke Volume (SV) (Mls)	81.84 ± 31.15
Ejection Fraction (Ef) (%)	66.75 ± 14.18
Relative Wall Thickness (RWT) (Cm)	-0.51 ± 0.18
Left Ventricular Mass (LVM) (Kg)	246.78 ± 7.22
E/A Ratio	1.04 ± 0.53
Deceleration Time (Dec T)	165.09 ± 56.77

2. Comparison Between Male and Female Data:
There was no statistical difference in Age, BMI, blood pressures both systolic and diastolic blood pressures between the males and females, in this study population. There was however statistical difference in the left ventricular mass and the relative wall thickness of the male vs the female, both parameters were significantly larger in the male subjects.

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Table 3: Comparison between male and female variables

Variable	Mean ± Sd Males	Mean ± Sd Females	T-Statistic	Degrees Of Freedom	P-Value
AGE (yrs)	55.89 ± 12.89	55.62 ±15.73	0.538	44	0.593
BMI (kg/m2)	24.22 ± 5.47	31.40 ± ±9.42	-1.199	11	0.000
Systolic Bp(mmHg)	139.46 ± 22.64	143.19 ±16.68	-0.492	8	0.636
Diastolic BP(mmHg)	86.27± 18.02	86.27 ± ±10.59	0.339	8	0.743
Left Atrial Diameter (cm)	4.08 ± 0.84	3.98 ± 0.68	1.131	89	0.261
RWTcm	0.42 ± 0.2	0.51 ± -03	2.280	89	0.025*
LVM (kg)	243.79 ± 87.64	198.25 ± 98.60	3.599	89	0.001**
E/AM - E/AF	1.11 ± 0.53	1.01 ± .47	1.777	77	0.080
DECTM - DEC TF	148.43 ± 37.83	160.64 ± 75.62	-0.874	3	0.447
AVAM – AVAF	4.18 ± 2.18	3.15 ± 1.13	0.718	2	0.540

Significant for p-value ≤, 0.05: Parameter m: Males, Parameter f: Females

3. Relationship between Echocardiographic Variables and Left Atrial Size:

Bivariate correlation using Pearson correlation coefficient of Left Atrial Size (LAD/I): and other echocardiographic parameters showed: Significant positive correlation with: LV E/A ratio ($r = 0.097^*$, $p < 0.05$),LV internal diameter ($r = 0.286^{**}$, $p < 0.001$),LV relative wall thickness ($r = 0.129^{**}$, $p < 0.01$),LV Mass Index (LVM/I) ($r = 0.241^{**}$, $p < 0.001$),Negative correlation with: LV ejection fraction (EF) ($r = -0.167^*$, $p < 0.05$), LV fractional shortening (FS) ($r = -0.148^*$, $p < 0.05$)

Table 4: Correlation between echo parameters and LAD/I

Echocardiographic Parameter	Mean ± SD	Correlation Coefficient(R)	Sig.
Left Atrial Diameter (cm)	4.01 ± 0.76		
Left Atrial Area /Index (cm/m²)	2.43cm²/m		
Interventricular Septal Thickness. cm	1.12 ± 0.36	0.03	0.651
Left Ventricular Internal Diameter (Lvidd)cm	5.11 ± 1.03	0.29	.000
Left Ventricular Posterior Wall Thickness (Lvpwd)	1.23 ± 0.32	0.06	0.427
Ejection Fraction (Ef)	66.75 ± 14.18	-0.17	0.026
Relative Wall Thickness (RWT)	-0.51 ± 0.18	0.13	0.04
E/A Ratio	-1.04 ± 0.53	0.097	0.05
Deceleration Time (Dec T)	165.09 ± 56.77	-0.17	0.32
Aortic Valve Area (AVA)	3.67 ± 1.67	0.18	0.54
Left Ventricular Mass Index LVM	246.78 ± 7.22	0.24	.000

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Table 3 presents a comparison of various cardiovascular variables between male and female hypertensive patients, with 182 females and 180 males. With regards to Age (AGEM – AGEF): The t-statistic is 0.538 with a p-value of 0.593, indicating no significant difference in age between male and female patients., for Body Mass Index (BMIM – BMIF): The t-statistic is -1.199 with a p-value of 0.256, suggesting no significant difference in BMI between males and females. The Systolic Blood Pressure (BPM – BPF): The t-statistic is -0.492 with a p-value of 0.636, showing no significant difference in systolic blood pressure between the two groups. Diastolic Blood Pressure (DBPM – DBPF): The t-statistic is 0.339 with a p-value of 0.743, indicating no significant difference in diastolic blood pressure between males and females.

