Evaluation of Left Atrial Size in Patients with Hypertension with Left Ventricular Hypertrophy in a Tertiary Care Hospital of Nepal

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Abstract

Background: The hypertensive heart disease is characterized by left ventricular hypertrophy (LVH), atrial remodeling and AF. The impact of hypertension on the left atrium is little known. LVH is a link between hypertension and left atrium enlargement (LAE). LAE raises the suspicion of increased BMI, DM, dyslipidemia in hypertension. Thus, the aim of this study is to evaluate the LA size hypertensive patients without metabolic disorder and to evaluate whether there is a relationship between LVH and LAE.

Methods: This is a prospective, observational study conducted in SGNHC, Kathmandu, Nepal. Our Study included 91 hypertensive patients fulfilling inclusion criteria from August 2021 to January 2022.

Results: 91 patients were enrolled for the study, out of which 50 (54.9%) were males and 41 (45.1%) were females. Mean age of patients was 47.77±12.1 years. 23(25%), 28(31%) and 40 (44%) patients fulfilled SV3+RaVL, SV1+RV5, RaVL criteria respectively of LVH. 10(11%),12 (13%) and 25(27.5%) satisfied the criteria of LVMI, IVSD, RWT respectively. The mean values of LA diameters, area, volume and volume Index were calculated. There were a significant associations between left ventricular internal diameters and age with LAVI (p-value <0.05). There was a mild positive association between SBP more than 140mm of Hg and LAVI, although not significant statistically. Similarly, there was a significant association between increased BMI above 25 and LAVI more than 34.

Conclusion: LAE is associated with LV diameter, age, BMI and SBP.

Key words: LA volume index (LAVI), Left Ventricular internal diameter (LVID), Left ventricular Hypertrophy (LVH)

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Introduction:

Worldwide, 1.28 billion persons between the ages of 30 and 79 are projected to have hypertension, with the majority (two-thirds) residing in low- and middle-income nations. According to estimates, 46% of persons with hypertension are asymptomatic. It is diagnosed and treated in 42% of cases only[1].

The spectrum of hypertensive heart disease is characterized by left ventricular hypertrophy (LVH), atrial remodeling and atrial fibrillation. Although the impact of hypertension on the left ventricle has been thoroughly researched, little is known about the impact on the left atrium. Left ventricular (LV) hypertrophy and coronary heart disease (CHD) mortality have been linked, according to research[2].

Increased LV mass as detected by echocardiography is a strong independent predictor of cardiovascular morbidity in hypertension. Age, body weight, the duration of atrial fibrillation, LV mass, annular calcification, the severity of coronary artery disease, and hypertension have been related to left atrium (LA) size in previous studies[3].

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LA volume is a marker of left ventricle (LV) diastolic dysfunction severity and duration. Increased LA volume is mainly the result of impaired LV filling. In patients with hypertension, the latter is a consequence of LV hypertrophy and remodeling. It has been suggested that LV hypertrophy is a link between hypertension and left atrium enlargement. Furthermore, LA enlargement caused by hypertension is often detected earlier than LV hypertrophy or dilatation in the course of hypertensive heart diseases[4].

In addition, the presence of left atrial enlargement is associated with increased body mass indexes, smoking, diabetes mellitus, dyslipidemia in hypertensive patients[5].

Thus the aim of the present study is to evaluate the LA size in diagnosed hypertensive patients without the history of metabolic disorder and to evaluate whether there is a relationship between LV hypertrophy and LA size among patients meeting the inclusion criteria.

Study Methodology

This study is a hospital based, cross-sectional, prospective study conducted at Shahid Gangalal National Heart Centre (SGNHC), Kathmandu, Nepal from August 2021 to January 2022 (6 months). Informed consent was taken prior to enrolment in the study. After approval from Institutional review board (IRB) of National Academy of Medical Sciences (NAMS), Bir hospital, 91 patients who fulfilled inclusion criteria were enrolled. We performed office blood pressure measurements twice on the non-dominant arm after 10 minutes of rest using Omron M5-I device (Omron, Kyoto, Japan) and results was averaged. Systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse pressure (PP SBP –DBP) and MAP was determined.

A 12-lead ECG and simultaneous rhythm strip was recorded at 25mm/s with a gain setting of 10mm/mV.The ECG (Sokolow- Lyon, Cornell voltage and RaVL criteria) was applied to calculate the size of LV. Those patient fulfilling ECG LVH criteria were further enrolled for echocardiography. Echocardiographic assessment was performed by using Vivid 7 ultrasound system (General Electric Healthcare, Milwaukee, WI) equipped with a harmonic 1.7 to 3.4 MHz variable frequency phased-array transducer. LV mass and LVMI was calculated by using Devereux formula. LA volume was measured using the modified Simpson's method using apical 2- and 4-chamber views at end systole of the LV. Left Atrial Volume Index was calculated as LA volume/body surface area.

