

Electrocardiography sensitivity for left ventricular hypertrophy according to etiology

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Abstract

Background and Objective: Left ventricular hypertrophy is a common condition that profoundly affects morbidity and mortality from cardiovascular diseases including myocardial infarction, congestive heart failure, and stroke. The ECG in the assessment of cardiac dimensions has lost its prominence in favor of imaging techniques that provide a multidimensional display of the heart but secondary ST-T changes due to LVH which are uniquely determined from the ECG are known to increase the risk of cardiovascular morbidity and mortality. Two-dimensional echocardiogram still demands considerably more time, cost, technical skill of the operator than routine 12 lead ECG. Considering the magnitude of LVH the study is designed to correlate between three different ECG criteria of left hypertrophy using echocardiography as diagnostic standard. **Methods:** The study was conducted on 100 patients at tertiary care hospital, during the year 2013-2015. Patients were divided into two groups the study group and the control group. Patients in the study group had echo evidence of LVH, whereas patient in control group had no echo evidence of LVH. After taking full detailed history all the patients were subjected to physical examination, ECG and echo. **Results:** The sensitivity and specificity for S – L Index was 35% and 82%, For R.E. system it was 49% and 80% and for total QRS voltage criteria it was 58% and 91%. The kappa measure of agreement was 0.15, 0.25 and 0.43 for the three criteria respectively. This means ECG has a poor correlation with echocardiography. **Interpretation and Conclusion:** This study shows that all the ECG criteria has a low sensitivity but a high specificity, so we cannot use ECG to rule out LVH but ECG can be recommended as a routine investigation because of high specificity and associated with high cardiac morbidity and mortality.

Key Word: Electrocardiography sensitivity, hypertrophy.

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INTRODUCTION

Left ventricular hypertrophy is a common condition that profoundly affects morbidity and mortality from cardiovascular diseases including myocardial infarction, congestive heart failure, and stroke. The prevalence of LVH is on the rise, more alarming in the developing nations. The Framingham heart study suggested that 1 in 10 persons will have left ventricular hypertrophy in age 65 to 69¹. The study also stated that electrocardiogram diagnosed LVH was associated with a 3-5 fold increase of

cardiovascular events with the greater risk ratios for cardiac failure and stroke. LVH is no longer consider as an adaptive process that compensates the pressure imposed on the heart and has been identified as an independent and significant risk factor for sudden death, acute myocardial infarction and congestive heart failure². LV mass represented a strong independent marker of cardiovascular risk both in the general population³⁻⁵ and in high-risk groups⁶⁻¹⁰ and suggest that, given its prognostic utility, should be preferred to qualify LVH severity. The increase in left ventricular mass represents a final pathway towards the adverse effects on the cardiovascular system and higher vulnerability to complication¹¹. The studies clarify strong relation between left ventricular hypertrophy and adverse outcome and hence emphasize on the clinical importance for its detection¹². The ECG in the assessment of cardiac dimensions has lost its prominence in favor of imaging techniques that provide a multidimensional display of the heart but secondary ST-T changes due to LVH which are uniquely determined from the ECG are known to increase the risk of cardiovascular morbidity and mortality¹³.

prognostic value of ECG-LVH is more than what can be explained by anatomical changes of the left ventricle. This concept has been suggested by several recent studies¹⁴⁻¹⁶, which calls for a paradigm shift in the thinking of ECG-LVH as a predictor of outcome rather than a measure of LV mass¹⁷. Today, two-dimensional echocardiogram still demands considerably more time, cost, technical skill of the operator and complexity of processing than routine 12 lead ECG. It may be expected that correlation with imaging techniques will improve the performance of the electrocardiogram in the assessment of cardiac anatomy by defining more accurately the limit of its capability. More than 30 ECG indexes for the diagnosis of LVH have been described. Many of the proposed indexes have remained anecdotal, but others are commonly used¹⁷. Considering the magnitude of LVH the study is designed to correlate between three different ECG criteria of left hypertrophy using echocardiography as diagnostic standard.