For the echocardiographic parameters, the analysis revealed several key findings. The left atrial diameter indexed for height (LAD/I) showed no significant difference between males and females, with a t-statistic of 1.131 and a p-value of 0.261. This suggests that the size of the left atrium is similar across both genders. However, relative wall thickness (RWT) was significantly higher in females compared to males, as indicated by a t-statistic of 2.280 and a p-value of 0.025. This finding highlights a notable gender difference in cardiac structure that may have clinical implications.

In contrast, males had a significantly higher left ventricular mass (LVM) than females, with a t-statistic of 3.599 and a p-value of 0.001. This suggests that male hypertensive patients tend to have more substantial changes in heart muscle mass, which could influence their cardiovascular risk profile.

The E/A ratio, which assesses diastolic function, showed a trend towards significance with a t-statistic of 1.777 and a p-value of 0.080, but it was not statistically significant. This indicates no clear difference in diastolic function between males and females.

Deceleration time (DEC T) and aortic valve area (AVA) also showed no significant differences between the genders, with t-statistics of -0.874 and 0.718, and p-values of 0.447 and 0.540, respectively. These results suggest that these parameters are similar in both male and female hypertensive patients.

Discussion

While most echocardiographic variables did not differ significantly between genders, females had higher relative wall thickness, and males had higher left ventricular mass. These findings underscore the importance of considering gender-specific differences in the clinical management of hypertensive patients.

In a study[15] of 863 hypertensive patients with left ventricular hypertrophy, gender differences in response to antihypertensive treatment were assessed over 4.8 years. The longitudinal study included patients aged 55 to 80 years, with baseline and annual echocardiograms analyzed. Women exhibited higher ejection fraction, stress-corrected mid-wall shortening, and prevalence of left ventricular hypertrophy at both baseline and study end.

To compare both studies, found significant gender differences in cardiac structure, with the index study with findings showing higher RWT in females and higher LVM in males, while the hypertrophy study found higher left ventricular hypertrophy prevalence in women. both sets of findings underscore the importance of considering gender differences in cardiovascular health, and gender-specific approaches may be beneficial in managing hypertensive patients.

Left Atrial Size (LAA/I and LV E/A Ratio: showed a significant positive correlation with: LV E/A ratio ($r = 0.097^*$, $p < 0.05$), The E/A ratio is a parameter derived from echocardiography that reflects diastolic function of the left ventricle. The E/A ratio is useful in assessing diastolic dysfunction and guiding therapeutic decisions[16] A higher E/A ratio indicates abnormal diastolic filling patterns and is often associated with diastolic dysfunction. The positive correlation between LA size and E/A ratio suggests that as the left atrium enlarges, there is an increased likelihood of abnormal diastolic function. A Mendelian randomization study investigated the causal association between AF and LA size and function. Study revealed that genetically determined AF was causally associated with: Increased LA maximal volume (LA max). The risk allele near the PITX2 gene contributed significantly to these associations. [17]

Left atrial size and LV internal diameter: Very few studies have evaluated the relationship between left atrial size and left ventricular diameter in different disease states, in this study of hypertensive patients there is a

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positive correlation using a bivariate analysis between left atrial diameter and left ventricular diameter in hypertensives. Another study that compared LV size and left atrial diameter in dilated cardiomyopathy[18] also showed a positive correlation between both echocardiogram variables, Patient with both left atrial enlargement and other echocardiographic parameters showed that patients with a larger LA volume (LA(max)/m(2) >68.5 ml/m(2)) had a risk ratio of 3.8 compared with those with a smaller LA volume. it will however important to compare LA/LV ratio in various disease states, to see a possible pattern and a ratio that can guide early in making a diagnosis.

Studies suggest that LAE may precede LV dilatation[19] in some cases, as the left atrium enlarges to compensate for increased pressure or volume, it may eventually lead to LV remodeling and dilatation. However, the exact temporal sequence can vary based on individual patient characteristics and underlying conditions.

