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Echocardiographic Assessment of LA Volume and Function in Hypertensive Patients

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Abstract: ***Background*: Chronic cardio vascular disorders such as hypertension imparts a variety of structural changes in the cardiac chambers. Left Atrial Enlargement is one such marker due to the hypertensive heart diseases. This study aims to assess the Left Atrial volume and function among hypertensives. *Objective*: 1.To determine LA volume and LA function in Hypertensive patients. 2. To estimate the prevalence of Left atrial Enlargement in Hypertensive patients and its significance. *Materials and methods*: A cross-sectional study was conducted among 350 patients attending Out Patient Department of Cardiology, Stanley Medical College – A tertiary care center in Tamilnadu. The study period was April – June 2019. Patients with known case of hypertension and the newly detected hypertensives were subjected to 2 D Trans thoracic Echocardiographic Examination.Parameters such as Left Atrial (LA) volume, Left Ventricular (LV) wall thickness, LA Function, LV systolic and LV diastolic function are measured based on standard views.Multiple regression models were constructed to evaluate the independent contributions of factors on LA volume. *Results*: A total of 350 study participants were enrolled in the study as per the eligibility criteria.The mean age of the population was 49.10 ± 12.3 years; range 30-78 years and 190 men were enrolled in the present study. The prevalence of Left Arterial Enlargement (LAE) among hypertensives was found to be 28.6%.Left Atrial Volume Index (LAVi)showed a positive correlation with MAP (r=0.44, p<0.001)and negatively correlated with LAEF (r=-0.15, p<0.001). *Conclusion*: The prevalence of Left Atrial Enlargement was high among the hypertensive patients and moreover isolated Left atrial Enlargement (without LVH) was also common among the hypertension patients. Larger studies are needed to understand the exact interplay between Left Atrial volume and Left Atrial Function.***

Keywords: Hypertension, Left Atrial Enlargement, Left Ventricular Hypertrophy, Left Atrial function, Left Atrial volume

1. Introduction

Left atrialenl argement (LAE) is a marker of Left Ventricular (LV) pressure and volume overload.[1]The main function of Left Atrium (LA) is modulating the left ventricular filling and cardiac performance by implicating its role by acting as a reservoir of pulmonary venous return during ventricular systole, a conducting agent for pulmonary venous return during early ventricular diastole, and also functions as a booster pump which augments ventricular filling during late ventricular diastole.[2]In various Cardio Vascular Disorders (CVD) there will be a dynamic change in size of the left atrium, characterized by alterations in LV structure and function, such as mitral valve or myocardial disease, as well as arterial hypertension. One such case in point is hypertensive heart disease wherein LAE is are liable marker of a chronically elevated LV filling pressure and diastolic dysfunction even in the absence of mitral valve disease.[3,4]On reviewing the natural history of essential hypertension, elusive modificationsare elicited in structure of left ventricle. (LV).[5]Increased LA volume is mainly the result of impaired LV filling and this is due toLV hypertrophy and remodelling (Inlong-standing cases). Studies found that LV hypertrophy is a link between hypertension and left atrium enlargement and also LA enlargement caused by hypertension is often detected earlier than LV hypertrophy or dilatation in the course of hypertensive heart disease.[6,7]A correlation between left-atrial (LA) size and the circulating levels of brain natriuretic peptide has been documented in patients with heart failure and preserved systolic function, as well as in hypertensive patients with asymptomatic diastolic dysfunction.[8,9]Although the increase in LA size may be a mechanism for offsetting the impairment of LV compliance and progression of LV diastolic dysfunction in the hypertrophied ventricle, LAE usually develops well before hypertensive LV hypertrophy (LVH) has beendocumented.[10,11]

Epidemiological studies proved the relation between systolic blood pressure (SBP), diastolic blood pressure and cardiovascularrisk, mortality and morbidity. It is important to recognize the interplay that exists among these atrial functions and ventricular performance throughout the cardiac cycle. Hence with this background and also there is a dearth of literature in these notions in our study setting, this study aimed to assess the LA volume and function and to estimate the prevalence of left atrial enlargement in hypertensive patients attending a tertiary care centre.

2. Materials and Methods

The present cross-sectional study was conducted in a tertiary care center (Stanley Medical College), Chennai. Hypertensive patients attending the Out-Patient department of Cardiology department, Stanley Medical College, Chennai. The study period was from April – June 2019.A semi-structured data collection form was used to interview hypertensive patients attending OPD after obtaining the informed consent.All patients diagnosed to have systemic hypertension (known case and also the newly detected)

attending Out Patient Department whoever was giving consent were included in the study. Hypertensive patients whoever was not willing to take part in the study, patients with valvular heart diseases, dilated cardiomyopathy, secondary Mitral Regurgitation, Atrial Fibrillation, known case of Diabetes Mellitus & hypothyroidism were excluded from the study.

