Original Article

Accuracy of Electrocardiography in Detecting Left Ventricular Hypertrophy in Patients Having Increased Left Ventricular Mass on Echocardiography

Masood Iqbal Bhutta,[1] **Abubakr Ali Saad,**[2] **Hadi Yousaf,**[3] **Haroon Aziz Khan Babar**[4]
Muhammad Tahir Mohyudin,[5] **Nisar Ahmed**[6]

Abstract

Objective: To determine the accuracy of electrocardiography in diagnosing left ventricular hypertrophy in patients having increased left ventricular mass on echocardiography which is still the most sensitive tool to diagnose left ventricular hypertrophy.

Materials and Methods: 250 male patients, suspected to have LVH on the basis of history (hypertension) and clinical examination, Ejection systolic murmur at aortic area were included in the study. Patients with Acute MI, pericardial effusion, dextrocardia, LBBB pre-excitation syndromes, COPD, Kyphoscoliosis were excluded. Demographic profile were taken from the subject. Presence or absence of LVH was detected on ECG and then positive and negative cases were confirmed on Echocardiography. Data was analysed using SPSS 10.

Results: Mean age of pts. was 53.01 ± 12.55 years. Forty two patients (16.8%) were diagnosed to have Aortic stenosis and 208 (83.2%) patients had hypertension. Majority of the patients 114 (45.6%) had weight between 55 – 69 kg. In 164 patients (65.6%) height of the patients was between 157 – 166 cm. Sensitivity and specificity of ECG was 48.26% and 80% respectively, whereas its Accuracy was 50.80%, PPV was 96.52% and NPV was 11.85%. Weight of the patients who were detected as positive LVH cases was ranging between 40 – 54 kg in 27 (24.3%) cases, 55 – 69 in 49 (44.2%) cases and 70 or above in 35 (31.5%) cases. Duration of hypertension was between 1 – 10 years in 70 (77.8%) cases who were detected as LVH positive cases and between 11 – 20 years in 20 (22.2%) cases.

Bhutta M.I.[1]
Medical Officer, Department of Cardiology, Ch. Pervaiz Elahi Institute of Cardiology, Abdali Road, Multan

Saad A.A.[2]
Senior Registrar, Department of Cardiology, Ch. Pervaiz Elahi Institute of Cardiology, Abdali Road, Multan

Yousaf H.[3]
Medical Officer, Department of Cardiology, Ch. Pervaiz Elahi Institute of Cardiology, Abdali Road, Multan

Babar H.A.K.[4]
Associate Professor, Department of Cardiology, Ch. Pervaiz Elahi Institute of Cardiology, Abdali Road, Multan

Mohyudin M.T.[5]
Assistant Professor, Department of Cardiology, Ch. Pervaiz Elahi Institute of Cardiology, Abdali Road, Multan

Ahmed N.[6]
Assistant Professor, Department of Cardiology, Ch. Pervaiz Elahi Institute of Cardiology, Abdali Road, Multan

Conclusion: Electrocardiography cannot be used as the screening tool for the diagnosis of Left Ventricular Hypertrophy.
Key words: Electrocardiography, Echocardiography, Left Ventricular Hypertrophy. LBBB, MI.

Introduction

Left ventricular hypertrophy (LVH) is characterized by the increased left ventricular (LV) mass; with hypertrophy of myocardial cells and an increase in myocardial collagen.[1] Epidemiological evidence indicates a multifactor etiology for left ventricular hypertrophy with major determinants including blood pressure, age, sex, body size and presence of diabetes.[2]

Left ventricular hypertrophy is a prime indicator of end – organ damage. It is associated with increased incidence of coronary artery disease, sudden cardiac death, arrhythmias and peripheral vascular disease. Its impact on prognosis is equivalent to presence of multivessel coronary artery disease.

Combined Echo – LVH and ECG – ST segment depression remained predictive of Cardiovascular mortality and all – cause mortality, with the presence of both Echo – LVH and ECG – ST segment depression associated with a 6.3 – fold increased risk of cardiovascular death and a 4.6 – fold increased risk of all – cause mortality.[3]

Furthermore, hypertensive with LVH are at increased risk of cardiac arrhythmias (atrial fibrillation, ventricular arrhythmias) and atherosclerotic vascular disease (coronary and peripheral artery disease).[4] Therefore, estimation of left ventricular mass represents an important parameter for cardiovascular risk stratification.[5]

Left ventricular hypertrophy can be distinguished by various diagnostic tools like X-ray chest (increased cardiothoracic ratio), MRI (increased LV mass), but widely used tools are Echocardiography (Echo) and Electrocardiography (ECG). Echocardiography is a more sensitive and specific tool for detection of left ventricular hypertrophy than ECG, but cost, operational consideration and availability tend to limit its utility in large scale population studies and clinical trials.[2,5,6]