MATERIAL AND METHODS

This study was conducted in tertiary care hospital, in 2013-2015. All patients were taken from medical wards. Diagnostic standard of left ventricular hypertrophy was taken by Echocardiography. Patients with high index of clinical suspicion of left ventricular hypertrophy were subjected to electrocardiography and echocardiography, clinical suspicion was done by thorough physical examination and history. Patients were divided into two

groups: 1) The study group: comprised of patients who have echocardiographic evidence of left ventricular hypertrophy. 2) The control group: comprised of patients who had no echocardiographic evidence of left ventricular hypertrophy.

Patients having diseases like Mitral regurgitation, Aortic regurgitation, Hypertension, Coarctation of aorta, Aortic stenosis, Ventricular septal defect are included and patients having diseases like myocardial ischemia and infarction, bundle branch blocks are excluded from study. After obtaining results of electrocardiogram and echocardiography statistical tests were performed. The statistical tests are, Diagnostic validity tests (specificity and sensitivity) and Kappa measure of agreement have been performed.

OBSERVATION AND RESULTS

In this study 100 patients were enrolled. Out of 100 patients 59 were male and 41 were female. Among the study subjects 58 were hypertensive, 14 patients were having pure MR, 7 were suffering from pure AR, 6 had pure AS and 15 were having combined lesions (MR, AR, AS and AR). The patients were divided into two groups, the study group and the control group.

This study group comprised of 65 patients out of which 40 were males and 25 females. The control group consisted of 35 patients out of whom 19 were males and 16 females.

Table 1: Showing sensitivity of various ecg criteria according to disease

	S-L INDEX	R.E POINT SYSTEM	TOTAL QRS VOLTAGE CRITERIA
HYPERTENSION	33	46	54
MITRAL REGURGITATION	33	33	44
AORTIC REGURGITATION	33	66	66
AORTIC STENOSIS	25	50	75
COMBINED LESION	40	70	80

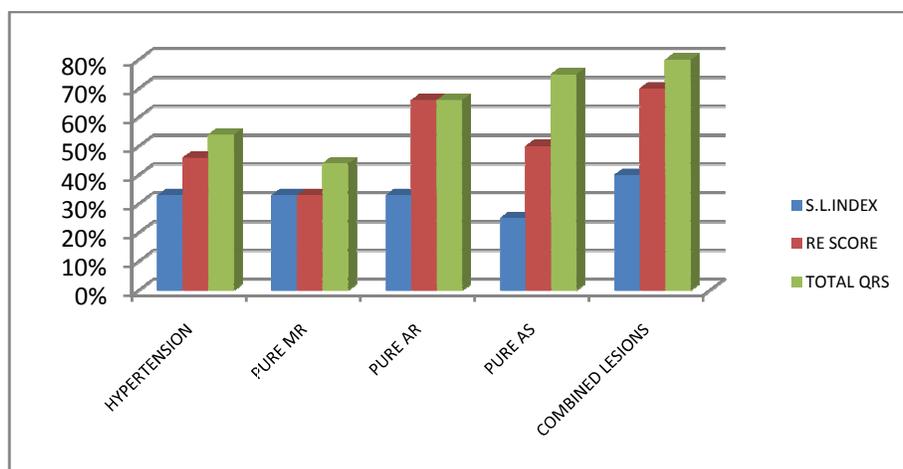


Figure 1: Sensitivity of various ECG criteria according to the diseases

DISCUSSION

This study compared three most important electrocardiographic criteria for diagnosis of left ventricular hypertrophy with echocardiography as diagnostic standard.

1) Hypertension: Out of 65 patients in the study group there were 39 patients who had hypertension and echocardiographic LVH. The left ventricular wall thickness in the echocardiographic recording ranged from 1.2-1.7cm. The Sokolov-Lyon criteria detected only 13 of them. The Romhilt - Estes point score system with 4 point detected 18. Whereas the total QRS voltage criteria detected 21 patients with LVH.

