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Comparison of left atrial size in hypertensive patients with or without left ventricular hypertrophy by Echocardiography

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Abstract: *Hypertension affects approximately one billion individuals worldwide and this figure is predicted to increase to 1.5 billion by 2025.Hypertension remains the most common, readily identifiable, and reversible risk factor for myocardial infarction, stroke, heart failure, atrial fibrillation, aortic dissection and peripheral arterial disease. The cardiac effects of systemic hypertension include systolic as well as diastolic dysfunction whereas increase in Left Ventricular mass has been shown to be a predictor of cardiovascular events, Left Atrial size is associated with likely hood of developing AF, indicator of diastolic function and in addition it is a predictor of stroke.*

This was a Cross sectional analytical case control study comprising 119 hypertensive patient conducted in the Department of Medicine Pt. J.N.M. Medical College and Dr. B.R.A.M. Hospital Raipur from August 2014 to Sept 2016 with aims and objectives to asses Left Atrial size in subjects with systemic hypertension with or without LVH by echocardiography & correlate Left Atrial size, Left Atrial Volume with Left Ventricular Hypertrophy LV mass & stages of systemic hypertension.

Result and conclusions*: Left Atrial size , mean Left Atrial Volume & mean Left Atrial Volume Index was found to be significantly higher in Left Ventricular Hypertrophy subjects compared to those without Left Ventricular Hypertrophy (p<0.0001). Study also suggests that there is significant positive correlation between Left Ventricular Hypertrophy and Left Ventricular mass. correlation was found to exist between Left Atrial Volume Index and Left Ventricular mass (r=0.244),which was statistically significant (p=0.007), Suggesting that increase in Left atrial volume occur even in the absence of Left Ventricular Hypertrophy which means that volume-based measurements are more sensitive and detect Left atrial enlargement at an earlier stage than diameter-based measurements.*

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I .Introduction

An elevated arterial pressure is probably the most important public health problem in developed and developing world. In Urban population of India prevalence in men 26.78%, women 27.65%. Framingham heart study published in 2002, suggests that individuals who are normotensive at age 55 have a 90% lifetime risk for developing hypertension. The cardiac effects of systemic hypertension include systolic as well as diastolic dysfunction whereas increase in LV mass has been shown to be a predictor of cardiovascular events**,** LA size is associated with likely hood of developing AF, indicator of diastolic function and in addition it is a predictor of stroke.

During ventricular diastole, LA is directly exposed to LV pressures through the open mitral valve. With worsening LV compliance, LA pressure increases to maintain adequate LV filling, which results in LA enlargement. Thus, LA size as a reflection of severity and chronicity of diastolic dysfunction provides prognostic information incremental to that of diastolic function.LA contributes for approximately 20% of LV stroke volume; several large population-based prospective studies have shown a strong association between M mode anteroposterior LA diameter and the risk of new onset AF. Evidences highlight the importance of enlarged left atrium (LA) as a barometer of diastolic burden**.** Left Atrial Volume Index (LAVI) is a good Predictor of cardiovascular outcomes – including heart failure, atrial fibrillation, stroke and mortality. The LA volume has been compared to the ―glycated hemoglobin of diabetes mellitus, as it is a reflection of long-standing hemodynamic condition**.**

II. Materials and Methods

It was a Cross sectional analytical case control study conducted in the Department of Medicine Pt. J.N.M. Medical College and Dr. B.R.A.M. Hospital Raipur from August 2014 to Sept 2016 after grant of Permission from ethical committee.

