Original Article

Comparison of Electrocardiography with Echocardiography in Terms of Concurrence of Results in the Diagnosis of Left Ventricular Hypertrophy

Masood Javed, Khalid Amin, Ghulam Abbas Sheikh, Dilshad Muhammad, Muhammad Khalid

ABSTRACT

Introduction: Left ventricular hypertrophy, common in hypertension, is an adaptive state of the heart to increase in wall stress. LVH has important prognostic implications for patients with hypertension. In detection of LVH, Echocardiography is considered to be superior to electrocardiography in patients with hypertension. **Objectives**: To compare the findings of electrocardiography with echocardiography in terms of concurrence of results in the diagnosis of left ventricular hypertrophy.

Study Design: Cross – sectional study. **Place and Duration of Study:** Medical Department of Allied Hospital and PINUM Faisalabad from 14-02-2014 to 13-08-2014. **Material & Methods:** A total of 88 patients were included in this study. After detailed history and examination, all patients had first ECG and then echocardiography.

Results: Mean age of the patients was 50.85±6.3 year. Out of 88 cases, 55 patients (62.5%) were male while remaining 33 patients (37.5%) were female. Mean height of the patients was 1.69±0.10 meter, mean weight was 66.1±9.86 kg and mean BMI was 23.38±1.20. Out of 88 cases, 67 cases were positive on echocardiography and 39 cases were positive on electrocardiography (ECG). Out of these 39 cases 37 cases were true positive, 2 cases were false positive. **Conclusion:** The results show that electrocardiogram has low sensitivity and low NPV for detecting LVH as compare to echocardiography. These findings are relevant for physiological LVH and should not be extrapolated to detection of hypertrophic cardiomyopathy. In clinical practice, echocardiography alone should be used to exclude LVH. **Keywords**: Left ventricular hypertrophy, electrocardiography, echocardiography, hypertension.

INTRODUCTION

Left ventricular hypertrophy is the compensatory mechanism of the heart to overcome arterial pressure and develops in 15-20% of hypertensive individuals.[1] It is one of the best predictors of cardiac outcomes and is an independent risk factor for sudden death, acute myocardial infarction and congestive cardiac failure.[2] Several studies have shown that left ventricular hypertrophy in an important risk factor in patient with hypertension leading to 5 to 10 fold increase in cardiovascular risk which is similar to myocardial infarction.[3,4] Patients with LVH who had normal coronary angiogram 5 year survival was 81.02% versus 90.2% for those without LVH.[5]

The presence of left ventricular hypertrophy in addition to hypertension thus has important implications for assessing risks and in managing patients including decision on intervention and hospitalization other than antihypertensive treatment.[3]

The change in left ventricular hypertrophy predicts time to cardiovascular events after controlling the change in blood pressure. These findings imply that hypertension treatment that leads to both regression of left ventricular hypertrophy and blood pressure reduction to goal

Corresponding Author:
Dr. Masood Javed
Associate Professor of Medicine
PMC/Allied Hospital, Faisalabad
Tel. +92 300-9652022
E-mail: drmasood1960@yahoo.com

may decrease cardiovascular events more than treatment of blood pressure control alone.[6]

Electrocardiography is considered to be relatively insensitive and cannot accurately assess the severity of left ventricular hypertrophy. Also left ventricular hypertrophy is difficult to diagnose by electrocardiography if changes other than hypertrophy are also present. Because of these limitations other diagnostic modalities have been used and the most successful of these is echocardiography, which detects left ventricular hypertrophy in those even with normal electrocardiogram.[7]

This study is important in our setup and useful in establishing diagnosis of left ventricular hypertrophy before complication to occur. As echocardiography is expensive and not readily available in our setting, so we cannot offer echocardiography to every patient for diagnosis of left ventricular hypertrophy. This study is thus a step in this direction to find out the accuracy of electrocardiography in diagnosing LVH. The results of this study may improve the utilization of available resources in our setting as well as primary care level.

OBJECTIVES

Objective of the study was to compare the findings of electrocardiography with echocardiography in terms of concurrence of results in the diagnosis of left ventricular hypertrophy.

Operational Definitions

Echocardiography is a technique by which 3 dimensional picture of left ventricle can be visualized and mass index criteria are used for hypertrophy in which patient height, weight and left ventricular mass are calculated and the following formula is applied.