Sokolov-Lyon index – In this study out of 58 patients with hypertension 39 patients has echocardiographic evidence of LVH. Out of these 39 patients S.L criteria detected 13 patients. This gives the Sensitivity for hypertension with S.L index is 33%. The numbers of false positive cases were 2.

The Romhilt–Estes Point score system – The maximum point score was 9. In this study, out of 58 patients with hypertension 39 had echocardiographic evidence of LVH. Out of these 39 patients The Romhilt -Estes system detected 18 patients. So the Sensitivity for hypertension with The Romhilt -Estes system is 46%. The numbers of false positive cases were 2.

Total QRS voltage criteria- In the total QRS voltage criteria the voltage ranged from 120-248. In this study out of 58 patients with hypertension 39 had echocardiographic evidence of LVH. Out of these 39 patients the total QRS voltage criteria detected 21. This gives the sensitivity for hypertension with total QRS voltage criteria is 54%. The no. of false positive cases was 2.

2) Mitral regurgitation (Pure) – Out of 65 patients in the study group there were 9 patients with Mitral regurgitation (pure) and echocardiographic LVH. The left ventricular wall thickness in the echocardiographic recording ranged from 1.3-1.5cm. The Sokolov-Lyon criteria detected only 3 of them. The Romhilt - Estes point score system with 4 point detected 3. Whereas the total QRS voltage criteria detected 4 patients with LVH.

The Sokolov-Lyon index- The Sokolov-Lyon Index (SVI + RV5 V6) recorded lowest of 25mm and the highest of 42mm in 9 patients of Mitral regurgitation (pure) with echocardiographic evidence of LVH. In this study out of 14 patients with Mitral regurgitation (pure) 9 has echocardiographic evidence of LVH. Out of these 9 patients S.L Index detected 3. So the Sensitivity for Mitral regurgitation (pure) with S.L index is 33%. The no. of false positive cases was 1.

The Romhilt –Estes Point score system – The maximum point score was 7. In this study out of 14

patients with Mitral regurgitation (pure) 9 had echocardiographic evidence of LVH. Out of these 9 patients The Romhilt –Estes system detected 3, So the Sensitivity for Mitral regurgitation (pure) with The Romhilt - Estes system is 33%. The no. of false positive cases was 1.

Total QRS voltage criteria- In the total QRS voltage criteria the voltage ranged from 136-188 mm. In this study out of 14 patients with Mitral regurgitation (pure) 9 had echocardiographic evidence of LVH. Out of these 9 patients the total QRS voltage criteria detected 4. So the Sensitivity for Mitral regurgitation (pure) with the total QRS voltage criteria is 44%. There was no false positive case.

3) Aortic regurgitation (pure) – Among 65 patients in the study group there were only 3 patients with Aortic regurgitation (pure) and echocardiographic LVH. The left ventricular wall thickness in the echocardiographic recording ranged from 1.2-1.5cm. The Sokolov-Lyon criteria detected only 1 of them. The Romhilt - Estes point score system with 4 point detected 2. Whereas the total QRS voltage criteria detected 2 patients with LVH.

The Sokolov-Lyon index – The Sokolov-Lyon Index (SVI + RV5 V6) recorded lowest of 28mm and the highest of 56mm in 3 patients of Aortic regurgitation (pure) with echocardiographic evidence of L.V.H. In this study out of 7 patients with Aortic regurgitation (pure) 3 had echocardiographic evidence of LVH. Out of these 3 patients S.L Index detected 1, So the Sensitivity for Aortic regurgitation (pure) with S.L index is 33%. The no. of false positive case was 1.

The Romhilt –Estes Point score system – The maximum point score was 8. In this study out of 7 patients with Aortic regurgitation (pure) 3 had echocardiographic evidence of LVH. Out of these 3 patients The Romhilt – Estes system detected 2. So the Sensitivity for Aortic regurgitation (pure) with The Romhilt - Estes system is 66%. The false positive case was only 1.

