

Research Article

“Accuracy of Chest Radiography plus Electrocardiogram in Diagnosis of Left Ventricular Hypertrophy in Hypertension”

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Abstract: Left ventricular hypertrophy is an adaptive state of the heart to increase in wall stress. It is common in hypertension. The prevalence of Left ventricular hypertrophy increases with age and based on ECG criteria is nearly 10 times more common in patients with blood pressure of more than 160/90 mm hg than in normotensives. Furthermore the presence of LVH has important prognostic implications for patients with hypertension. Though echocardiography is superior to electrocardiography in detecting LVH in patients with hypertension, it is costly and not widely available in our country. Hence it is important to study the reliability of clinical signs, chest X-ray and electrocardiography in diagnosing LVH in hypertensive patients. **OBJECTIVES:** To identify the left ventricular hypertrophy in essential hypertension. Comparison of relative sensitivity, and specificity of echocardiogram, standard 12 lead ECG and chest roentgenography for detecting left ventricular hypertrophy in essential hypertension. To evaluate whether the association chest radiography-electrocardiogram provides the accuracy to justify its use in LVH detection in hypertension. Correlation of left ventricular hypertrophy and target organ involvement in hypertensive patients. **RESULTS:** Out of 200 patients, 88 had increased LVMI, by echocardiogram. Out of which 60 showed LVH in chest x-ray, 56 by ECG Sokolov Lyon criteria, 32 by ECG Romhilt Estes score. Target organ damage including Retinopathy was found in 80 patients, renal failure in 12 patients, TIA/stroke in 20 patients, cardiac failure in 20 patients with increased LVMI.

Keywords: Left Ventricular mass index; left ventricular hypertrophy.

INTRODUCTION:

The Prevalence of Hypertrophy Increases with the Severity of Hypertension

Left ventricular hypertrophy (LVH) is a powerful independent predictor of morbidity and mortality predisposing to heart failure, ventricular tachyarrhythmia, ischemic stroke, atrial fibrillation, and embolic stroke. (Victor, R.G. (2012) There are many ways of diagnosing left ventricular hypertrophy like ECG, chest X-ray and echocardiography having varied efficiency.

There are no well-coordinated national surveys of prevalence of hypertension available from Indian subcontinent. Several regional small surveys with varying protocols have reported a prevalence which varies widely from 6.15% to 36.36% in men and 2% to 39.4% in women in urban areas and 3% to 36% in men and 5.8% to 37.2% in women in rural areas.

Hence, this study is undertaken to compare the diagnostic efficiency of these methods in diagnosing LVH because, the best means of decreasing the increased mortality and morbidity is to prevent the development of LVH which requires early and continuous antihypertensive therapy even before the hypertrophy becomes clinically manifest.

AIMS AND OBJECTIVES:

1. To identify the left ventricular hypertrophy
2. Comparison of relative sensitivity and specificity of echocardiogram, standard 12 lead ECG and chest X-ray for detecting LVH in essential hypertension.
3. Correlation of left ventricular hypertrophy and target organ involvement in hypertensive patients.
4. To evaluate whether the association chest radiography-electrocardiogram provides the accuracy to justify its use in LVH detection in hypertension.

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METHODOLOGY

The study was carried out at Navodaya Medical College Hospital and Research Centre from November 2017 to October 2018. The study group consisted of 200 patients of both sexes with essential hypertension attending the outpatient clinic as well as those admitted in medical wards.

The study group consisted of patients of hypertension. All freshly detected and old cases of essential hypertension, irrespective of duration of hypertension and type of treatment receiving was taken into the study. The exclusion criteria were all cases of secondary hypertension, patients with previous ischemic heart disease either

Myocardial infarction or ischemic cardiomyopathy, congenital heart disease and patients with valvular heart disease. History, physical examination, chest X-ray, standard 12 lead ECG and twodimensional echocardiography was done for all patients.

The Following Clinical Information Was Obtained, Apart From Investigations.

