Original Research Article

Regression of LVH after anti-hypertensive treatment in patients with mild to moderate hypertension

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Abstract

Hypertension remains the most common predisposing factor for cardiac failure, and the presence of electrocardiographic evidence of left ventricular hypertrophy magnifies this risk. Echocardiography provides a more accurate and sensitive means of detecting left ventricular hypertrophy than electrocardiography. This diagnostic technique therefore permits the identification of more subtle cardiac involvement, which nevertheless has prognostic importance. Echocardiography has the added advantage of providing information on the structure and function of the heart. A sustained reduction in arterial pressure leads to regression of left ventricular hypertrophy, with maintenance of or improvement in left ventricular function. Although improvement in clinical outcomes has been associated with echocardiographic evidence of regression of left ventricular hypertrophy, there is no solid evidence of an independent benefit beyond blood-pressure control in terms of morbidity or mortality. Left ventricular adaptation to hypertension can present with any of the geometric patterns. The hemodynamic predominance between pressure and volume overload plays an important role in the determination and development of various LV geometric patterns. Concentric remodeling tends to occur early in hypertension due to pressure overload but the left ventricular mass is normal while eccentric hypertrophy is due to volume overload with increased left ventricular mass which cannot be picked up by electrocardiography. The present study observed echocardiography is the best tool to detect LVH as target organ damage in hypertension as compared to surface ECG. Our study showed that in concentric remodeling, chamber dimensions were smaller with reduced stroke volume, cardiac output and increased heart rate compared to the other geometric patterns. The present study results suggest that this procedure could significantly improve cardiovascular risk stratification in those patients with multiple risk factors, with evidence of early detection of target organ damage by detecting LVH by Echocardiography. It requires further more follow ups to comment on the morbidity and mortality benefits with control of hypertension and degree of regression of LVH in hypertensive patients.
Key Word: Hypertension, Left ventricular Hypertrophy, Anti hypertensive treatment effect

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INTRODUCTION

Increased left ventricular (LV) mass is a recognised complication of systemic hypertension and has been shown to be an important predictor of cardiovascular morbidity and mortality in hypertensive patients[1]. Several studies have shown the significance of left ventricular geometry in hypertensive. Hypertension remains the most common predisposing factor for cardiac failure, and the presence of electrocardiographic evidence of left ventricular hypertrophy magnifies this risk. All the clinical squeal of coronary artery diseases are worsened in patients with evidence of left ventricular hypertrophy on electrocardiography, and there is a six fold increase in the likelihood of sudden death from cardiac causes. The basis for these risks has been intensively investigated. Although there is an increased prevalence of complex ventricular dysrhythmias in patients with

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electrocardiographic findings of left ventricular hypertrophy and repolarization abnormalities, electrophysiologic testing has not identified sustained ventricular tachycardia (2-5). Evidence indicates that the increased risk of sudden death is most likely related to myocardial ischemia, which is common in such patients. Myocardial fibrosis is also commonly associated with electrocardiographic findings of left ventricular hypertrophy, and it is believed to contribute to the heightened risk of sudden death. Echocardiography provides a more accurate and sensitive means of detecting left ventricular hypertrophy than electrocardiography. This diagnostic technique therefore permits the identification of more subtle cardiac involvement, which nevertheless has prognostic importance. In 1979, the Framingham Heart Study incorporated echocardiography into the assessment of risk and subsequently demonstrated the prognostic importance of increased left ventricular mass. Echocardiography has the added advantage of providing information on the structure and function of the heart. A sustained reduction in arterial pressure leads to regression of left ventricular hypertrophy, with maintenance of or improvement in left ventricular function (6-8). Although improvement in clinical outcomes has been associated with echocardiographic evidence of regression of left ventricular hypertrophy, there is no solid evidence of an independent benefit beyond blood-pressure control in terms of morbidity or mortality. Several clinical trials designed to address this issue are now in progress. Currently, the data regarding the ability of various antihypertensive agents to decrease left ventricular hypertrophy are limited and not sufficiently convincing to support the preferential use of one class of antihypertensive agents in patients with left ventricular hypertrophy. Until such evidence is produced, the extent of the reduction in blood pressure must be regarded as more important than the type of antihypertensive agent used. As a practical matter, since many patients require several antihypertensive agents for optimal control of blood pressure, the relative merits of each agent become less important.