Moreover, it is also sometimes difficult to distinguish physiological from pathological left ventricular hypertrophy and thereby to grade cardiovascular risk.[7] By contrast, ECG is easy to acquire, readily available, inexpensive and less operator dependent.[2,5,8] ECG provides prognostic information that is complementary and independent of echocardiographic data in the assessment of patients with hypertension and in the general

population.[2]

Left ventricular hypertrophy has been shown to be an extremely strong indicator of cardiovascular morbidity and mortality whether diagnosed by electrocardiogram or by echocardiogram. ECG is a simple and economical bedside tool to assess the size of various cardiac chambers. Echocardiography is not universally done because of logistic problems and operator – dependence.

Methodology

The study was conducted in cardiology Department Cardiology Department at Ch. Pervaiz Elahi Institute of Cardiology, Multan from February 27, 2010 to August 26, 2010. It was a cross – sectional survey. Sample size of 250 cases Non-Probability Purposive Sampling was calculated with 95% confidence level, 10.5% margin of error and taking expected percentage of LVH i.e. 16% and sensitivity and specificity of ECG i.e. 87.5% and 50% respectively in comparison with echocardiography.

Only male patients of age between 25 – 70 years suspected to have LVH on the basis of history (hypertension) and clinical examination (loud A2, Ejection systolic murmer at aortic area) were included. Patients with Pericardial effusion on clinical examination, Left bundle branch block, Pre-excitation syndromes Acute myocardial infarction on ECG, Dextrocardia on clinical examination and ECG, Respiratory problems like COPD, Kyphoscoliosis on history and clinical examination were excluded.

After taking permission from Institutional Committee to conduct this study, 250 patients, meeting the inclusion criteria, presenting in cardiology department (including OPD, Emergency room and Inpatients) were included in the study. Informed consent and demographic profile were taken from the subject describing the procedure of study. Presence or absence of LVH was detected on ECG by a single technician (having more than 2 years experience) in ECG room of the department of cardiology. Then positive and negative cases were confirmed on Echocardiography that was done by a single cardiologist (having more than 5 years experience) in echocardiography room of the cardiology department. All these information were recorded on proforma (attached) by researcher himself.

All data were entered in a computer using SPSS (statistical package for social sciences) version 11.0 for windows. Continuous variables like age were expressed as mean ± SD (standard deviation). Sensitivity, specificity and accuracy of ECG were calculated in comparison with echocardiography.

Results

Mean age of presentation of the patients was 53.01 ± 12.55 years with range of 25 – 70 years. Majority of the patients were above 45 years of age. Weight in majority of the patients 114 (45.6%) was between 55 – 69 kg. Height of the patients was between 157 – 166 cm in 164 patients (65.6%) while it was 167 – 176 cm in 86 patients (34.4%).

Forty two patients (16.8%) were diagnosed to have Aortic stenosis and 208 (83.2%) patients had hypertension as shown in Figure 1. Duration of hypertension was 1 – 10 years in majority of the cases 156 (62.4%) while it was 11 – 20 years in 52 cases (20.8%).

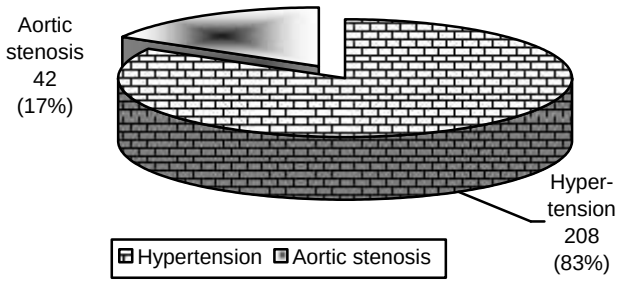

Fig. 1: Distribution of patients according to Disease (n = 250).

Most of the LVH positive cases detected on both ECG and Echocardiography were above the age of 45 years. There were 12 (10.8%) patients each in age gro-

up 25 – 34 years and 35 – 44 years. There were 36 (32.4%) patients in age group 45 – 54 years, 24 (21.7%) patients in age group 55 – 64 years and 27 (24.3%) in age group 65 and more (Table 1).

There were 1 (6.2%) patient between 35 – 44 years, 6 (37.5%) patients between 45 – 54 years, 7 (43.8%) patients between 55 – 64 years and 2 (12.5%) patients of 65 years and above who were detected as LVH negative cases both on ECG and echocardiography (Table 1).

Weight of the patients who were detected as positive LVH cases was ranging between 40 – 54 kg in 27 (24.3%) cases, 55 – 69 in 49 (44.2%) cases and 70 or above in 35 (31.5%) cases (Table 2).

