SENSITIVITY AND SPECIFICITY OF ROMHILT-ESTES POINT SCORE SYSTEM FOR DETECTING LEFT VENTRICULAR HYPERTROPHY

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ABSTRACT

The present study was conducted to determine the sensitivity and specificity of Romhilt and Estes point score system of ECG for the assessment of left ventricular hypertrophy by comparing it with the gold standard of echocardiography. Fifty clinically diagnosed patients of LVH were included in this collaborative study of Dept. of Physiology, Army Medical College, Rawalpindi and Department of Cardiology, Armed Forces Institute of Cardiology, Rawalpindi. ECG of the patients were recorded and Romhilt-Estes point score calculated. This was followed by echocardiography and left ventricular mass and left ventricular mass index was calculated. It was found that Romhilt-Estes point score system had a sensitivity of 35% and specificity of 90%. The sensitivity of ECG is low in detecting LVH, however, sensitivity can be increased by combining Sokolow Lyons voltage criteria and Cornell voltage criteria with Romhilt-Estes point score. ECG is however still recommended as a routine investigation because of its cost effectiveness and easy availability.

Keywords: Left ventricular hypertrophy, ECG, echocardiography, Romhilt-Estes Point score system

INTRODUCTION

Left ventricular hypertrophy (LVH) is associated with a substantially increased risk of cardiac morbidity and mortality [1-4], so its detection is of major importance, especially for individuals with hypertension or other cardiovascular risk factors. Left ventricular hypertrophy is no longer considered 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 failure [5,6]. According to Devereux et al [7], the increase in left ventricular mass represents a common final pathway towards the adverse effects on the cardiovascular system and higher vulnerability to complications [3].

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Several criteria exist for the electrocardiographic detection of left ventricular hypertrophy (LVH). From the earliest times of electrocardiographic use, many indices for the magnitude and duration of QRS complexes have been developed. Electrocardiographic evidence of left ventricular hypertrophy is one of the most widely used markers of cardiovascular morbidity and mortality [8]. It has become a clinical priority to precociously detect left ventricular hypertrophy by effective, low-cost screening, applicable to the population in general. [9,10].

Despite their high specificity, the ECG indices still bear low sensitivity. Although echocardiography has become the gold standard for LVH detection in clinical

practice, ECG remains widely used due to its simplicity and accessibility. Caution should nevertheless be taken when using ECG criteria for LVH detection because they exhibit only limited accuracy (generally due to poor sensitivity) [11-14]. Furthermore, their unrestricted applicability to nonwhite individuals remains to be demonstrated. Historically, these criteria have been almost exclusively elaborated on and calibrated in white (or mixed) populations, and several interethnic differences in ECG characteristics have been demonstrated [15-18].

The present study was designed to study one of the ECG criteria for detection of LVH by comparing it with the gold standard of echocardiography.

MATERIAL AND METHODS

The present study was conducted from June 2002 to March 2003 in Armed Forces Institute of Cardiology / National Institute of Heart Diseases (AFIC/NIHD). Fifty patients of either sex between the ages of 13 – 65 years who were provisionally diagnosed by the cardiologist on the basis of clinical signs and symptoms, for LVH were included in the study.

Obese, smokers, and patients with physical abnormalities of chest wall such as kyphosis or scoliosis were excluded from the study. Known cases of ischemic heart diseases, obstructive lung disease and patients manifesting ECG findings of bundle branch block, atrial fibrillation or flutter and Wolff Parkinson-White syndrome were not included. Patients on digitalis therapy or other drugs, which can alter ECG, were also excluded.

General physical examination of the patients was done and detailed history was taken. Body surface area and body mass index using the Mosteller formula [19,20] were calculated. A standard 12 lead ECG was recorded with subjects lying comfortably in supine position by Cardiofax electrocardiograph. The machine was calibrated before recording ECG with paper speed at 25mm/sec and amplitude of stylus deflection at 1mV/cm. Romhilt Estes point score was calculated (table).

In the present study a score of ≥ 5 points was considered as LVH. Using 2-D echocardiogram as a guideline M-mode recording was obtained with the help of Toshiba Power Vision 6000 machine. Left ventricular posterior wall thickness (LVPWT), left ventricular internal diameter (LVID) and interventricular septal thickness (IVS), in both systole and diastole, were measured. Left ventricular mass (LVM) was calculated by using Devereux's anatomically validated formula [21].

$$LVM = 1.04 [(LVIDd + IVS + LVPWT)3 – (LVIDd)3 – 13.6$$

Left ventricular mass index (LVMI) was calculated and cut off value for LVH in males and females was taken as 108 gm/m2 and 100gm/m2 [22] respectively.