- a. Duration of hypertension <5 years, 6-10 years, >11 years.
- b. Number and type of antihypertensive drugs.
- c. Standard cuff blood pressure in supine and standing.
- d. Body surface area.
- e. Cardiovascular examination: Site and character of apical impulse Character of heart sounds, Presence of abnormal heart sounds and murmurs.
- f. H/O stroke or recurrent transient cerebral ischemia.
- g. Ophthalmic examination for any evidence of hypertensive retinopathy
- h. Chest X-ray: PA view- to measure cardiothoracic ratio.
- i. 12 lead ECG: Sokolov –Lyon index and Romhilt – Estes point Score system.

RESULTS:

In this study 200 patients were included and were divided into two groups. Group I with normal Left ventricular mass index (LVMI) and group II with increased left ventricular mass index (LVMI). Out of 200 patients 88 patients had increased LVMI and 112 patients had normal LVMI.

TABLE-1: Correlation of left ventricular hypertrophy with age.

Age (years)	Patients N-LVMI (group-1)	Patients Increased LVMI (group-2)
41-50	38(17.9%)	10(4.5%)
51-60	30(50%)	35(54.5%)
>61	44(32.1%)	43(40.9%)
Total	112	88
Mean +SD	37.33±15.43	29.33±9.44

In this study more number of patients, 54.5 % (12) in group II and 50% (14) in group I are in the age group between 51-60 years. More number of females

i.e. 63.6 % (14) were found to have increased LVMI as compared to males 36.4 % (8), P<0.05, so statistically significant.

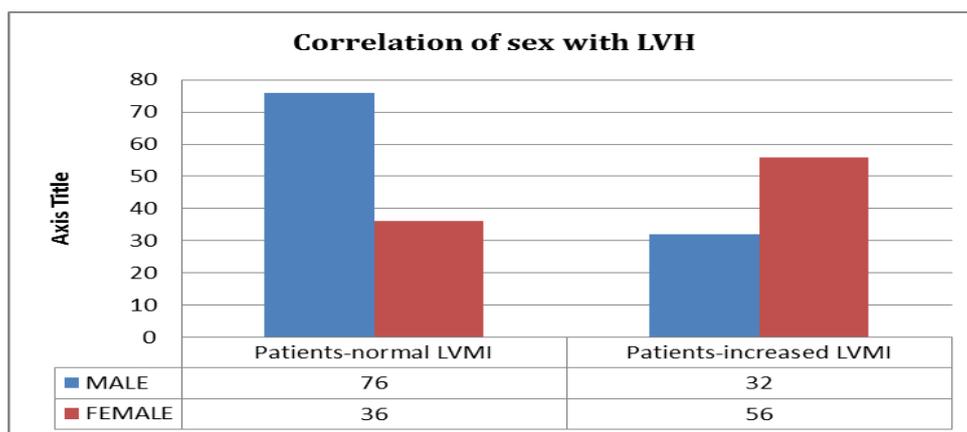


FIGURE-1: Correlation of sex with left ventricular hypertrophy.

More number of patients in Group I i.e. 46.4%(13) were found to have a duration of HTN between 1-5 years. More number of patients in Group II

were found to have a duration of HTN of ≥6 years i.e. 40.95% (9) between 6-10 years and 40.9%(9) >10 years, P < 0.05, so statistically significant.

TABLE-2: Correlation of duration of Hypertension with left ventricular Hypertrophy.

Duration of HTN in years	Patients N-LVMI (group-1)	Patients Increased LVMI (group-2)
1-5 years	52 (46.4%)	16(18.2%)
6-10 years	44 (39.3%)	36 (40.9%)
>10 years	16 (14.3%)	36 (40.9%)
Mean + SD	37.33±15.43	29.33±9.44

Chest X- ray showed cardiac enlargement more in group II patients i.e. 68.2%(60) than in group I 35.7 %(40), $P < 0.05$, so statistically significant.