LV mass=0.8X
[1.04[((IVSD+LEVDD+LVPWTD) 3-(LVEDD3]) +0.6g [7]

IVSD (interventricular septum in diastole), LVEDD (LV end diastolic diameter). LVPWTD (LV posterior wall in diastole). LV mass is indexed to body surface area for adjustment of heart weight to patient size variation. LV mass index $\geq 89 g/m^2$ for women and $\geq 103 g/m^2$ for men was called LVH.[7,8]

Electrocardiogram is electric reading of action potential in heart by using 12 leads and electrodes. Romhilt-Estes point scoring system (given below) is used to diagnosis left ventricular hypertrophy.[2,9]

Any limb lead R wave or S wave > 2.0mV	3 point
Sv1 or Sv2 $\geq$ 0mV	3 point
R v5 to R v6 $\geq$ 3.0mV	3 point
St-T wave abnormality (no digitalis)	3 point
St-T wave abnormality (digitatis therapy)	3 point
P terminal force in VI > 4mV-msec	3 point
Left axis deviation	3 point

Score of 3 points = no left ventricular hypertrophy
Score of 4 points = probable left ventricular hypertrophy
Score of 5 points = left ventricular hypertrophy.[7]

MATERIALS & METHODS

Sample Size

Anticipated population proportion = 35%.[2]
Confidence level = 95%
Absolute precision required = 10%
Sample size 88
Sample size is calculated by using WHO sample size calculator.

Sampling Technique

Non – probability consecutive sampling.

Sample Selection

Inclusion Criteria

1. Age between 13-65 Years
2. Both sexes
3. Known hypertensive for more than 2 years, patients taking medicine confirmed on history.

Exclusion Criteria

Known cases of Ischemic heart disease, obese patients, smokers, patients with skeletal abnormalities, COPD, atrial fibrillation and patients taking drugs affecting ECG were excluded from study.

Data Collection

After taking approval from hospital ethical committee, patients were included in the study through outdoor and emergency on the basis of inclusion criteria. Exclusion criteria were observed to overcome confounding factors. Written informed consent was taken. Detailed history and examination was done and all patients underwent first electrocardiography and then echocardiography. Electrocardiography was done in outdoor and emergency ward by technician and was reported by trainee researcher. Echocardiography was done and reported by consultant in the affiliated PINUM Hospital. Specially designed Performa was used to collect information by research.

Data Analysis

Data was analyzed by using SPSS version 10. Mean and standard deviation was determined for age, height, weight and BMI. Frequency and percentage was calculated for qualitative variable i.e. gender, true positives and left ventricular hypertrophy seen on ECG and echocardiography.

RESULTS

A total of 88 patients were included in this study during the study period of six months from 14-02-2014 to 13-08-2014

Age distribution shows, majority of patients i.e. 28 (31.8%) were 41-50 year of age and minimum 8 patients were < 20 years old. Mean age of the patients was 50.85+6.3 year (Table-1).Out of 88 cases, 55 patients (62.5%) were male while remaining 33 patients (37.5%) were female (Table-2).

Mean height of the patient's was1.69+0.10 meter, mean weight was 66.1+9.86 kg and mean BMI was 23.38+1.20 (Table-3). Out of 88 cases, 67 cases were positive on echocardiography and 39 cases were positive on electrocardiography (ECG). Out of these 39 cases 37 cases were true positive, 2 cases were false positive (Table-4).

Key:

TP = True Positive FP = False Positive TN = True negative FN = False negative

Table 1: Distribution of cases by age

Age (Year)	Number	Percentage
< 20	08	09.1
20-30	12	13.6
31-40	19	21.6
41-50	28	31.8
>50	21	23.9
Total	**88**	**100.0**
Mean	**50.85±6.3**	

Table 2: Distribution of cases by sex

Sex	Number	Percentage
Male	55	62.5
Female	33	37.5
Total	**88**	**100.0**

Table 3: Mean values

Variable	Mean	Standard deviation
Height (meter)	1.69	0.10
Weight (Kg)	66.1	9.86
BMI	23.38	1.20

Table 4: Comparison of Electrocardiography Versus Echocardiography in detecting left Ventricular hypertrophy n = 88

		Echocardiography		Total
		Positive	Negative	
ECG	Positive	37 (TP)	2 (FP)	39
	Negative	30 (FN)	19 (TN)	49
	Total	67	21	88

DISCUSSION

LVH is an adaptive state of the heart to increase in the wall stress. It is common in hypertension. The prevalence of LVH increases with age and based on ECG criteria is ten times more common in patients with BP more than 160/90 than in normotensive patients. Furthermore the prevalence of LVH has important prognostic implications for patients with hypertension.