Left Atrial Size and Left Ventricular Relative Wall Thickness: The positive correlation between left atrial size and left ventricular wall thickness ($r = 0.129^{**}$, $p < 0.01$) suggests that as the left atrial size increases, the LV wall thickness also increases. This finding implies that, there is a relationship between atrial enlargement and LV remodeling, which can be accounted for by pressure overload. Hypertension (high blood pressure) is a common cause of LV remodeling. Increased pressure in the LV can lead to LV hypertrophy (thickening of the LV wall) as an adaptive response.
Previous research has shown that concentric LV remodeling (increased wall thickness relative to cavity size) is associated with cardiovascular events, especially in hypertensive patients.[20]
Our finding aligns with this concept, suggesting that LAD enlargement may be a marker of LV remodeling and potential cardiovascular risk and this finding gives valuable insight to the disease process

Left Atrial Area index for height (LADI) and Left Ventricular Mass Index (LVM/I) and its potential implications:
LVM: there has been limitations in the assessment of left ventricular mass using echocardiography, this limitation dependent on the method utilized, either the M-mode, 2D or the 3D. the Mode and 2 D limitations assumes a fixed geometry whilst the 3D has been shown to exaggerate the values of LV geometry.
LV mass is an independent cardiovascular risk factor and plays a pivotal role in determining mortality. Both M-mode and 2D echocardiography assume a prolate ellipsoid shape, with a ratio of long- to short-axis lengths of 2:1, which provided the best simplified geometric model for LV mass estimation. The late changes of hypertension on the heart is a dilated cardiomyopathy due to pressure and volume overload. With both diastolic and systolic dysfunction. This results in a heart that is not able to pump sufficient cardiac output and also not able to maintain sufficient blood pressure a term that has been widely used but requiring more understanding of its impact and importance Decapitated or burn- out hypertension. The significant positive correlation between positive correlation ($r = 0.241^{**}$, $p < 0.001$) indicates that as LAD increases, the left ventricular mass (adjusted for body size) tends to increase as well. Possible explanation to this is: Hemodynamic Stress: Hypertension (high blood pressure) can lead to both left atrial enlargement (LAD) and left ventricular hypertrophy (LVM). Increased pressure in the LV due to hypertension results in LV remodeling and thickening of the LV wall. Previous research has shown that LV mass (LVM) is an independent predictor of adverse cardiovascular events and mortality.[21] The findings of the index study align with the concept that LAD enlargement may be associated with LV remodeling and increased mass, especially in hypertensive patients.

Left Atrial Area/I (LAA/I) And Two Measures of Left Ventricular Systolic Function: Ejection Fraction (EF) And Fractional Shortening LAA/I vs. EF: The negative correlation ($r = -0.167^{*}$, $p < 0.05$) suggests that as LAD increases, EF tends to decrease. In other words, larger atrial size is associated with reduced systolic function.
LAA/I vs. FS: Similarly, the negative correlation ($r = -0.148^{*}$, $p < 0.05$) indicates that as LAD increases, FS tends to decrease. Reduced FS implies impaired contractility. Hypertensive heart disease often leads to LV remodeling, including atrial enlargement (LAE) and reduced systolic function (lower EF and FS) previous research has consistently shown negative correlations between LAD and EF/FS[22]. These findings align with the concept that atrial enlargement may be a marker of LV dysfunction, especially in hypertensive patients.

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Strengths and limitations of the study:

Comprehensive Analysis: The study provides a thorough analysis of the relationship between left atrial size and various echocardiographic parameters in hypertensive patients. This comprehensive approach offers valuable insights into how hypertension affects cardiac structure and function.

Well-defined Inclusion and Exclusion Criteria: The study clearly defines the inclusion and exclusion criteria, ensuring a homogeneous study population. This reduces confounding factors and enhances the validity of the findings.

Correlation with Multiple Parameters: The study investigates the correlation between left atrial size and multiple parameters, including left ventricular mass index, left ventricular diameter, and left ventricular systolic function. This multi-faceted approach provides a comprehensive understanding of the relationship between left atrial enlargement and left ventricular remodeling.

Clinical Relevance: The findings have significant clinical implications, the positive correlation to both systolic and diastolic functions suggesting that left atrial enlargement may serve as a marker of left ventricular remodeling and potential cardiovascular risk in hypertensive patients. This can inform clinical practice and guide the management of hypertensive patients.

Limitations of the Study

Cross-sectional Design: The cross-sectional design of the study limits the ability to establish causality. Longitudinal studies are needed to determine the temporal relationship between left atrial enlargement and left ventricular remodeling.

Potential for Selection Bias: The study population is limited to hypertensive patients attending a specific echocardiogram laboratory, which may introduce selection bias and limit the generalizability of the findings to the broader hypertensive population.