TABLE-3: X-ray findings

X-ray findings	Patients N-LVMI (group-1)	Patients Increased LVMI (group-2)
Showing LVH (n =100)	40(35.7%)	60(68.2%)
Normal (n = 100)	72(64.3%)	28(31.8%)
Total=200	112	88

ECG:

28 (25%) in group I and 56(63.6%) in group II had left ventricular hypertrophy by Sokolo Lyon criteria. The P value was <0.01 , so statistically significant. 12 (10.7%) in group I and 24(36.4%) in group II showed left ventricular hypertrophy according to Romhilt Estes score. The P value was found to be <0.05 , hence was considered to be statistically significant.

ECHOCARDIOGRAPHY:

2 D- Echocardiography detected concentric left ventricular hypertrophy in 80(90.9%) patients in group II and 12 (14.3%) patients in group I. Diastolic dysfunction was found in 40 (45.5%) patients in Group II and in 40 (35.7%) patients in Group I. Sclerotic aortic valve was found in 4(3.6%) patient in Group I and in 4(4.5%) patient in Group II. 4 patients in Group I showed Asymmetric septal hypertrophy. The relative sensitivity, specificity and accuracy of chest x- ray, 12 lead ECG and 2D echocardiography are shown below.

TABLE-4: Sensitivity, specificity and accuracy of Chest X-ray, Electrocardiogram and Echocardiogram

CRITERIA	SENSITIVITY	SPECIFICITY	ACCURACY
Chest X- ray	68%	64%	66%
ECG-Sokolov-Lyon	64%	75%	70%
ECG-Romhilt-Estes criteria	36%	89%	66%
ECG + chest radiography	52.3%	76.8%	66%
2D ECHO	91%	86%	88%

The sensitivity being 68%, 64%, 36% 52.2% and 91% for chest X-ray, ECG Sokolo Lyon, ECG-RE Scoring, ECG+chest x-ray and 2D echo respectively.

The specificity being 64%, 75%, 89%, 76.8% and 86% for chest X-ray, ECG Sokolo Lyon, ECG-RE Scoring, ECG+chest x-ray and 2D echo respectively.

The accuracy was found to be 66% for chest X-ray, 70% for ECG-Sokolo

Lyon, 66% for ECG-RE Scoring. 66% for ECG+chest x-ray 2D Echo was found to have maximum accuracy i.e. 88%.

DISCUSSION

Systemic arterial hypertension impacts constant hemodynamic burden on the heart. LVH is the end result of the same .It is an adaptation method of the myocardium to systemic arterial hypertension. A number of studies have identified LVH as a major and independent risk factor for development of sudden death, acute myocardial infarction, congestive cardiac failure and other cardiovascular morbidity and mortality.

For a criterion to be useful for detecting left ventricular hypertrophy, it should be anatomically validated, having high specificity in a general non-diseased population and sensitive for the detection of left ventricular hypertrophy. Anatomic validity of echocardiography methods of determining left ventricular hypertrophy using the Penn and American society of echocardiography measurements was demonstrated in 2 independent correlation studies, using the sex-specific criteria, which showed high sensitivity of 97% and specificity of 96%. In a previous study, LV mass index for Indian population was studied as 110g/m² in females and 121g/m² in males. These values were taken as reference values in this study and used as gold standard for left ventricular hypertrophy.

The overall presence of LVH in hypertension as defined by sex-specific reference standard is reported to be 25 to 30% with 97% specificity by Devereux RB *et al.*,⁴⁶. Similarly Tingleff J *et al.*,⁶¹ reported the prevalence of the LVH of 25-26% in hypertensives. Martinez *et al.*,⁶² also reported LVH to be 26% in hypertension.

Cuspidi C63 *et al.*, reviewed 30 studies on the prevalence of LVH, as assessed by echocardiography, and found that the prevalence of LVH in essential hypertension ranged from 36% to 41%. Drayer64 *et al.*, reported the prevalence of LVH of 48% in hypertensives according to M-mode echocardiography. In similarity to other studies prevalence of left ventricular hypertrophy detected by 2D Echocardiography in this study is 44% with specificity of 71%.