The data was collected by questionnaire at OPD, ER and ward by the principal investigator. The patient's detailed history, physical examinations, and required investigation was recorded in structured proforma.

Inclusion Criteria

All hypertensive patients with age > 18 years were included in the study.

Exclusion Criteria

1. The patient with coronary artery disease (CAD)
2. The patient under treatment with congestive heart failure
3. The patient with cardiomyopathy or arrhythmia
4. Valvular Heart disease
5. Known case of diabetes mellitus

Statistical Methods

All data were collected and checked manually. Data were entered into an electronic spread sheet (Microsoft Excel, Redmond) and the statistical analysis was done by using the SPSS version 26 software. All categorical variables were expressed in frequency and percentage. For numerical data, normality was checked by using visual inspection of Histograms, Q-Q plots and Shapiro Wilk test. All normal numerical data were presented in a mean±SD. For association, Karl Pearson correlation coefficient was computed and interpreted. Chi-square test was performed for categorical data. Processing of all available information and statistical analysis of their significance was done. For the purpose of this study a 95% confidence interval was accepted.

Results:

Among 91 patients, 50 (54.9%) were males and 41 (45.1%) were females. Mean age of patients was 47.77±12.1 years. Majority of them were asymptomatic 41 (45.1%) that was followed by presenting symptoms of headache 31(34.1%), palpitation 10 (11%), Shortness of breath 5(5.5%), chest pain 3(3.3%), pedal edema 1(1.1%) respectively. Majority of patients were taking CCB+ ARB i.e. 53 (58.2%) that was followed by amlodipine 24 (26.4%). The mean systolic, diastolic BP and MAP was found to be 154.03, 95.48 and 114.83 mm of Hg respectively

(Table 1). The mean BMI of patients was found to be 25.5. 51(56%) had BMI 25 and above. 23(25%) patients fulfilled SV3+RaVL criteria of LVH. 28(31%) satisfied SV1+RV5 criteria. 40 (44%) patients fulfilled RaVL criteria. 10(11%) satisfied increased LVMI criteria.12 (13%) satisfied IVSD more than 0.9(female) and more than 1(male). RWT 0.42 and above were 25(27.5%). The mean EF of the patients was found to be 65.55%. The mean values of LA longitudinal diameter (in cm), LA transverse diameter (in cm), LA surface area (in cm2), LA volume Biplane (in ml) and LA Volume Index (ml/m2) were 4.4, 3.2, 13.8, 36.2 and 20.9 respectively (Table 2). There was no any significant association between ECG LVH criteria and LA volume index. There was significant association between left ventricular internal diameter in systole and diastole with left atrial volume index (p-value <0.05) but no association was seen between IVSD, LVMI and RWT with left atrial volume index (Table3). There was a significant association between age and LAVI with p-value 0.008 (Table 4). There was a mild positive association between SBP more than 140mm of Hg and LAVI, although not significant. Similarly, there was a significant association between BMI 25 and above and LAVI more than 34 with p-value 0.046.

Table-I

Blood Pressure Measurement (n=91)

	Minimum	Maximum	Mean	Std. Deviation
Systolic Blood Pressure (in mm of Hg)	110.00	197.00	154	17.6
Diastolic Blood Pressure (in mm of Hg)	70.00	117.00	95.5	9.7
Mean Arterial Pressure (in mm of Hg)	83.00	137.00	114.8	11.4

Table-II

Descriptive statistics of left ventricular size (n=91)

	Minimum	Maximum	Mean	Std. Deviation
LA longitudinal diameter (in cm)	3.00	6.00	4.4	.6
LA transverse diameter (in cm)	2.100	4.300	3.2	.46
LA surface area (in cm2)	7.80	21.00	13.7	3
LA volume Biplane (in ml)	16.00	80.00	36.2	13.5
LA Volume Index (ml/m2)	10.00	48.00	20.9	8

Table-III

Correlation between Left Ventricular statistics and LA Volume index (n=91).