The importance of blood-pressure reduction, which is critical for the prevention and possibly also the regression of left ventricular hypertrophy, cannot be overemphasized. However, concern has again been recently expressed regarding complacency among physicians in initiating and maintaining reductions in blood pressure in patients with hypertension. The results of the Framingham Heart Study underscore the necessity for physicians to remain vigilant in their treatment of hypertension and modification of other risk factors. Despite all the major medical advances that have occurred during the first 50 years of the Framingham Heart Study, preventing cardiovascular disease through multifactorial modifications of risk factors continues to be the most effective approach. Three patterns of left ventricular hypertrophy have been identified. These patterns depend on left ventricular mass index (expressed in g/m2) and relative wall thickness[9]. Left ventricular hypertrophy is independently associated with increased incidence of cardiovascular disease, cardiovascular and all-cause mortality[10] and stroke[11]In a quantitative analysis of 17 studies involving 20 000 patients, the adjusted odds ratios for morbid events among patients with left ventricular hypertrophy compared with those without this condition ranged from 1.4 to 5.4[12]. Among patients with essential hypertension, the risk for death and morbidity is higher among those with concentric left ventricular hypertrophy than among those with eccentric hypertrophy or concentric remodelling[13]. Diminished coronary vasodilator reserve, increased myocardial oxygen demand, sub endocardial ischemia, lethal arrhythmias, and diminished ventricular performance may explain the increased risk associated with left ventricular hypertrophy[14]. Non pharmacologic interventions, such as weight reduction, sodium restriction, and aerobic physical exercise[15], can reduce left ventricular mass. In patients with essential hypertension, effective blood pressure control is the most important intervention to reduce left ventricular mass[16]. In a subset analysis of 104 patients from the Systolic Hypertension in the Elderly Program, a diuretic based regimen significantly reduced left ventricular mass index[17]. In severe pressure elevation the problems of stroke and cardiac failure dominate. Framingham data showed that hypertension was the most common cause of heart failure, but this reflects the poor detection and treatment of hypertension 30–50 years ago. Hypertension is now second to ischemic heart disease as a cause of heart failure.4 However, the two conditions frequently co-exist. High pressure initially induces useful compensatory hypertrophy but later decompensation results in heart failure. Myocardial infarction may also play an important part in this decompensation. Among patients with essential hypertension, the risk for death and morbidity is higher among those with concentric left ventricular hypertrophy than among those with eccentric hypertrophy or concentric remodelling morbid events in patients with progression of left ventricular hypertrophy was 13% to 59% compared with 7% to 12% in patients with regression of left ventricular hypertrophy[11]. Diminished coronary vasodilator reserve, increased myocardial oxygen demand, sub endocardial ischemia, lethal arrhythmias, and diminished ventricular performance may explain the increased risk associated

with left ventricular hypertrophy[14]. Non pharmacologic interventions, such as weight reduction, sodium restriction, and aerobic physical exercise[15,16] can reduce left ventricular mass. In patients with essential hypertension, effective blood pressure control is the most important intervention to reduce left ventricular mass[16]. It is suspected that different antihypertensive medications have disparate effects on left ventricular mass, independent of reduction of blood pressure. In a meta-analysis of 39 clinical trials performed through June 1995, the use of angiotensin-converting enzyme inhibitors, calcium-channel blockers, diuretics, or b-blockers was associated with respective reductions in left ventricular mass of 13%, 9%, 7%, and 6% [17]. In a recent trial, patients whose blood pressure was adequately controlled while receiving monotherapy with captopril, hydrochlorothiazide, or atenolol showed reduction in left ventricle mass, but those receiving diltiazem, clonidine, or prazosin did not[18]. Substantial evidence exists for a relation between inflammatory markers, and procoagulant substances and vascular disease.