DEMOGRAPHIC FEATURES:

Age:

The mean age in years in group II is higher than in group I indicating the association of increased age with LVH. Hammond *et al.*, also showed increased age is associated with LVH. Cuspidi C *et al.*, also showed that LVH is highly prevalent in essential hypertensives, particularly in the elderly, who exhibited a more severe increase of LV mass index, compared with young and middle-aged sub-groups.

There is no much difference in the mean body surface area of the two groups.

SEX:

A Significantly Higher Percentage (63.6%) Of Females Than Males (36.4%) Had

LVH in the present study. Hammond *et al.*,46 reported a greater proportion of LVH in women. J. Tingleff *et al.*, reported a prevalence of LVH of 26% in women and 25% in men. Gerds *et al.*, also reported a higher prevalence of LVH in women (80%) as compared to men (70%). G de Simone67 *et al.*, also reported a higher prevalence of LVH in hypertensive obese women (58%) as compared to men (49%).

DURATION OF HYPERTENSION:

The duration of hypertension in patients with increased LVMI is more than in patients with normal LVMI. Ross *et al.*, reported duration of hypertension as a significant factor in the development of LVH. Glasser SP *et al.*, also showed duration of hypertension added significantly in predicting an elevated LVMI.

Clinical correlation also show that heaving apical impulse, loud A2 component of second heart sound and third and fourth heart sound are more often seen in patients

with left ventricular hypertrophy. Ejection systolic murmur in aortic area may be due to sclerotic aortic valve. The sclerotic aortic valve may be due to the pro atherogenic effect of hypertension. Similar findings have been reported in earlier studies.

INVESTIGATION:

In This Study on Comparing the Echocardiogram to Chest –X-Ray And 12 Lead

ECG for detecting LVH, the echocardiogram is found to be more sensitive, specific and accurate than the other two. The sensitivity being 68%, 64%, 36% and 91% for chest x-ray, ECG-Sokolov Lyon, ECG Romhilt-Estes criteria and 2D- Echo respectively, and the specificity being 64%, 75%, 89%, 86% for chest xray,

ECG –SOKOLOV LYON, ECG-ROMHILT-ESTES CRITERIA AND 2D- ECHO RESPECTIVELY

The accuracy was found to be 66%, 70%, 66%, 88% for chest x-ray, ECG Sokolov Lyon, ECG-Romhilt Estes criteria and 2D- Echo respectively. JN Woythaler *et al.*, showed that LVH as detected by Echocardiography was more accurate than electrocardiography. Similarly Reichek *et al.*, also showed that Echocardiography was superior to ECG for diagnosis of LVH. Nkado RN *et al.*, also showed that Echocardiography is highly accurate for measurement of left ventricular mass compared to electrocardiography. Ribeiro *et al.*, showed that LVH was detected by ECG & Chest x-ray with sensitivity of 54.2%, specificity of 62.8% and accuracy of 60.4%. In the standard 12 lead ECG on comparing the Sokolov-Lyon criteria and

Romhilt-Estes point score system, it is seen that sensitivity of 64% and specificity of 75% is found in Sokolov-Lyon criteria whereas Romhilt-Estes has sensitivity of 36% and specificity of 89%. Therefore Romhilt-Estes point score system becomes the ideal criteria for diagnosing left ventricular hypertrophy, if 2D- Echocardiography is not feasible.

CONCLUSION

In hypertensive patients increased left ventricular mass index has been found to be associated with Higher age (> 50 years), Female sex (63.6%), Long duration of hypertension (>6 years).

M-mode and two dimensional echocardiography is found to be more sensitive and accurate non-invasive method of detecting left ventricular hypertrophy in hypertensive patients as compared to ECG and Chest X-ray.

Left ventricular hypertrophy is more associated with other end organ damage and therefore increased risk of morbidity and mortality.

In the evaluation of hypertensive patients for LVH, the role of ECG and chest x-ray is of limited value and ECHO is the method of choice.

The accuracy of chest radiography plus ECG (Romhilt – Estes point score) for diagnosis of LVH is sufficient to justify its use in the initial evaluation of hypertensive patients, as these exams are inexpensive and easily available in primary health care center.

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