ORIGINAL ARTICLE

Frequency of True Positive Cases of Left Ventricular Hypertrophy on Electrocardiography Taking Echocardiography as Gold Standard

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ABSTRACT

Aims and Obkectives: Left Ventricle of heart, being a muscular organ is capable of undergoing hypertrophy, defined as an increase in the mass of the left ventricle (LVH). LVH can be diagnosed by radiography, echocardiography and electrocardiography. The first two need expertise, not readily available and expensive so the objective is to find out how much we can solely rely on the electrocardiography for the diagnosis of LVH.
Study Design: Non probability purpose sampling.
Duration: Jan 2012 to Dec 2012 in the cardiology department of Jinnah Hospital Lahore.
Results: Majority of the patients between 45-65 years of age 45% (n=90) were found between 56 to 65 years while only 1.5 %(n=3) were found between 16 to 25 years of age. Mean and standard deviation was found on 47.88±4.67. Regarding gender distribution, 67% (n=134) patients were found male and 33% (n=66) were found female. Left ventricular hypertrophy on electrocardiography, 48% (n=96) patients were found positive and 52 %(n=104) were found negative.
Conclusion: The frequency of true positive cases of Left Ventricular Hypertrophy on Electrocardiography taking Echocardiography as gold standard is acceptable.

Key words: Hypertension, LVH, Echocardiography, Electrocardiography.

INTRODUCTION

Hypertension is one of the important public health problems. Hypertension is defined as the presence of a blood pressure elevated to a level that places patients at increased risk for target organ damage in several vascular beds. Clinically hypertension is characterized by a blood pressure more than 140/90mmHg.[1] It is estimated that the life time probability of development of hypertension is 90% for individuals aged 55-65 years of age in western countries.[1] It is common, asymptomatic, readily detectable, usually easily treatable, and often leads to lethal complication if left un-treated.[2] Arterial hypertension is a major cause of coronary heart disease, stroke, and heart failure. Several studies have shown that left ventricular hypertrophy is an important risk factor in patients with hypertension, leading to a fivefold to 10-fold increase in cardiovascular risk[3-7] which is similar to the increase in patients with a history of myocardial infarction.[8] The presence of left ventricular hypertrophy, in addition to hypertension, thus has important implications for assessing risk and managing patients, including decisions on interventions other than antihypertensive treatment, such as lipid lowering treatment and lifestyle modifications.[9,10] Accurate and early diagnosis of left ventricular hypertrophy is therefore an important component of the care of patients with hypertension.

Although left ventricular hypertrophy is an infrequent finding on the electrocardiography, it is a forerunner of coronary disease, congestive cardiac failure, stroke and even peripheral arterial disease. Despite being strongly related to hypertension left ventricular hypertrophy remains associated with excess risk for adverse cardiovascular morbidity and fatal outcomes even after adjusting for blood pressure.[11] The most readily available diagnostic modality for left ventricular hypertrophy has been the electrocardiography. Most physicians have relied on it to detect the presence of left ventricular hypertrophy in hypertensive patients due to the reason that it is cost effective, no much expertness is required and it can be easily provided in rural areas of our country. However, results of ECG have been reported as 21-54% sensitivity and 77%

specificity while ECHO has 88-93% sensitivity and 97% specificity.

Although left ventricular mass determined on echocardiography is the most sensitive tool to diagnose LVH but electrocardiography remains a useful initial investigation especially the ventricular mass calculated by the modified penn cube formula (1.04[(LVIDP + PWTP + IVSTP) ^{3} – (LVIDP) ^{3}] – 13.6).[12] Therefore ECG should be performed in addition to echocardiography in patients with LVH to check the validity of Romhilt Estee point score system of LVH in our population.

METHOD

Many different criteria for electrocardiographic LVH have been proposed over the years. Most use the voltage in one or more leads, with or without additional factors such as QRS duration, secondary ST-T wave abnormalities, or left atrial abnormalities. The most well-known electrocardiographic criteria are the Cornell voltage[14,] the Cornell product,[15] the Sokolow-Lyon index,[16] and the Romhilt-Estes point score system.[17]

A systematic review of 21 studies[13,] published in 2007, found that Romhilt-Estes point score system is less sensitive than specific i.e Romhilt-Estes point score—median sensitivity 17%, median specificity 95%.