Sample size calculation: The sample size is calculated using OpenEpi version 3.01. A minimum sample size of 285 adults are required for the study considering prevalence of Left Atrial Enlargement as 24.5%,[12] precision as 5% and confidence levels as 95% (5% alpha error). Universal sampling method was adopted to select study participants as per the eligibility criteria during the study period

Data collection procedure: From the Cardiology OPD, Stanley medical college, all the patients with hypertension were included in this study as per the eligibility criteria. A semi-structured interview schedule was used to collect information on socio-demographic characteristics and clinical features.2DTransthoracicEchocardiographic examination was performed in all the Hypertensive patients and LA size, LV wall thickness, LA Function, LV systolic and LV diastolic function are measured based on standard views.The LA size is measured based on the standard Echocardiographic criteria. LA volume calculated by Area Length Biplane method

Parameters studied: According to 2017 guidelines for the Prevention, Detection, Evaluation and Management of high Blood pressure in adults, patients with systolic BP of 130-139 mm Hg were categorized as Stage I Hypertension and patients with systolic BP of ≥140mm Hg were categorized as Stage II Hypertension.[13]The Left Atrial Volume index of more than 34 in both the sexes indicates the Left Atrial Enlargement (LAE). The normal cut-off for Antero Posterior diameter of Left Atrium is taken as 3.8 for female and 4.0 for males. Left Atrial Emptying Fraction (LAEF) of less than 50 was considered as declined function of Left Atrium.

Statistical analysis: The quantitative data entry was done in Microsoft excel while analysis was done by using Microsoft excel and Statistical Package for the Social Sciences for Windows (SPSS Inc., Chicago, Illinois, USA) version 16.0. Descriptive statistics, chi-square test and logistic regression were applied to assess the significance of study findings. $p<0.05$ was considered as statistically significant. The study has been approved by Institutional Human Ethical Committee.

3. Results

A total of 350 hypertensive patients were assessed through Echocardiogram for LA volume along with LA function, LV thickness, LV systolic function, LV diastolic Function are noted. The mean age of the population was 49.10 ± 12.3 years; range 30-78 years and 190 men were enrolled in the present study. The mean BMI of the study population was 26.1 and the mean systolic and diastolic pressure was 153.2 and 84.9 respectively (Table. 1)

From the Echo findings it was determined that the mean LAVi was 27.7 ± 7.5 and the mean EF was 60.7 ± 4. The prevalence of Left Arterial Enlargement (LAE) among hypertensives was found to be 28.6%. It was found that nearly 20.6% of the patients have developed Left Atrial enlargement without LVH (Table 2) and the duration for the development of isolated LAE among hypertensives was 4.0 ± 1.3 years.

Correlation Analysis

In the overall population Left Atrial Volume Index (LAVi) being a continuous variable showed a positive correlation with MAP ($r=0.44$, $p<0.001$), BMI ($r=0.22$, $p<0.001$), and negatively correlated with LAEF ($r=-0.15$, $p<0.001$). Multiple regression models were constructed to evaluate the independent contributions of factors on LA size. A first set of models included age (> 65 years), gender, overweight (BMI > 25kg/m^2), Systolic blood pressure(>130mmHg) and duration(>10 years). Age, gender and SBP were each independently associated with LA enlargement. When the first set of models was run again after adding LAEF, Age, gender, BMI and SBP was independently associated with LA enlargement. (Table 3)

Table 1: Clinical Characteristics of Overall Population

	Mean ± SD
Age (years)	49.1 ± 12.3
Weight(kgs)	72.3 ± 9.0
BMI	26.1 ± 2.3
Systolic Blood Pressure	153.2 ± 7.2
Diastolic Blood Pressure	84.9 ± 6.4

Table 2: Association between LAE and LVH

Left Ventricular Hypertrophy (LVH)	Left Atrial Enlargement (LAE)		X^2 (p value)
	Present	Absent	
Absent	49 (20.6%)	189(79.4%)	21.5579
Present	51(45.5%)	64(54.5%)	<0.001

Table 3: Independent covariates of Left Atrial Enlargement by Logistic regression

	Odds Ratio	p value	95% CI
Age >65 years	1.172	0.008	0.30-2.04
BMI > 25	1.27	0.01	0.29-2.25
Duration > 10years	1.82		0.28-3.36
Systolic Blood pressure > 130mmHg	1.95	<0.001	0.92-2.98
Decreased LA Function LAEF<50	7.38	<0.001	5.43-9.33

