Comparision between Chest X Ray, Electrocardiogram and Echocardiography in Detecting Left Ventricular Hypertrophy in Essential Hypertension

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ABSTRACT

Introduction: Left ventricular hypertrophy is an important complication of long standing hypertension and is proven to be associated with target organ damage. Hence presence of left ventricular hypertrophy in essential hypertension indicates a grave prognosis and should be diagnosed using the most accurate method.

Material and methods: The study was conducted at a tertiary care hospital over a period of one year. The study group consisted of 50 patients with essential hypertension above the age 40years who were evaluated with history, clinical examination and specific investigations like Chest X-ray,Electrocardiography and 2D Echocardiography.

Result: The sensitivity was 68%, 64%, 36% and 91% for chest X-ray, ECG-Sokolov Lyon, ECG-Romhilt Estes Scoring and 2D echo respectively. The specificity was 64%, 75%, 89%, and 86% for chest X-ray, ECG-Sokolov Lyon, ECG-Romhilt Estes Scoring and 2D echo respectively. The accuracy was found to be 66% for chest X-ray, 70% for ECG-Sokolov Lyon, 66% for ECG-Romhilt Estes Scoring. 2D Echo was found to have maximum accuracy i.e. 88%.

Conclusion: M-mode and two dimensional echocardiography is found to be more sensitive and accurate than Electrocardiography and Chest x-ray for detecting left ventricular hypertrophy in hypertensive patients.

Keywords: Left ventricular mass index

INTRODUCTION

Hypertension is one of the leading causes of morbidity and mortality worldwide. Left ventricular hypertrophy(LVH) is an important pathological consequence of hypertension. Individuals with left ventricular hypertrophy are at increased risk for coronary heart disease, stroke, congestive heart failure, and sudden death.[1] Left ventricular hypertrophy is considered a structural adaptation of the heart, a compensatory mechanism for chronic neurohormonal activation and an abnormal hemodynamic load (i.e. increased preload or after load). There are many ways of diagnosing left ventricular hypertrophy like ECG, chest roentgenography and echocardiography.[2] This study is undertaken to compare the efficiency of these methods in diagnosing left ventricular hypertrophy since it can be reversed with aggressive control of hypertension, thus reducing morbidity and mortality. Hence this study aims to compare the sensitivity, specificity and accuracy of echocardiogram, standard 12 lead ECG and chest roentgenography for detecting left ventricular hypertrophy in essential hypertension.

MATERIAL AND METHODS

The study was carried out at a tertiary care hospital over a period of one year.

The study group consisted of 50 patients aged above 40 years with essential hypertension irrespective of duration of hypertension. The sample was selected from all the patients who visited the hospital and was based on inclusion exclusion criteria. 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. Informed consent was obtained from the patients and institutional ethical committee approval was taken to conduct the study.

The patients were evaluated with a detailed history, physical examination, chest X-ray, standard 12 lead ECG and two dimensional echocardiography.

Chest X-ray: A postero-anterior view Chest X ray was obtained in all patients. A cardiothoracic ratio is >0.5, was considered as left ventricular hypertrophy

Electrocardiogram

Standard 12 lead ECG was obtained in all patients.

The ECG criteria used in this study-

1. Sokolov –Lyon index:
   S in V1+R in V5/V6 >35mm.
2. Romhilt –Estes point Score system:(RE)
   Left ventricular hypertrophy is considered to be present if total score is five or more.

			Points
1.	R or S in limb leads or S in V1, V2 or V3 or R in V4, V5or V6.	20 mm or more 25 mm or more 25 mm or more	3
2.	ST-T changes		3
3	'P' terminal force in V1 more than 0.04 sec		3
4	Left axis deviation of -15 degrees or more		2
5	Intrinsicoid deflection in V5 or V6 ≥0.04		1
	Total		12

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Echocardiography

Combined M-mode and 2-dimensional echocardiographic studies were performed in all study subjects. The average sum of septal wall thickness and posterior wall thickness of 1.1cm was taken as normal. Any value above this was taken as evidence of left ventricular hypertrophy.The left ventricular mass index was calculated by using Penn's convention formula:

$LVM = 1.04 [(LVIDd + PWT + IVST)^3 – LVIDd^3] – 14$ gm.

LVMI = LVM/BSA.

[LVM = left ventricular mass; LVIDd = left ventricle internal dimension in end diastole; PWT = posterior wall thickness; IVST = interventricular septal thickness; LVMI= left ventricular mass index; BSA=body surface area]

The normal left ventricular mass index for the Indian population[2] is:

1. Males = 121g/m^2
2. Females = 110g/m^2

Any value more than this was considered as left ventricular hypertrophy.

STATISTICAL ANALYSIS

Diagnostic validity tests (Specificity and sensitivity) and Chi – square test were the statistical tests used.*P<0.05* was considered statistically significant. Computer software used were MS Word and MS Excel.

RESULTS

Out of 50 patients 28 patients had normal LVMI (group 1) and 22 patients had increased LVMI (group 2).

Chest X- ray showed cardiac enlargement more in group II patients i.e. 68.2 % (15) than in group I- 35.7 % (10), P< 0.05, so statistically significant, as shown in Table-1.