ROMHILT_ESTEE POINT SCORE SYSTEM:
(Diagnostic ≥ 5 Points &Probable 4 points)

Voltage criteria (any of)	
R or S in limb leads ≥ 20 mm	3
S in V1 or V2 ≥ 30 mm	
R in V5 or V6 ≥ 30mm	
ST- T Abnormalities	
Without digitalis	3
With digitalis	1
Left atrial enlargement in V1	3
Left axis deviation	2
QRS duration 0.09 sec	1
Delayed intrinsicoid deflection in V5 or V6 > 0.05 sec	1

POSITIVE ECHO

- Left ventricular hypertrophy is defined on Echocardiography with PWT (posterior wall thickness) more than 11mm and IVST (inter ventricular septal thickness) more than 12mm and left ventricular mass index more than 118g/m^2 in males and 104g/m^2 in females.

MATERIALS AND METHODS

Inclusion Criteria:

1. Both males and females of age above 15yrs.
2. Patients positive (fulfilling the criteria) for left ventricular hypertrophy on electrocardiogram as per operational definition.

Exclusion Criteria:

Patients with following diseases were excluded from the study.

1. Ascites by history, physical examination, and laboratory investigations.
2. Patient with history of cardiac surgery.
3. Patient with history of Acute Myocardial infarction and stroke.
4. Left ventricular aneurysm on the basis of history, previous echo reports and electrocardiogram.
5. Female with history of mastectomy.
6. Atrial fibrillation on electrocardiogram
7. Pre excitation syndrome on electrocardiogram.
8. Right and left bundle branch block on electrocardiogram.
9. Pneumothorax on the basis of chest x-ray.

Sampling Technique:

- Non probability purposive sampling

Data Collection Procedure

200 patients coming to the cardiology outpatient department fulfilling the ROMHILT-ESTEE criteria (identified as having left ventricular hypertrophy) for left ventricular hypertrophy were labeled as positive case and were included in the study and informed consent and the demographic profile like age, sex etc. was obtained. Clinical examination was also done along with necessary investigations to rule out the conditions. The electrocardiograms were done by single ECG technician with standard settings and protocol. Echocardiography was done on these patients by single consultant having good expertise on the procedure to eliminate the risk of inter observer variability. Echocardiography was done with M-mode- Gee Machine model Vivid 7. Echocardiography was done primarily for the left ventricular mass and the following measurements was also taken and if found positive the case was mentioned as positive for left ventricular hypertrophy on Echocardiography.

1. Posterior wall thickness (PWT) calculated in mm,
2. Interventricular septum thickness (IVST) calculated in mm
3. Left ventricular internal dimensions in diastole

Data Analysis:
Computer software SPSS 11.0 was used for data analysis and interpretation. Quantitative variable like age was presented by calculating their mean and standard deviation. Qualitative variable like gender and true positive cases were presented as frequency and percentage. As it was descriptive study, no test of significance was applied. In this study, a total of 200 patients were recruited after fulfilling the inclusion/exclusion criteria to determine the frequency of true positive cases of Left Ventricular Hypertrophy on Electrocardiography taking Echocardiography as gold standard.

This research work shows majority of the patients between 45-65 years of age 45% (n=90) were found between 56 to 65 years, 28% (n=56) were found between 46 to 55 years, 9 %(n=18) between 26 to 35 years and only 1.5 %(n=3) were found between 16 to 25 years of age. Mean and standard deviation was found on 47.88±4.67. (Table 1)

Table 1: Age distribution of the Patients (n=200)

Age(in years)	No. of Patients	Percentage
16 to 25	3	1.5
26 to 35	18	9
36 to 45	33	16.5
46 to 55	56	28
56 to 65	90	45
Total	**200**	**100**
Mean and S.D= 47.88±4.67		

Table 2: Gender distribution of the Patients (n=200)

Gender	No. of Patients	Percentage
Male	134	67
Female	66	33
Total	**200**	**100**

Regarding gender distribution, 67% (n=134) patients were found male and 33% (n=66) were found female. (Table No. 2)

Table No. 3 describes left ventricular hypertrophy on electrocardiography, 48% (n=96) patients were found positive and 52 %(n=104) were found negative. (Table No. 3)