Left ventricular statistics		LA Volume Index (ml/m2)
Interventricular Septal Diameter End Diastole (in cm)	Pearson Correlation	-.038
	p-value	.719
Left ventricular internal diameter end systole(in cm)	Pearson Correlation	.244*
	p-value	.020
Left ventricular internal diameter end diastole (in cm)	Pearson Correlation	.231*
	p-value	.028
Relative Wall Thickness	Pearson Correlation	-.175
	p-value	.096

*. Correlation is significant at the 0.05 level (2-tailed).

Table-IV

Correlation between Age of the patients and LA Volume index (n=91).

		LA Volume Index (ml/m2)
Age of the patients (in years)	Pearson Correlation	.278**
	p-value	.008

** Correlation is significant at the 0.01 level (2-tailed).

Chi-Square Test

		LA Volume index above 34		Total	Chi-square value	p-value
		35.00	42.00			
BMI 25 and above	27.60	0	3	3	4.0	0.046
	29.00	1	0	1		
Total	1	3	4			

Discussion:

Left atrial enlargement is risk factor for atrial fibrillation, embolism and death. Left atrial size is regarded as reflection of the average effect of left ventricular filling pressure against the LA over time and it has been proposed as marker of diastolic burden[14].

In a study conducted in Nepal concluded that the Left Atrial Size correlates significantly with the Left Ventricular Mass Index. In addition, the presence of left atrial enlargement was predominantly seen among patients with increased BMI, DM, dyslipidemia[5]. LA diameter was assessed as an indicator of LA enlargement in this study. However, associations among increasing age and BMI with increased LA volume index is similar findings in our study as well.

A study in Japan to find out the factors affecting LVMI in hypertensive patients concluded that Left ventricular volume and mass are independent factors affecting LAVI. The incidence of PAF is associated with LA size. LA size may be useful surrogate marker for monitoring the effectiveness of medical therapy and occurrence of AF. In this study, LA volume index is not associated with BP,BMI and age but left atrial volume index has positive correlation with left ventricular volume, LVMI[6].In our study, we have excluded the patients with AF, there was a mild correlation of BMI and SBP more than 140 with left atrial volume index. Similar to the findings of the study in Japan, LAVI is associated with left ventricular systolic and diastolic diameter. In contrast to this, LVMI is not associated with LAVI in our study. Most of the patients in our study were taking ACEI/ARB as antihypertensive that have tendency to reduce LAVI as per the same study findings.

According to Rojek et. al., LV mass and function are the main determinants of LAVI. However, in persons with lower LV mass, LAVI depends on the steady component of blood pressure, but not pulsatile one. Increased LAVI reflects early changes in response to systemic blood pressure elevation[4]. To the contrary, in our study, LVMI is not found significantly associated with LAVI. Also, there is a mild association between SBP more than 140 mm of Hg but not statistically significant.

According to Meel R et. al., there is no significant differences in the maximum and minimum LAVI among different age categories[8]. This study was conducted among normal population but our study is conducted among hypertensive patients so hypertension itself could be the risk factor for abnormal LAVI.

According to recent study published in European Heart Journal 2021 showed that LAV is significantly increased in patients with high BMI[9]. This study was conducted among normal population without having hypertension. In our study, there is a significant association between BMI more than 25 and LA volume index more than 34ml/m2. Such association may be either due to hypertension itself or may be due to confounding effect of increased BMI.

According to Seko Y. et. al., 2021 showed that patients with both ECG-based and echo-based LVH cases in only 4.1% of cases applying LVMI more than 95 gm/m2 in female and more than 115 gm/m2 in

male[10]. Similar to our study where only 10 (11% patients) satisfied increased LVMI criteria for male and female.

In a study published in ESC heart failure Journal in 2021 showed that in patients with heart failure with preserved Ejection fraction , only age atrial fibrillation NT-proBNP and LVMI were associated with LAVI[11]. But in our study LAVI is not associated with increased LVMI. The study designs of both studies are different as in this study patient with heart failure were enrolled but that were excluded in our study.

A recent study showed that LA volume index was superior to LA diameter index. LA volume index had independent prognostic implications in terms of coronary heart disease prediction in hypertension patients with preserved left ventricular ejection fraction[12]. Even though the study design is different from our study, LAVI was taken as the major indicator of LA enlargement in our study.

Limitations

Our study is single centered hospital based study with sample size of 91. Most of the enrolled patients in our study were newly diagnosed hypertension and had no any hypertensive complications. Two dimensional echocardiography modality was used in our study.

Conclusion:

LA enlargement in hypertension is significantly associated with age and increased LV diameter. There is a mild association with SBP More than 140 mm of Hg and BMI 25 and above though not statistically significant. There was no significant association between LVMI and LAVI.

Conflict of Interest: None

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