Total QRS voltage criteria- In the total QRS voltage criteria the voltage ranged from 166-240mm. In this study out of 7 patients with Aortic regurgitation (pure) 3 had echocardiographic evidence of LVH. Out of these 3 patients the total QRS voltage criteria detected 2. So the Sensitivity for Aortic regurgitation (pure) with the total QRS voltage criteria is 66%. There was no false positive case.

4) Aortic stenosis (pure)- Out of 65 patients in the study group there were only 4 patients with Aortic stenosis (pure) and echocardiographic LVH. The left ventricular wall thickness in the echocardiographic recording ranged from 1.3-1.5cm. The Sokolov-Lyon criteria detected only 1 of them. The Romhilt - Estes point score system with 4

point detected 2. Whereas the total QRS voltage criteria detected 3 patients with LVH.

The Sokolov-lyon index – The Sokolov-lyon Index (SVI + RV5 V6) recorded lowest of 19mm and the highest of 62mm in 6 patients of Aortic stenosis (pure) with echocardiographic evidence of LVH. In this study out of 4 patients with Aortic stenosis (pure) had echocardiographic evidence of LVH. Out of these 4 patients S.L Index detected 1. So the Sensitivity for Aortic stenosis (pure) with S.L index is 25%. The no. of false positive cases was 1.

The Romhilt –Estes Point score system – The maximum point score was 7. In this study out of 6 patients with Aortic stenosis (pure) 4 had echocardiographic evidence of LVH. Out of these 4 patients The Romhilt –Estes system detected 2. So the Sensitivity for Aortic stenosis (pure) with The Romhilt -Estes system is 50%. The no. of false positive cases was 1.

Total QRS voltage criteria- In the total QRS voltage criteria the voltage ranged from 138-216mm. In this study out of 6 patients with 4 had echocardiographic evidence of LVH. Out of these 4 patients the total QRS voltage criteria detected 3. So the Sensitivity for Aortic stenosis (pure) with the total QRS voltage criteria is 75%. There was 1 false positive case.

5) Combined lesions- Out of 65 patients in the study group there were only 10 patients with combined lesions and echocardiographic LVH. The left ventricular wall thickness in the echocardiographic recording ranged from 1.3-1.7cm. The Sokolov-lyon criteria detected only 4 of them. The Romhilt - Estes point score system with 4 point detected 7. Where as the total QRS voltage criteria detected 8 patients with LVH.

The Sokolov-Lyon index – The Sokolov-Lyon Index (SVI + RV5 V6) recorded lowest of 32mm and the highest of 58mm in 4 patients of Combined lesions with echocardiographic evidence of LVH. In this study out of 15 patients with Combined lesions 10 had echocardiographic evidence of LVH. Out of these 10 patients S.L Index detected 4. So the Sensitivity for Combined lesions with S.L index is 40%. The no. of false positive cases was 1.

The Romhilt –Estes Point score system –The maximum point score was 8. In this study out of 15 patients with Combined lesions 10 had echocardiographic evidence of LVH. Out of these 10 patients The Romhilt – Estes system detected 7. That gives the Sensitivity for Combined lesions with The Romhilt-Estes system is 70%. The no. of false positive cases was 2.

Total QRS voltage criteria- In the total QRS voltage criteria the voltage ranged from 149-300mm. In this study out of 15 patients with combined lesions 10 had

echocardiographic evidence of LVH. Out of these 10 patients the total QRS voltage criteria detected 8. So the Sensitivity for Combined lesions with the total QRS voltage criteria is 80%. There was 1 false positive case.

SUMMARY AND CONCLUSION

The study was carried out on 100 patients for finding the role played by electrocardiogram in the diagnosis of left ventricular hypertrophy. The sensitivity was in the range of 80% for total QRS voltage criteria to 33% for S.L criteria. Sensitivity was more for total QRS voltage criteria in all diseases. Sensitivity was more in case of combined lesions for all criterias. ECG can still be recommended as a routine investigation for LVH because of its cost effectiveness and easy availability but should not be used to rule out LVH.

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