Limited Assessment of Confounding Factors: While the study addresses some potential confounders, there may be other unmeasured factors, such as medication use, lifestyle factors, and comorbidities, that could influence the observed associations.

Implications of the findings of the study: The study provided evidence of a relationship between left atrial diameter and important measures of systolic and diastolic functions, this points to importance of monitoring left atrial size in hypertensive patients and it valued position as an indicator of overall LV function. It will encourage further evaluation of the left atrial functions and possible enhance molecular studies on how to ameliorate disease progression in hypertensives.

Conclusion

The index study found a significant positive correlation between left atrial size (LAA/I) and various echocardiographic parameters, notably the LV E/A ratio, suggesting that as the left atrium enlarges, there is an increased likelihood of abnormal diastolic function. The positive correlation between left atrial diameter and left ventricular diameter in hypertensive patients supports previous findings that LA enlargement may precede LV dilatation as a compensatory response. Additionally, LA size was positively correlated with left ventricular wall thickness, indicating a relationship between atrial enlargement and LV remodeling due to pressure overload from hypertension. The significant positive correlation between LAA/I and left ventricular mass index (LVM/I) further highlights the impact of hemodynamic stress in hypertensive patients. As left atrial diameter increases, left ventricular mass tends to increase as well, suggesting that LAD enlargement may be a marker of LV remodeling and potential cardiovascular risk. The study also found negative correlations between LAA/I and measures of left ventricular systolic function, such as ejection fraction (EF) and fractional shortening (FS), indicating that larger atrial size is associated with reduced systolic function. These findings align with previous research showing that hypertensive heart disease often leads to LV remodeling, including atrial enlargement and reduced systolic function. Overall, this study provides valuable insights into the relationship between left atrial enlargement, LV remodeling, and cardiovascular risk in hypertensive patients.

Declarations

Ethics statement and approval: Ethical approval was received from the ethics committee of the Rivers State University Teaching Hospital

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References

1. Hendriks T, Said MA, Janssen LMA, et al. Effect of Systolic Blood Pressure on Left Ventricular Structure and Function: A Mendelian Randomization Study. Hypertension. 2019;74(4):826-8321.
2. Gustavo G. Blume, Christopher J. Mcleod, Marion E. Barnes, James B. Seward, Patricia A. Pellikka, Paul M. Bastiansen, Teresa S.M. Tsang, Left atrial function: physiology, assessment, and clinical implications, European Journal of Echocardiography, Volume 12, Issue 6, June 2011:421–430, https://doi.org/10.1093/ejechocard/jeq175
3. Ferkh A, Clark A, Thomas L Left atrial phasic function: physiology, clinical assessment and prognostic value, Heart 2023;109:1661-166
4. Inciardi RM, Bonelli A, Biering-Sorensen T, Cameli M, Pagnesi M, Lombardi CM, Solomon SD, Metra M. Left atrial disease and left atrial reverse remodelling across different stages of heart failure development and progression: a new target for prevention and treatment. Eur J Heart Fail. 2022 Jun;24(6):959-975. doi: 10.1002/ejhf.2562. Epub 2022 Jun 6. PMID: 35598167; PMCID: PMC9542359.
5. Zhou D, Yang W, Yang Y, Yin G, Li S, Zhuang B, Xu J, He J, Wu W, Jiang Y, Sun X, Wang Y, Sirajuddin A, Zhao S, Lu M. Left atrial dysfunction may precede left atrial enlargement and abnormal left ventricular longitudinal function: a cardiac MR feature tracking study. BMC Cardiovasc Disord. 2022 Mar 13;22(1):99. doi: 10.1186/s12872-022-02532-w. PMID: 35282817; PMCID: PMC8919633.
6. Ikejder Y, Sebbani M, Hendy I, Khramz M, Khatouri A, Bendriss L. Impact of Arterial Hypertension on Left Atrial Size and Function. Biomed Res Int. 2020 Sep 14; 2020:2587530. doi: 10.1155/2020/2587530. PMID: 33015158; PMCID: PMC7512039.
7. Akintunde AA. Prevalence of echocardiographic left atrial enlargement among hypertensive Nigerian subjects. Afr Health Sci. 2022 Jun;22(2):257-263. doi: 10.4314/ahs.v22i2.29. PMID: 36407404; PMCID: PMC9652649.
8. Molnár A.Á, Merkely B. The Added Value of Atrial Strain Assessment in Clinical Practice. Diagnostics 2022, 12, 982. -Q7https://doi.org/10.3390/diagnostics12040982
9. Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiography 2015; 28:1-39. e14.
10. Gottdiener, J, Reda, D, Williams, D. et al. Left Atrial Size in Hypertensive Men: Influence of Obesity, Race and Age fn1. J Am Coll Cardiol. 1997 Mar, 29 (3) 651–658.https://doi.org/10.1016/S0735-1097(96)00554-2
11. Zhou D, Yang W, Yang Y, Yin G, Li S, Zhuang B, Xu J, He J, Wu W, Jiang Y, Sun X, Wang Y, Sirajuddin A, Zhao S, Lu M. Left atrial dysfunction may precede left atrial enlargement and abnormal left ventricular longitudinal function: a cardiac MR feature tracking study. BMC Cardiovasc Disorder. 2022 Mar 13;22(1):99. doi: 10.1186/s12872-022-02532-w. PMID: 35282817; PMCID: PMC8919633.
12. Seko Y, Kato T, Haruna T, Izumi T, Miyamoto S, Nakane E, Inoko M. Association between atrial fibrillation, atrial enlargement, and left ventricular geometric remodeling. Sci Rep. 2018 Apr 23;8(1):6366. doi: 10.1038/s41598-018-24875-1. PMID: 29686287; PMCID: PMC5913256.
13. Hesse B, Schuele SU, Thamilasaran M, Thomas J, Rodriguez L. A rapid method to quantify left atrial contractile function: Doppler tissue imaging of the mitral annulus during atrial systole. Eur J Echocardiogr. 2004 Jan;5(1):86-92. doi: 10.1016/s1525-2167(03)00046-5. PMID: 15113019.
14. Vaziri SM, Larson MG, Lauer MS, Benjamin EJ, Levy D. Influence of blood pressure on left atrial size: The Framingham Heart Study. Hypertension. 1995 Jun;25(6):1155-60.
15. van de Vegte YJ, Siland JE, Rienstra M, van der Harst P. Atrial fibrillation and left atrial size and function: a Mendelian randomization study. Sci Rep. 2021 Apr 19;11(1):8431. doi: 10.1038/s41598-021-87859-8. PMID: 33875748; PMCID: PMC8055882.