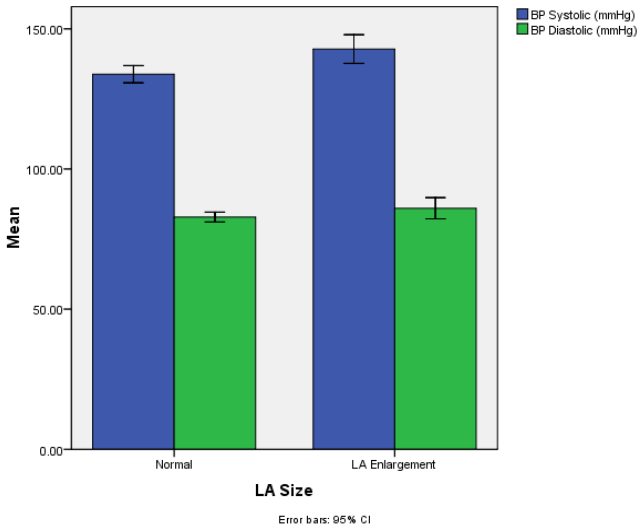
Inclusion criteria: Subjects with blood pressure >140/90 mm Hg
Exclusion criteria: Age less than 20 or >80,Valvular heart disease,CHF, Arrhythmia's, History of Angina or MI, Dilated Cardiomyopathy, Anemia, Uremia, COPD,Pregnancy, Diabetes Mellitus 1 and 2,Morbid Obesity-BMI >35 Kg/meter square, Thyroid Disorders.
Method Procedure was explained and informed consent was taken. Detailed clinical history, age, sex, duration of hypertension, other cardiac disease etc.detailed clinical examination, BP Recording: systolic and diastolic readings were measured in the right arm with mercury sphygmomanometer with subjects in sitting position, as per the first and fifth korotkoff phases.Height and weight was recorded, resting 12 ECG was done with Philips Page writer TC 20 &routine biochemical tests including RBS, blood urea, serum creatinine, lipid was done.
Assessment of LA size by echocardiography The size of the LA is determined from the PLAX view at End systole The convention for M mode measurement is to measure from the leading edge of the Posterior Aortic wall to the leading age of the posterior LA wall ,However the trailing edge of posterior Aortic wall is recommended.
Biplane area- length method for measurement of LA volume: Orthogonal apical views, apical four and two–chamber views are obtained for determination of LA area and length. The length is determined from the middle of the plane of mitral annulus to posterior wall. Left atrial volume is calculated on the basis of the algorithm $0.85 \times A1 \times A2 \div L$; where A1 and A2 are the areas of LA in four and two chamber views and L is the shortest of the lengths obtained from the orthogonal views and indexed to body surface area.
Measurement of left ventricular diameter and LV mass by M-Mode echocardiography Distance between the left side of the IVS and the posterior left ventricular endocardium at the level of chordae tendinae. LVID was measured both in systole and diastole. Septal wall thickness of IVS: distance between the anterior right septal echo and the anterior left septal echo at end diastole. Posterior wall thickness: distance between the anterior endocardial echo and the anterior surface of the epicardial echo at the beginning of QRS.LV mass calculate as per Modified cubed formula: LV mass (g) = $1.04\ [(LVID+ST+PWT)^3 - LVID^3] \times 0.8+0.6$ Where 1.04 is specific gravity of myocardium.
Assessment of LV diastolic function by Doppler echocardiography was done and following parameters were measured1) early filling peak velocity (E), atrial filling peak velocity (A), E/A ratio 4) Deceleration time (DT) & E/A ratio during Valsalva maneuver.
Study variables: Age, Sex, Height/weight, SBP, DBP, Duration of hypertension
Outcome variables: LA Size, LV mass, Grade of Diastolic dysfunction, Ejection fraction
Confounding variables: Sex, cardiac pathology other than hypertension.

Sample Size was calculated using G* power 3.1.9.2 software.
Mostellar formula: BSA (m2**)** =square root of {(height in cm x weight in kg)/3600}
LA Index (cm/m2) = LA (cm) / BSA (m2)
EF (%) = EDV-ESV/EDV X 100

All data were compiled in Microsoft excel charts and summary measures like mean and standard deviation were calculated for continuous variables.