SELECTION OF CASES AND METHODOLOGY

The cases for present work were selected from outdoor and patients admitted in the Department of Medicine and Cardiology at D.Y. Patil Hospital Nerul, Navi Mumbai.

Inclusion Criteria

- Mild to Moderate hypertension without any complication: The patients of mild to moderate essential hypertension were selected according to Seventh Joint National Committee on Prevention, Detection, Evaluation and Treatment of high blood pressure of Stage I (mild) i.e. systolic blood pressure range from 140-159 and diastolic blood pressure range from 90-99 and Stage II (moderate) i.e. systolic blood pressure >160 and diastolic blood pressure >100
- No secondary hypertension.

Exclusion Criteria

1. Clinical, Radiological or ECG evidence of LVH.
2. Patients with history of coronary artery disease or vascular heart disease.
3. Patients were included only after consent had been obtained after detailed explanation of the nature and
4. purpose of the investigation.

After having recorded the history and physical examination findings the cases were subjected to routine laboratory investigations and some special investigations. Electrocardiogram and X-ray chest were done to exclude LVH before sending the patients for Echocardiography. Echocardiography performed on first day and repeated at the end of 4 months and 6 months of anti-hypertensive treatment of the patients. Echocardiography: Echocardiographic examinations were done with the patient in partial left lateral decubitus position using an Aloka SSD 1700 machine (Aloka Co. Ltd., Tokyo, Japan) with 3.5 MHz transducer. Two-dimensional guided M-mode measurements were obtained as recommended by the American Society of Echocardiography. Two experienced physicians performed the echocardiography. Left ventricular mass (LVM) was calculated using the formula that has been shown to yield values closely related ($r = 0.90$) to necropsy LV weight (Devereux-modified ASE Cube formula). LV mass (g) = 0.8 (1.04 (IVSd + LVIDd + PWTd) 3 - LVIDd3) + 0.6 Left ventricular mass was indexed by the allometric power of height. Left ventricular hypertrophy (LVH) was considered present if the left ventricular mass index $\geq$ 46 g/m2.7 (i.e. 2 standard deviations above the mean value for LVMHt2.7 in the control group). Relative wall thickness (RWT) was calculated as 2 × PWTd/LVIDd. Increased relative wall thickness was present when RWT $\geq$ 0.45. LV geometry was defined using RWT and LV mass index (LVMI).

RESULTS

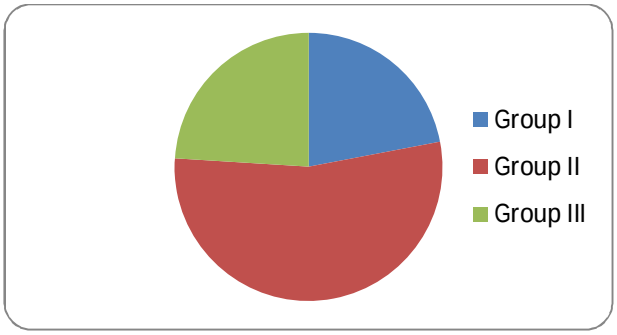

Figure 1: shows the age wise distribution of the study participants

Table 2: Distribution and statistical significance of LV Mass Index (LVMI IN g/m^2) in different age groups at different levels of treatment

Age group	level of treatment	Range	Mean	± SD	± SE	Mean FALL
25 - 45	i) INITIAL LVMI	82 – 213	118.82	35.78	10.79	
	ii) LVMI AFTER 4 MONTHS	74 – 156	95.27	23.20	6.99	**23.55**
	iii) LVMI AFTER 6 MONTHS	81 – 120	93.36	11.46	3.45	**25.46**
46 - 60	i) INITIAL LVMI	85 – 167	126.59	20.88	4.02	
	ii) LVMI AFTER 4 MONTHS	73 – 134	102.44	14.51	2.79	**24.15**
	iii) LVMI AFTER 6 MONTHS	75 -113	93.04	10.95	2.11	**33.56**
61 - 80	i) INITIAL LVMI	91 - 60	129.33	20.66	5.96	
	ii) LVMI AFTER 4 MONTHS	79 – 132	102.67	17.42	5.03	**26.66**
	iii)LVMI AFTER 6 MONTHS	**75 – 122**	**93.83**	**13.46**	**3.89**	**35.50**