Hypertension is an important modifiable cardiovascular risk factor. Left ventricular hypertrophy, the marker of hypertension has emerged as an independent risk factor that can be detected by electrocardiography (ECG) and echocardiography (ECHO).[10]

Left ventricular hypertrophy (LVH) particularly in hypertensive patients is a strong predictor of adverse cardiovascular events. Identifying LVH not only helps in the prognostication but also in the choice of therapeutic drugs. The prevalence of LVH is age linked and has a direct correlation to the severity of hypertension. Adequate control of blood pressure, most importantly central aortic pressure and blocking the effects of cardiomyocyte stimulatory growth factors like angiotensin II helps in regression of LVH.[11]

Although electrocardiography is the technique most often recommended in the diagnosis of hypertrophy, its diagnostic accuracy is hampered.[12] Several factors are known to interfere with electrocardiogram (ECG) sensitivity when diagnosing left ventricular hypertrophy (LVH), with gender and cardiac mass being two of the of the most important ones.[13]

Despite its low sensitivity, the electrocardiogram (ECG) is the most used tool used in the daily practice for detection of left ventricular hypertrophy (LVH).[14] 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.

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.[15]

In, Appropriate Blood pressure Control in Diabetes (ABCD) trial, the change in left ventricular hypertrophy predicted time to cardiovascular events after controlling the change in blood pressure. These findings imply that hypertension treatment that leads to both regression of left ventricular hypertrophy and blood pressure reduction to goal may decrease cardiovascular events more than treatment of blood pressure control alone.[5]

A Similar study conducted in Medicine and cardiology indoor of Army Medical College Rawalpindi and Shifa College of Medicine Islamabad showed left ventricular hypertrophy in 35% cases of electrocardiography when compared with echocardiography.[2]

In a study, the point scoring of Romhilt – Estes had 60% sensitivity and 98% specificity when the electrocardiography was compared with findings at necropsy by the scientists Romhilt and Estes.[16] 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. Present study revealed sensitivity much lower (50.7%) than that presented by these authors. Specificity was high (90.4%). In current study, true positive cases of ECG for left Ventricular hypertrophy were 37 (42.0%).

In a study carried out by Casale et al,[17] sensitivity of the Romhilt –Estes criterion was 33%, this is less as compare to the current study (50.7%). Specificity was high at 94%, quite close to the value calculated in our study i.e. 94.4%.

Okin et al[18] evaluated the point scoring in men, finding in comparison with the echocardiography, a sensitivity of only 12%, with a specificity of 100% for the Romhilt-Estes criterion. Devereux et al[15] found a sensitivity of 34% and a specificity of 98% in the comparison with left ventricular mass shown by the echocardiography, without differences between results for either sex.

CONCLUSION

In conclusion, the electrocardiogram has low sensitivity and low NPV for detecting LVH. These findings are relevant for physiological LVH

and should not be extrapolated to detection of hypertrophic cardiomyopathy. In clinical practice, ECHO alone should be used to exclude LVH.

Echocardiography, though superior, is expensive and not freely available to all patients and at all levels of health care so we need to improve the utilization of available resources of health care in our setting.

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AUTHORS

- **Dr. Masood Javed**
  Associate Professor of Medicine
  PMC/Allied Hospital, Faisalabad
- **Prof. Dr. Khalid Amin**
  Professor of Medicine
  PMC / Allied Hospital, Faisalabad
- **Dr. Ghulam Abbas Sheikh**
  Associate Professor of Medicine
  Aziz Fatimah Medical & Dental College, Faisalabad
- **Dr. Dilshad Muhammad**
  Assistant Professor of Medicine
  PMC/DHQ Hospital, Faisalabad
- **Dr. Muhammad Khalid**
  Assistant Professor of Oncology
  PMC/Allied Hospital, Faisalabad

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