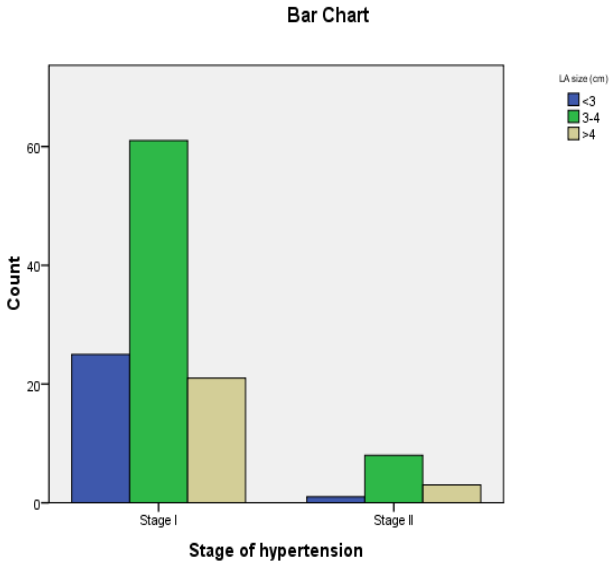
Statistical methods: Quantitative student t test were applied to assess the significance of difference between means of two independent groups' cases and controls for following comparisons.LA Size of cases and controls, LA index of cases and controls, LA Volume of case and controls, LV Mass of cases and controls, LV index of cases and controls, Grading of diastolic dysfunction was done.
Test of significance:
Chi Square test: This was done to find out significance of difference observed between two variables in following steps :a) First expected proportion of cases calculated from the observed.
b) Then X^2 was applied as $\mathbf{X^2=\sum \frac{(O-E)^2}{E}}$
Pearson correlation coefficient (r) was calculated for studying the relationship between two continuous variables, the significance of which was tested with t test. Correlation of LA size with LV mass, LAVI, and LVID was done
P value of **0.05** was considered as significant.
Result and observations: Total number of cases taken was 119, Out of which 75 cases (63%) were males and 44(37%) were females, ratio of male to female was **1.7:1**.
LA enlargement was present in 75 patients & LVH by echo criteria was present in 62 cases.
Mean Age of patients with LA enlargement was 55.96 years as compare to 54.34 years in patients with normal LA size. The mean age of hypertensive subject's with LVH was 58 years and that of hypertensive patients without LVH was 51 years.

Graph and Table 1: Assosiation of LA size with SBP & DBP

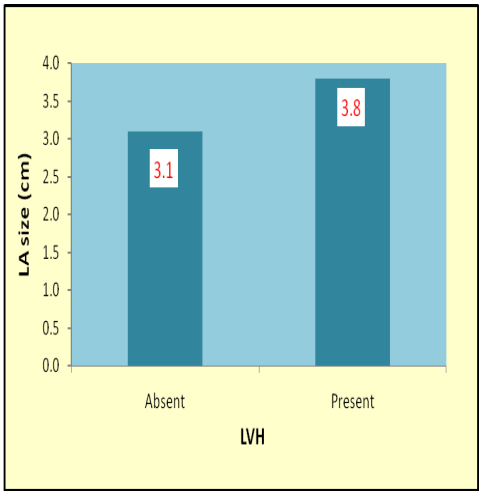


In present study mean Diastolic BP was 82.mmHg and with enlarged LA size was 86.0mmHg, whereas mean SBP was 133.81mmHg in patients with normal LA Size and 142.82 mmHg in patients with enlarged LA size. Comparison of BP between LA sizes was performed using students t test, no significant difference was noted in diastolic BP, while systolic BP was found to be significantly higher in cases with LA enlargement (<0.0001).

Graph & Table 2: Association of LA size with stage of hypertension



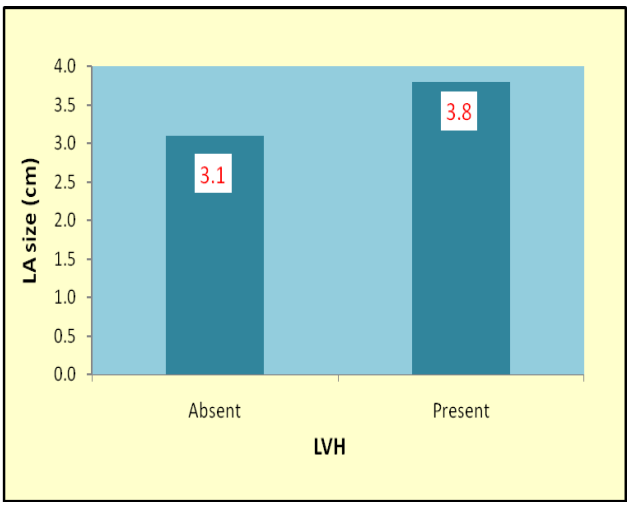
	LA Size	No. of patients	Mean BP (mmHg)	Std. Deviation	Std. Error Mean	t	df	P value
Systolic	Normal	44.00	133.81	14.95	1.54	-3.08	44.35	0.0001
	Enlarged	75.00	142.80	12.42	2.48			
Diastolic	Normal	4.00	82.87	8.55	0.88	-1.54	36.00	0.13
	Enlarged	75.00	86.00	9.13	1.83			



A positive correlation was found between LA enlargement and systolic blood pressure.
It suggests that in both men and women, a stepwise increase in prevalence of left atrial enlargement occurred with increasing levels of SBP.