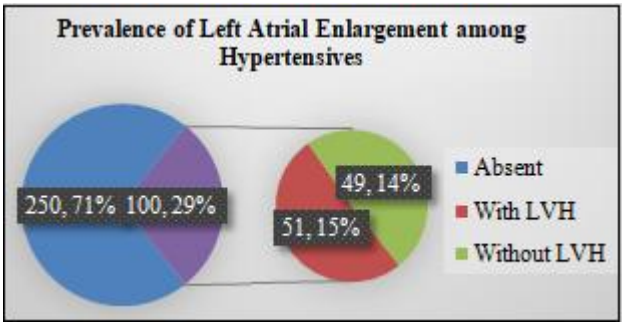

Figure 1: Pie Chart depicting the prevalence of Left Atrial Enlargement among hypertensives

4. Discussion

In the current study, we found that Left Atrial Enlargement (increased LAVi) was found to be present in 28.6% (≈29%) of hypertensive patients. The mean LAVi was 27.7 ± 7.5. These findings were consistent with the study done by Cesare et al on prevalence and correlates of left atrial enlargement in essential hypertension: role of ventricular geometry and the metabolic syndrome - The Evaluation of Target Organ Damage in Hypertension study.[12] They also found that enlarged LA diameter was present in 24.5% of women and in 21.5% of men. Minimal differences in the study findings may be attributed to geographical variation of the study setting. They also found that patients with enlarged LA were older and more frequently overweight. In our study also we found that BMI (BMI>25) was independently associated with Left Atrial Enlargement with an Odds Ratio of 1.27.

A study on "The relation between blood pressure components and left atrial volume in the context of left ventricular mass index" done by Marta et al[6]found that left atrial volume index (LAVI) positively correlated with Left Ventricular Mass Index (LVMI) (r=0.36, P<.001). They had 2 subgroups such as LVMI below median value and above median value. MAP and Left Ventricular Emtying Fraction (LVEF) negatively correlated with LVMI over median value (-0.06 and -0.21 respectively). In contrary to the above study, our study found that Left Atrial Volume Index (LAVi) being a continuous variable showed a positive correlation with MAP (r=0.44, p<0.001) and it is negatively correlated with LAEF (r= -0.15, p<0.001).

A systematic Review has been done by Cesare et al on the prevalence of Echocardiographic Left-Atrial Enlargement in Hypertension in 2013.[11] The review showed the prevalence of left-ventricular hypertrophy was significantly higher in patients with LAE when compared with the patients without LAE. In this present study also, we were able to trace the association between LAE and LVH. It wasfound that nearly 20.6% of the patients have developed Left Atrial enlargement without LVH. (Table 2) and the duration for the development of isolated LAE among hypertensives was 4.0 ± 1.3 years.

Hence in our cross-sectional study, using multiple regression models, we found that age,gender, BMI and SBP were independently associated with LA enlargement.

5. Conclusion

The prevalence of Left Atrial Enlargement was High among the hypertensive patients and moreoverisolated Left atrial Enlargement (without LVH) was also common among the Hypertension patient. Left Atrial Enlargement is an independent risk factor which predicts future Risk of Stroke, Cardiovascular morbidity and Mortality. As the Left Atrium initially enlarged, it tries to compensate by good Left Atrial Contraction(Left Atrial Emptying Fraction is Within normal range). But as Left Atrium further enlarges, the Left Atrial Contraction decreases and Left Atrial Emptying Fraction decreases. Larger studies are needed to understand the exact interplay between Left Atrial Size and Left Atrial Function especially Left Atrial Emptying Fraction since in some studies Left Atrial Emptying Fraction are more accurate predictor of future risk of stroke and Cardiovascular morbidity and mortality.

6. Recommendations

All patients with hypertension need to be screened for Left Atrial enlargement in addition to Left Ventricular Hypertrophy. In patients with hypertension combined with diabetes, the prevalence and significance of Left Atrial Enlargement needs to be studied in large numbers.Newer diagnostic tools like LA strain and Cardiac MRI are more helpful in assessingdifferent components of Left Atrial Function and these have huge impact in monitoring and management of the patient. Larger studies are needed in this aspect.

7. Strengths

Multi-factorial approach was used for the diagnosis of Left Atrial Enlargement such as Antero-Posterior diameter of Left Atrium, Left Atrial Emtying Fraction, Left Atrial Volume index which strongly supports the diagnosis and it was not done based only on a single parameter. Also, the confounding factors such as other cardiac disorders like valvular heart diseases, atrial fibrillation were eliminated in the study.

8. Limitation

Since it's a cross-sectional study, this gives information at a specific point of time. To establish this study finding and to assess the risk and further complications due to impaired functions of Left Atrium and Left Ventricle, longitudinal assessments on a large scale is recommended.

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