Table 3: Left Ventricular Hypertrophy On Electrocardiography (n=200)

LVH	No. of Patients	Percentage
Yes	96	48
No	104	52
Total	**200**	**100**

DISCUSSION

Previous investigations have demonstrated that three-dimensional echocardiography improves the accuracy and reproducibility of estimates of left ventricular volume and mass.[18, 19, 20] However; three-dimensional cardiac reconstructions have been limited by such factors as using video quality images, lengthy image acquisition times, limited acoustic windows, respiratory gating, and assumptions of left ventricular shape. In addition, its cost and the need of an expert to perform, makes it difficult as a routine investigation.

The purpose of this study was to determine the frequency of true positive cases of Left Ventricular Hypertrophy on Electrocardiography taking Echocardiography as gold standard so that it may be determined that how much we can rely solely on electrocardiography in figuring out, in those areas where the facility of echo is not available especially in rural areas and non-specialized centres, that how much cases are noted to have true left ventricular hypertrophy confirmed on echocardiography because the treatment of a chronic hypertension leading to left ventricular hypertrophy is different from the acute hypertensive because the later needs acute lowering of the blood pressure which may lead to target organ damage in contrast to the former which needs slow lowering of the blood pressure.

Although left ventricular mass determined on echocardiography is the most sensitive tool to diagnose LVH but electrocardiography remains a useful initial investigation.[21] Some studies have shown that electrocardiographic LVH and echocardiographic LVH are separate entities and the former predicts cardiac morbidity and mortality independent of the latter.[22,23] Therefore ECG should be performed in addition to echocardiography in patients with LVH to check

the validity of Romhilt Estee point score system of LVH in our population.

ECG criteria for LVH, particularly those that are heavily reliant on voltage criteria, may result from abnormal thickening of the LV free wall or ventricular septum, LV chamber dilatation or increased LV wall tension.[24-26] Echocardiography provides direct information concerning LV wall thickness and chamber size. Increased LV mass is also used as a diagnostic standard because the formula takes into consideration LV wall thickness and diastolic dimension presumably defining LV hypertrophy more accurately than increased LV wall thickness or LV enlargement alone. [26]

In the current study, we found 48% positive for LVH on Electrocardiography, though this result is not very high but in our population, majority of the patients are poor and not affordable for echocardiography and they may be screened out first on ECG and if no result is found then echocardiography may be done and it can be more effective by combining Sokolow Lyons voltage criteria and Cornell voltage criteria with Romhilt-Estes point score.[27]

Another study by Abid Amin Khan, Zaheer Alam, Sara Inayat[28] shows that patients with left ventricular hypertrophy was found in 44% and without left ventricular hypertrophy 56% on electrocardiography, which shows in agreement with the results of our study.

A study conducted by Shahid Abbas[29] concluded that echocardiography should be used in preference to electrocardiography to determine left ventricular mass in hypertensive patients.

The point scoring of Romhilt-Estes has been reported as 60% sensitivity and 98% specificity when the electrocardiogram was compared with findings at necropsy by the scientists Romhilt and Estes[30]. The same study used in its majority as population samples cases of serious cardiac disease, with large values of ventricular mass that could have led to overestimation of the method's sensitivity.

On the other hand, the 2004 guidelines from the British Hypertension Society state that echocardiography is not required routinely but is valuable to confirm or refute the presence of left ventricular hypertrophy when the electrocardiogram shows high left ventricular voltage without T wave abnormalities. [31] In the United States, the seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) recommends routine electrocardiography but makes no mention of echocardiography.[32]

Although left ventricular mass determined on echocardiography is the most sensitive tool to diagnose LVH but electrocardiography remains a useful initial investigation and it can be used in those areas where the facility of echo is not available especially in rural areas and non-specialized centres.

CONCLUSION

The frequency of true positive cases of Left Ventricular Hypertrophy on Electrocardiography taking Echocardiography as gold standard is acceptable and should be the prime investigation for the diagnosis of the hypertension but keeping in mind that the gold standard test is echocardiography, electrocardiography aids but not completely rules in or rules out the LVH. But it can be used in rural areas with less specialized centers with the aid of history and clinical examination.

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