In present study mean LA size by linear dimensions of patients without LVH was 3.1 cm and with LVH was 3.8 cm.
Subjects with LVH and without LVH were compared for LA size using student's t test.
LA size was found to be significantly higher in LVH subjects compared to those without LVH ($p<0.0001$).

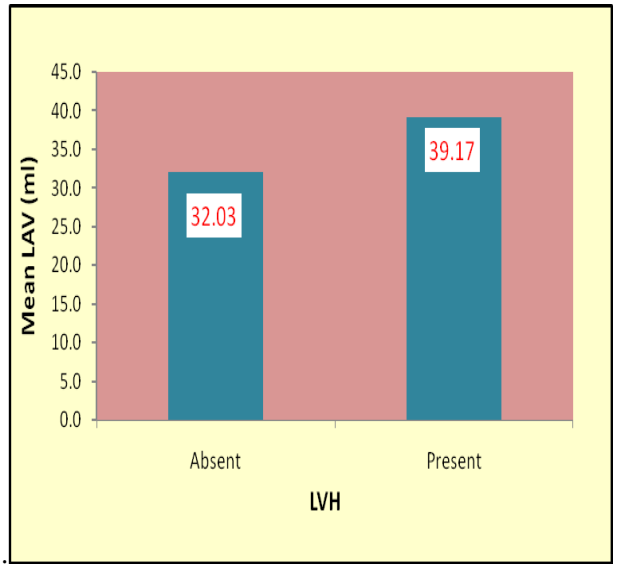
Graph &Table 3: Comparison of LA in subjects with and without LVH



LVH	No. of patients	Mean LA size (cm)	S.D.	Std. Error Mean	P Value
Absent	57.0	3.1	0.5	0.1	<0.0001
Present	62.0	3.8	0.6	0.1	

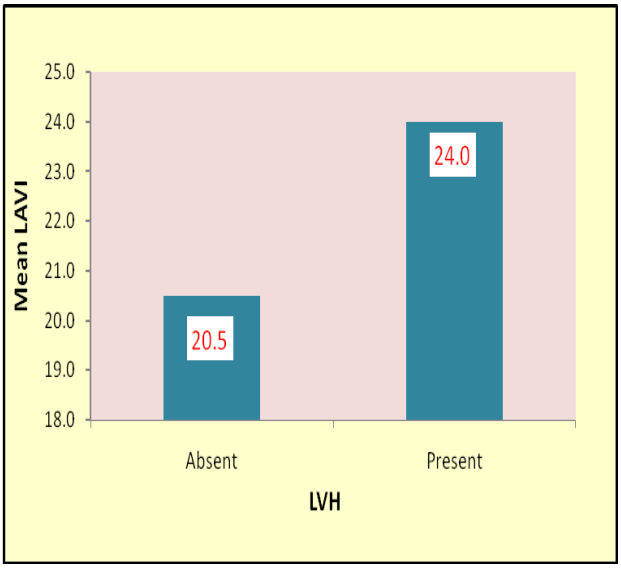
Mean LA Volume (using Biplane area method) of patients without LVH was 32.03 ml and with LVH was 39.17 ml.
Subjects with LVH and without LVH were compared for LAV (left atrial volume) using student's t test.
Significant higher levels of LAV was noted in LVH with respect to than those without LVH($p<0.001$.

Graph & Table 4: Comparison of LAV in subjects with and without LVH



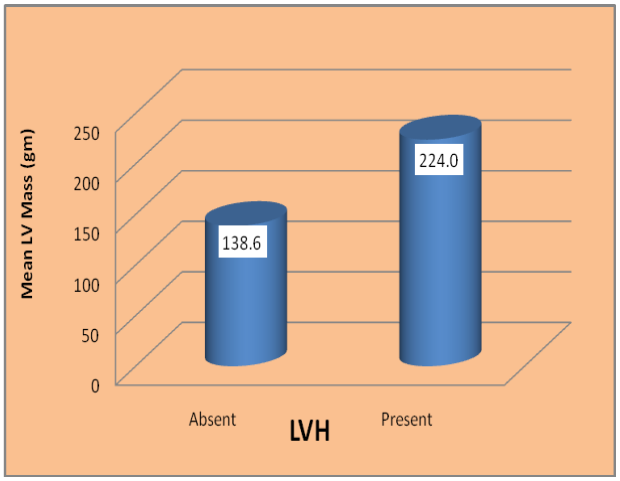
LVH	No. of patients	Mean LAV (ml)	S.D.	Std. Error Mean	P Value
Absent	57.0	32.03	7.31	0.96	<0.0001
Present	62.0	39.17	9.82	1.24	