In the present study a substantial proportion [76% i.e. 38 out of 50] of mild to moderate hypertensive patients presenting in primary care with normal ECG and X-Ray Chest have LVH determined by ECHO. The study also showed that majority of patients [78.9% i.e.30 out of 38] on control of both systolic and diastolic blood tpressure shown significant regression of LVH after six months [$p < 0.0001$] of anti hypertensive treatment.

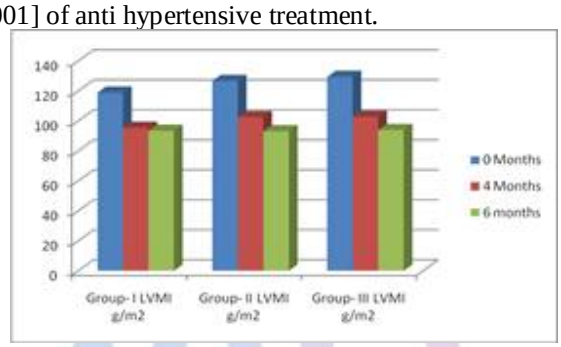

Figure 2: Effect of treatment on LVMI amongst three groups and the duration of the treatment

DISCUSSION

Adaptation of the left ventricle to systemic hypertension is complex and it is characterized by functional and structural changes in the left ventricle and diastolic dysfunction. The old concept that the heart responds to systemic hypertension by developing concentric or eccentric hypertrophy have been challenged by recent studies. Some authors have observed that age significantly affects left ventricular structure and geometric patterns. In one of the study 168 patients with hypertension and were grouped into 3 according to age (young <40, middle-aged and elderly >60). The result showed that the occurrence of normal geometry reduced with age while concentric hypertrophy and concentric remodeling increased with age. Left ventricular adaptation to hypertension can present with any of the geometric patterns. The hemodynamic predominance between pressure and volume overload plays an important role in the determination and development of various LV geometric patterns. Concentric remodeling tends to occur early in hypertension due to pressure overload but the left ventricular mass is normal while eccentric hypertrophy is due to volume overload with increased left ventricular mass which cannot be picked up by electrocardiography[16-18]. The present study observed echocardiography is the best tool to detect LVH as target organ damage in hypertension as compared to surface ECG. Our study showed that in concentric remodeling, chamber dimensions were smaller with reduced stroke volume, cardiac output and increased heart rate compared to the other geometric patterns. Various geometric patterns are also influenced significantly by LV systolic function parameters. Persistent pressure overload in concentric LV geometry with increased total peripheral resistance subsequently impair the systolic function[19,20]. LV mass reduction improves LV filling and mid-wall fractional shortening, decreases cardiovascular morbidity and mortality and increases coronary reserve. There fore a targeted therapy at LVH and abnormal LV geometry would be beneficial in management of hypertension. Since relative wall thickness and left ventricular mass indexation derived from echocardiographic measurements are necessary in determining left ventricular geometric pattern, echocardiographic evaluation of the newly diagnosed hypertensive should be an essential step in their initial workup. In view of the abnormal geometric alterations in newly diagnosed hypertensives noted in this study, longitudinal studies to determine the prognosis of abnormal LV geometry[21]. Our results suggest that this procedure could significantly improve cardiovascular risk stratification in those patients with multiple risk factors, with evidence of early detection of target organ damage by

detecting LVH by Echocardiography. It requires further more follow ups to comment on the morbidity and mortality benefits with control of hypertension and degree of regression of LVH in hypertensive patients.

LIMITATIONS:

Sample size is our limitation to comment on the choice of antihypertensive agent for LV mass reduction.

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