Accuracy of ECG Criteria for Diagnosis of Left Ventricular Hypertrophy in Various Body Mass Index Groups: A Comparison with Cardiac Magnetic Resonance

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Background: Patients with left ventricular hypertrophy (LVH) increases risk for cardiovascular event. There are many electrocardiographic (ECG) criteria for diagnosis of LVH. Higher body mass index (BMI) has been shown to be associated with lower ECG amplitudes in similar LV mass.

Objective: To determine the sensitivity, specificity and accuracy of ECG criteria for diagnosis of LVH in various BMI groups in comparison with Cardiac magnetic resonance (CMR).

Methods: We investigated patients who underwent CMR during 2005-2009. ECG and CMR were performed in the same day. CMR was done to evaluate left ventricular function, volume, and mass. Indices of CMR variables were calculated by index to body surface area (BSA). Standard ECG criteria were measured: Sokolow-Lyon, Sokolow-Lyon-Rappaport, Romhilt-Estes point score system (score of at least 4 and 5 points calculated), Cornell voltage, Cornell product, and sum of 12 leads QRS voltage. A number of 184 healthy volunteers were performed CMR as control group. Patients were considered to have LVH when LVMASSI above 95% of LVMASSI in the control group. Diagnostic performance of each ECG criteria were calculated and analyzed in 4 BMI groups: underweight (BMI < 18.5 kg/m²), normal (BMI 18.5-22.9 kg/m²), overweight (BMI 23-24.9 kg/m²), and obesity (BMI ≥ 25 kg/m²) groups.

Results: A total of 1882 patients were studied with 67 underweight patients, 459 normal patients, 434 overweight patients, and 922 obesity patients. LVH were diagnosed in 34 (50.7%) underweight patients, 144 (31.4%) normal patients, 100 (23.0%) overweight patients, and 181 (19.6%) obesity patients. ECG criteria yielded high specificity (0.728-0.970) but low sensitivity (0.210-0.706). The specificity of each ECG criteria among various BMI groups was quite similar, while the sensitivity was decreased in higher BMI groups. The accuracy was increased in higher BMI groups.

Conclusion: All ECG criteria have relative high specificity and low sensitivity. The four criteria with highest specificity were Cornell voltage, Cornell product, Sokolow-Lyon, and Sum QRS 12 leads (similar value). Higher BMI groups are associated with a decrease of sensitivity and an increase of accuracy, while specificity remains quite unchanged. Romhilt-Estes point score system of at least 4 points yields highest sensitivity. Higher BMI groups show inferior sensitivity, probably due to the increased subcutaneous adipose tissue following the increasing of distance between ECG recording electrodes and the heart.

Keywords: Left ventricular hypertrophy, Electrocardiography, Cardiac magnetic resonance, Sokolow-Lyon, Sokolow-Lyon-Rappaport, Romhilt-Estes, Cornell voltage, Cornell product, sum of 12 leads QRS voltage