Mean LA Volume Index of patients without LVH was 20.5 Cm/ m^2 and in patients with LVH Mean LA Volume Index were 24.0 Cm/ m^2.
Subjects with LVH and without LVH were compared for LAVI using student's t test.
LAVI was found to be significantly higher in LVH subjects compared to those without LVH ($p<0.001$).
Suggesting that LA size, LA volume and LAVI all had significant positive correlation with LVH.
Table: Comparison of LAVI in subjects with and without LVH



LVH	No. of patients	Mean LAVI Cm/ m^2	S.D.	Std. Error Mean	P Value
Absent	57.0	20.5	5.1	0.7	0.001
Present	62.0	24.0	6.4	0.8	

In the present study left ventricular mass was significantly increased among hypertensive subjects with LVH. Mean left ventricular mass was 138.06 ±42.1gm in control group (Hypertensive's without LVH) whereas 224 ± 76.1 gm in hypertensive's with LVH cases. This difference was statistically significant. (P<0.000 1).
Our study suggests that there is significant positive correlation between LVH and LVH.
Table: Comparison of LV mass in subjects with and without LVH



In the present study also there was statistically significant positive correlation between left atrial size and left ventricular mass (r=0.501; P < 0,000 1).It was found that strong uphill correlation (r=0.646) existed between LA size and LAVI, while week uphill correlation existed between LA size and LVID (r=0.395), septal thickness (r=0.436) and LV mass (r=0.501). Suggesting that increase in LA size also results in increase in LA Volume.
Weak correlation was found to exist between LAVI and LV mass (r=0.244), this absence of correlation was statistically significant (p=0.007).Suggesting that increase in Left atrial volume can occur in the absence of LVH.

III. Discussion & conclusion:

A positive correlation was found between LA enlargement and systolic blood pressure.
It suggests that in both men and women, a stepwise increase in prevalence of left atrial enlargement occurred with increasing levels of systolic blood pressure and pulse pressure, irrespective of the gender.
LA size, LA volume and LAVI all had significant positive correlation with LVH, and there is significant positive correlation between LVH and LV mass.
The mean LA size (mm) and LV mass (gms) was found to be significantly increased amongst the hypertensive subjects with LVH as compared to compared to those without LVH.
The LA size was found to be more in stage 2 hypertensive's as compared to stage 1 hypertensive's, though not statistically significant. The reason for this statistical insignificance might be the small sample size of the study and the small number of cases in stage I hypertension.
Similarly LAV index of subjects with stage 2 hypertension was greater as compared to those with stage 1 hypertension, though the difference was not statistically significant.
The findings in our study indicate that echocardiographic assessment is simple, non invasive, reproducible, **safe and easily available tool to identify large percentage of asymptomatic hypertensive subjects who have left atrial enlargement, left ventricular hypertrophy, left ventricular diastolic dysfunction before abnormalities detected by clinical examination.**
Left Atrial Enlargement is a frequent finding in patients with preserved systolic function seen in current practice; this abnormality is strongly related to Left ventricular hypertrophy.
The Left atrial size is directly correlated with the Left ventricular hypertrophy (reflected by LV mass).
Early detection of Left atrial enlargement may identify patients at higher cardiovascular risk and promote appropriate prevention strategies. Adopting volume measurements for the Left atrial enlargement may result in increase in the number of patients reported as having Left atrial enlargement.
The lower LVMI found in these patients suggests that volume-based measurements are more sensitive and detect Left atrial enlargement at an earlier stage than diameter-based measurements.
Limitation of the study: The sample size of the study was small. Most of the cases were on one or more antihypertensive drugs which might have created a bias as per segregation of cases in stage 1 and 2 of hypertension were considered. As the exact onset of hypertension could not be pointed out, we haven't

correlated any of the parameters with the duration of hypertension. Echocardiography is operator dependent making the measure less reproducible than CT or MRI. Follow up of patients with increased LAVI is needed to confirm the Predictive value of LAVI for future hypertension.

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