Duration of hypertension was between 1 – 10 years in 70 (77.8%) cases who were detected as LVH positive cases and between 11 – 20 years in 20 (22.2%) cases. Duration of hypertension in cases who were detected as LVH negative was 1 – 10 years in 11 (73.3%) cases and 11 – 20 years in 4 (26.7%) cases (Table 3).

Discussion

For the last many years, many studies have been carried out for the electrocardiographic diagnosis of LVH on the basis of ECG criteria related to the deviation of electrical axis of the heart, to the voltage a duration of ventricular complexes, to the time of intrinsicoid deflection in the precordial leads. The criteria were used alone or in association, comprising according to some authors, scores of points to increase the accuracy of the method for diagnosing LVH.

In my study of measuring the diagnostic accuracy of ECG in detecting LVH, in addition to conventional ECG, the echocardiogram has shown great accuracy not only in detecting LV dimensions but also in

Table 1:
Age Distribution in Relation to Accuracy of ECG in Patients with Cardiovascular Disease.

Age (in Years)	No. of Patients Detected on ECG and Echo. with LVH Positive	No. of Patients Detected on ECG and Echo. with LVH Negative
25 — 34	12 (10.8%)	0 (0.0%)
35 — 44	12 (10.8%)	1 (6.2%)
45 — 54	36 (32.4%)	6 (37.5%)
55 — 64	24 (21.7%)	7 (43.8%)
65 and more	27 (24.3%)	2 (12.5%)
Total	111	16

Table 2: Weight Distribution in Relation to Accuracy of ECG in Patients with Cardiovascular Disease
(n = 127)

Weight (in Kg)	No. of Patients Detected on ECG and Echo. with LVH Positive	No. of Patients Detected on ECG and Echo. with LVH Negative	
70 and above	25 (31.5%)	5 (31.3%)	
Total	111	16	
40 — 54	27 (24.3%)	1 (6.2%)	
55 — 69	49 (44.2%)	10 (62.5%)	

Table 3: Duration of Hypertension in Relation to Accuracy of ECG in Patients with Cardiovascular Disease (n = 105).

Duration (in Years)	No. of Patients Detected on ECG and Echo. with LVH Positive	No. of Patients Detected on ECG and Echo. with LVH Negative
1 — 10	70 (77.8%)	11 (73.3%)
11 — 20	20 (22.2%)	4 (26.7%)
Total	90	15

quantifying the thickness of the walls. We analyzed Cornell voltage criteria for detection of left ventricular hypertrophy.

Alfakih et al[5] analyzed the gender specific partition values for ECG criteria of LVH recaliberated against cardiac MRI, and evaluated that Cornell voltage criterion had highest sensitivities in males (26.2%) as compared to females (16.3%) with a combined sensitivity in both males and females of 22.2%. In this study cardiac MRI was taken as gold standard, all the patients were hypertensive and LV mass index was used for evaluation of sensitivity. More number of males with higher LVM index values were included in the study.

In another study Pewsner et al[9] searched Medline and (pre-) Medline (Pubmed version) from 1966 to December 2005. 21 atricles were reported in this systematic review. In this review, sensitivity of Cornell voltage index ranged between 2% as lowest and 41% as highest values.[9]

Sergio et al[10], assessed both the sensitivity and specificity of Sokolow – Lyow and Cornell voltage criteria for left ventricular hypertrophy as participants of the second phase of MONICA Project. In their study, the sensitivity of Cornell voltage criterion was 22.5% for males and 28% for females, also Cornell voltage criterion showed a better association with the left ventricular mass as estimated by echocardiography than the Sokolow – Lyon criteria.

Gender specific criteria of LVH, validation with autopsy findings was studied by Casale et al[11] and they mentioned the sensitivity of Cornell voltage criteria 42%. Albert et al[12] studied postmenopausal women for evaluation of left ventricular hypertrophy, by using Cornell voltage criterion. They found the sensitivity of cornell criterion 46% in women after the adjustment for age and body mass index.

Study Limitation

Most of the patients in the study were receiving antihypertensive therapy, including both patients with mild to moderate hypertension. Study included the patients with angina, but excluded the patients with myocardial infarcts. Hence, results cannot be explorated to patients with LVH secondary to LV remodeling following myocardial infarcts. LV mass was used for correlation with voltage criteria instead of LV mass index (LVMI) which shows better association with voltage criteria for detection of left ventricular hypertrophy than LV mass.

Conclusion

Because their sensitivity is unacceptably low Cornell voltage criteria cannot be used as a substitute of echocardiogram in detecting left ventricular hypertrophy. However, the ECG is a safe, accessible, low cost, complementary test with an excellent reproducibility. Thus, the search for new criteria capable of increasing its diagnostic sensitivity in the detection of left ventricular hypertrophy must be stimulated and encouraged.

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