Print ISSN: 0189-9287 Online ISSN: 2992-345X

16. Rossi A, Cicoira M, Zanolla L, Sandrini R, Golia G, Zardini P, Enriquez-Sarano M. Determinants and prognostic value of left atrial volume in patients with dilated cardiomyopathy. J Am Coll Cardiol. 2002 Oct 16;40(8):1425. doi: 10.1016/s0735-1097(02)02305-7. PMID: 12392832.
17. Bakalli A, Georgievska-Ismail L, Musliu N, Koçinaj D, Gashi Z, Zeqiri N. Relationship of left ventricular size to left atrial and left atrial appendage size in sinus rhythm patients with dilated cardiomyopathy. Acta Inform Med. 2012 Jun;20(2):99-102. doi: 10.5455/aim.2012.20.99-102. PMID: 23322961; PMCID: PMC3544319.
18. Dittrich HC, Perace LA, Asinger RW, et al. Left Atrial Diameter in Nonvalvular Atrial Fibrillation: An Echocardiographic Study. Am Heart J. 1999;137(3):494–499.
19. Bakalli A, Kamberi L, Pllana E, Zahiti B, Dragusha G, Brovina A. The influence of left ventricular diameter on left atrial appendage size and thrombus formation in patients with dilated cardiomyopathy. Turk Kardiyol Dern Ars. 2010;38(2):90–94.
20. Koren MJ, Devereux RB, Casale PN, Savage DD, Laragh JH. Relation of left ventricular mass and geometry to morbidity and mortality in uncomplicated essential hypertension. Ann Intern Med. 1991 Mar 1;114(5):345-52.
21. Laukkanen JA, Khan H, Kurl S, Willeit P, Karppi J, Ronkainen K, et al. Left ventricular mass and the risk of sudden cardiac death: a population-based study. J Am Heart Assoc. 2014;3:e001285. doi: 10.1161/JAHA.114.001285.
22. Pathophysiology of Hypertensive Heart Disease: Beyond Left Ventricular Hypertrophy. Current Hypertension Reports. 2020;22(11):11-22. doi: 10.1007/s11906-020-1017-9

Print ISSN: 0189-9287 Online ISSN: 2992-345X