ECG correlation with LVH: 7 (25%) in group I and 14(63.6%) in group II had left ventricular hypertrophy by Sokolov Lyon criteria. The P value was <0.01, so statistically significant as shown in table-2.

3(10.7%) in group I and 8(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 as shown in table-3.

Echocardiography: 2 D- Echocardiography detected concentric left ventricular hypertrophy in 20 (90.9%) patients in group II and 4 (14.3%) patients in group I.

Figure-1 shows the Sensitivity, specificity and accuracy of Chest X-ray, Electrocardiogram and Echocardiogram in detecting LVH.

The sensitivity was 68%, 64%, 36% and 91% for chest X-ray, ECG-Sokolov Lyon, ECG-RE Scoring and 2D echo respectively.

The specificity was 64%, 75%, 89%, and 86% for chest X-ray, ECG-Sokolov Lyon, ECG-RE Scoring and 2D echo respectively.

The accuracy was found to be 66% for chest X-ray, 70% for ECG-Sokolov Lyon, 66% for ECG-RE Scoring. 2D Echo was found to have maximum accuracy i.e. 88%.

DISCUSSION

The left ventricular mass index as calculated by using Penn's convention formula closely correlated with necropsy, with a sensitivity and specificity of 93% and 95% respectively.[3] Hence this was chosen to calculate LV mass.

In this study on comparing the echocardiogram to chest –x-ray and 12 lead ECG for detecting left ventricular hypertrophy, 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 x-ray, 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.

Woythaler JN[4] et al showed that left ventricular hypertrophy as detected by Echocardiography was more accurate than electrocardiography. Similarly Reichek et al[5] also showed that Echocardiography was superior to ECG for diagnosis of LVH. Nkado RN et al[6] also showed that Echocardiography is highly accurate for measurement of left ventricular mass compared to electrocardiography.

X-ray findings	Patients N- LVMI (Group 1)	Patients increased LVMI (Group 2)
Showing LVH (n =25)	10(35.7%)	15(68.2%)
Normal (n = 25)	18(64.3%)	7(31.8%)
Total=50	28	22
P<0.05=Significant; LVMI: Left ventricular mass index		

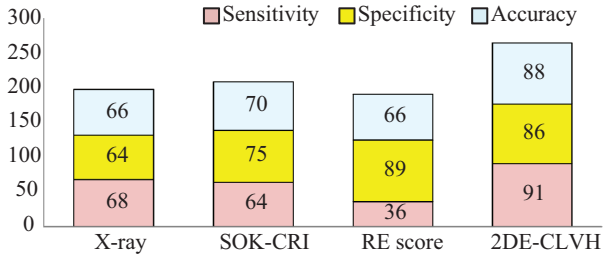
Table-1: Correlation of X-ray findings with LVMI

Sokolov Lyon criteria	Patients N-LVMI (Group 1)	Patients Increased LVMI (Group 2)
Showing LVH (n = 21)	7(25.0%)	14(63.6%)
Normal (n = 29)	21(75.0%)	8(36.4%)
Total=100	28	22
P<0.01=Significant		

Table-2: Correlation of Sokolov Lyon criteria with LVMI

Romhilt Estes Scoring	Patients normal LVMI (Group 1)	Patients increased LVMI (Group 2)
Score ≥ 5 (n=32)	3(10.7%)	8(36.4%)
Score <5 (n=18)	25(89.3%)	14(63.6%)
Total=50	28	22
P<0.05=Significant.		

Table-3: Correlation of Romhilt Estes Scoring system with LVMI



SOK CRI: Sokolov lyon criteria

RE:Romhilt estes

2DE CLVH:2D Echocardiography concentric left ventricular hypertrophy

Figure-1: Sensitivity, Specificity and Accuracy of Chest x-ray, Electrocardiogram and Echocardiography

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. ECG criteria have a high specificity but low sensitivity and hence, have limited use as a screening method. However, in a resource-poor countries where Echo facilities are not available improved ECG criteria such as total QRS voltage can be recommended as a routine investigation for LVH because of its cost-effectiveness and easy availability despite certain limitations.[7]

However one study concluded that the association of chest radiography-electrocardiogram is useful for the screening of hypertensive patients for the diagnosis of left ventricular hypertrophy, especially if echocardiogram is unavailable.[8,9]

Cardiac computed tomographic (CT) scanning and magnetic resonance imaging (MRI) are other techniques for accurately detecting LVH but their use is limited by lack of availability and cost.[10]

The limitation of this study is a small sample size of 50 patients and only 2 ECG criteria for detecting LVH have been studied.

CONCLUSION

M-mode and two dimensional echocardiography is found to be more sensitive and accurate than ECG and Chest X-ray. non-invasive method for left ventricular hypertrophy in hypertensive patients. Hypertensive patients with LVH are at an increased risk for hypertensive complications, including heart failure, stroke, and atrial fibrillation. However LVH is reversible with aggressive control of hypertension and use of angiotension converting enzyme inhibitors and angiotensin receptor blockers. Therefore it is important to detect the presence of LVH in hypertensive patients using the most accurate technique, so that drug therapy can be initiated to reverse it, thus reducing morbidity and mortality.

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