Statistical Analysis

Data was analyzed by SPSS version 11. Sensitivity (%) was calculated by dividing true positives by the sum of true positives and false negatives, then multiplying the quotient by 100. Sensitivity is the quality of a test to diagnose true cases. Specificity (%) was calculated by dividing true negatives by the sum of true negatives and false positives, then multiplying the quotient by 100. Specificity is the quality of a screening test to identify healthy cases. Cases diagnosed as LVH on both ECG and echocardiography were labeled as True Positive. Those patients who were not diagnosed as LVH on both ECG and echo were True Negative. Those patients whose ECG did not reveal any findings of LVH but were diagnosed as LVH by echocardiography were False Negative. Positive predictive value, negative predictive value and

diagnostic efficacy of the Romhilt – Estes point score system were also calculated.

RESULTS

The age of the patients was 54.08 ± 6.33 years (mean ± standard deviation). The scores ranged between zero (minimum score) and 13 (maximum score). Out of 50 patients studied, the number of true positive cases for Romhilt and Estes Point Score system were 14 and false negative cases were 26. The number of true negatives was 9 while one subject was found to be false positive for the test. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic efficacy of the test were calculated. The calculated sensitivity and specificity were 35% and 90% respectively (figure).

The positive predictive value was 93.33% whereas negative predictive value was 25.71%. The diagnostic efficacy of the test was calculated as 46%.

Influence of Sex

Although prevalence of echocardiographic LVH was higher in women than in men, yet sensitivity of the Romhilt-Estes point score was marginally lower in women (42.85% vs. 44.44%). Specificity was high in both sexes (100% in women and 83.33% in men).

DISCUSSION

Electrocardiographic 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 [23-25]. 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 [25].

The point scoring of Romhilt-Estes had

Table: Romhilt-Estes point score system

Any limb lead 'R' wave or 'S' wave ≥ 2.0 mV	3 Points
S_{V1} or $S_{V2} \geq 3.0$ mV	3 Points
R_{V5} to $R_{V6} \geq 3.0$ mV	3 Points
ST-T wave abnormality (no digitalis therapy)	3 Points
ST-T wave abnormality (digitalis therapy)	1 Points
P terminal force in $V_1 > 4$mV-msec	3 Points
Left axis deviation	1 Point
Intrinsicoid deflection in V_5 or $V_6 \geq 50$ msec	1 Point

Score of 3 points = no LVH
Score of 4 points = probable LVH
Score of 5 points = LVH present
Ventricular Hypertrophy using Echocardiogram as the gold standard

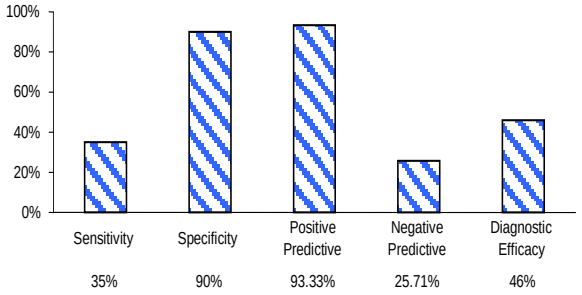

Fig: Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic efficacy of romhilt and estes point score system of ECG in diagnosis of left ventricular hypertrophy using echocardiogram as the gold standard.

60% sensitivity and 98% specificity when the electrocardiogram was compared with findings at necropsy by the scientists Romhilt and Estes [26]. 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. Our study revealed sensitivity in both sexes much lower than that presented by these authors. Specificity was high (90%), similar to the findings in both sexes in our study. In the study by Casale et al [27], sensitivity of the Romhilt-Estes criterion was 33%, similar to that found in the present work (35%). Specificity was high at 94%, quite near to the value calculated in our study. Okin et al [28] evaluated the point scoring in men, finding in comparison with the echocardiogram, a

sensitivity of only 12%, with a specificity of 100% for the Romhilt-Estes criterion. Devereux et al [25] found a sensitivity of 34% and a specificity of 98% in the comparison with left ventricular mass shown by the echocardiogram, without differences between results for either sex. Sensitivity in that study was very close to sensitivity found in the present study.

We found that the sensitivity of the Romhilt-Estes point score system of ECG for echocardiographic LVH is marginally lower in women than in men, possibly because of attenuation of QRS voltage by the greater spatial separation of myocardium from precordial electrodes because of breast tissue in women. Consistent with this is the finding that precordial QRS voltage is lower in women than in men. [29]. Similarly mastectomy results in increased QRS amplitude [30]. Diminished Electrocardiographic sensitivity in women might also be, in part, a result of less voltage generated by the female heart, which contains approximately 25% less wall mass than the male heart [31]. The findings of this study suggest that the voltage threshold for defining LVH should be lower in women than in men.

The point scoring of Romhilt-Estes showed a low correlation with the echocardiogram, and also was a difficult method to apply, because it was dependent on a close subjective analysis, which may generate doubts and cannot always be regularly applied, as for instance, in atrial fibrillation.

However the sensitivity of ECG to detect LVH can be increased by adding Cornell Voltage criteria and Sokolw Lyons voltage criteria to Romhilt-Estes point score system.

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