

UDK: 616.127-007.61-06:616.124.2-007.61-073.96

DIAGNOSTIC VALUE OF ECG CRITERIA FOR LEFT VENTRICULAR HYPERTROPHY IN CARDIOMYOPATHY, ISCHEMIC HEART DISEASE, AND HYPERTENSION

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Abstract: This study evaluated the diagnostic performance of electrocardiographic criteria for left ventricular hypertrophy in patients with hypertrophic cardiomyopathy, ischemic heart disease, and arterial hypertension. A total of 161 patients were examined, with echocardiography used as the reference method. Sokolow-Lyon index and Cornell product were assessed for sensitivity, specificity, and diagnostic accuracy. Left ventricular hypertrophy was detected by ECG in 46% of hypertrophic cardiomyopathy, 25% of ischemic heart disease and hypertension cases, compared with 94% and 65% by echocardiography, respectively. The findings support combined ECG assessment for improved diagnostic assessment.

Keywords: hypertrophic cardiomyopathy; left ventricular hypertrophy; electrocardiography; Sokolow-Lyon index; diagnostic accuracy.

ДИАГНОСТИЧЕСКАЯ ЦЕННОСТЬ ЭКГ-КРИТЕРИЕВ ГИПЕРТРОФИИ ЛЕВОГО ЖЕЛУДОЧКА ПРИ КАРДИОМИОПАТИИ, ИШЕМИЧЕСКОЙ БОЛЕЗНИ СЕРДЦА И АРТЕРИАЛЬНОЙ ГИПЕРТЕНЗИИ

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Аннотация: В исследовании оценена диагностическая информативность электрокардиографических критериев гипертрофии левого желудочка у пациентов с гипертрофической кардиомиопатией, ишемической болезнью

сердца и артериальной гипертензией. Обследован 161 пациент, а эхокардиография использована как верифицирующий метод. Оценивались индекс Sokolow-Lyon и Корнельское произведение по показателям чувствительности, специфичности и диагностической точности. Гипертрофия левого желудочка по ЭКГ выявлена у 46% пациентов с гипертрофической кардиомиопатией и у 25% пациентов с ишемической болезнью сердца и гипертензией, тогда как по эхокардиографии показатели составили 94% и 65% соответственно. Полученные данные подтверждают значение комплексной ЭКГ оценки для диагностики и повышения точности клинической диагностики заболевания.

Ключевые слова: гипертрофическая кардиомиопатия; гипертрофия левого желудочка; электрокардиография; индекс Sokolow-Lyon; диагностическая точность.

Introduction: Left ventricular hypertrophy is a structural manifestation of chronic myocardial overload and is associated with increased cardiovascular morbidity. It may develop in hypertrophic cardiomyopathy, arterial hypertension, and ischemic heart disease, although the underlying mechanisms and degree of myocardial remodeling differ between these conditions. Electrocardiography remains available and inexpensive, making ECG-based recognition of left ventricular hypertrophy clinically useful when echocardiography is not immediately available. However, the diagnostic performance of individual ECG criteria depends on the underlying cardiac disease and the degree of ventricular remodeling. The Sokolow-Lyon index and Cornell product are among the established voltage-based criteria used to identify increased left ventricular mass. Their diagnostic value is determined by sensitivity, specificity, false-negative results, false-positive results, and overall diagnostic accuracy. In hypertrophic cardiomyopathy, marked myocardial thickening can produce characteristic electrical changes, whereas patients with ischemic heart disease or arterial hypertension may demonstrate less pronounced ECG manifestations despite structural hypertrophy. Therefore, comparison of ECG

findings with echocardiographic measurements is important for understanding the practical limitations of electrocardiographic screening. The source study examined patients with hypertrophic cardiomyopathy, ischemic heart disease, and arterial hypertension and assessed ECG criteria against echocardiography as the verification method. Particular attention was given to the relationship between ECG findings and myocardial thickness, left ventricular mass, and ventricular cavity dimensions. A clinically appropriate combination of ECG criteria may improve identification of left ventricular hypertrophy and support further echocardiographic evaluation.

Aim of the study: To evaluate the diagnostic performance of the Sokolow-Lyon index and Cornell product for detecting left ventricular hypertrophy in patients with hypertrophic cardiomyopathy, ischemic heart disease, and arterial hypertension, using echocardiography as the verification method.

Materials and methods. The prospective study examined 161 patients, including 50 patients with hypertrophic cardiomyopathy, 60 patients with ischemic heart disease, and 51 with arterial hypertension. The hypertrophic cardiomyopathy group included 20 women and 30 men, mean age 44.6 ± 2.20 years. The ischemic heart disease and arterial hypertension groups included 56 women and 55 men, mean age 49.5 ± 1.46 years. Hypertrophic cardiomyopathy was established according to accepted recommendations and was characterized by left ventricular myocardial thickness greater than 1.5 cm, increased cardiac mass without enlargement of ventricular cavities, and left ventricular diastolic dysfunction. ECG assessment included the Sokolow-Lyon index for left ventricular hypertrophy, defined as $Rv5 + SV1 > 38$ mm, and the Cornell product, calculated from $RaVL + SV3$ with an additional 6 mm for women and multiplied by QRS duration, with a threshold above 2440 mm×ms. Patients with bundle branch blocks were excluded during the study period for each participant. Echocardiography was used for verification. Echocardiographic assessment included left ventricular end-diastolic dimension, interventricular septal thickness, posterior wall thickness, left ventricular

myocardial mass, anterior right ventricular wall thickness, and right ventricular end-diastolic dimension. Left ventricular hypertrophy by echocardiography was defined by indexed myocardial mass of at least 125 g/m² in men and 110 g/m² in women. Diagnostic sensitivity, specificity, accuracy, false-negative, and false-positive rates were calculated for criteria and combinations. Nonparametric tests and chi-square analysis were used for statistical comparisons, with data presented as mean ± standard error.

Results. Electrocardiographic left ventricular hypertrophy also was identified in 23 of 50 patients with hypertrophic cardiomyopathy, or 46%, whereas echocardiography demonstrated increased left ventricular mass in 47 patients, or 94%. Among patients with ischemic heart disease and arterial hypertension, ECG identified left ventricular hypertrophy in 28 of 111 patients, or 25%, while echocardiography identified it in 72 patients, or 65%. In the overall cohort, the Sokolow-Lyon index showed sensitivity of 32.5%, specificity 100%, diagnostic accuracy of 50.0%, a false-negative rate of 67.5%, and a false-positive rate of 0%. The Cornell product demonstrated sensitivity of 31.1%, specificity of 95.4%, accuracy of 48.2%, a false-negative rate of 69.0%, and a false-positive rate of 4.70%. Using both criteria increased sensitivity to 36.8%, with specificity of 95.6% and accuracy of 49.3%. In the hypertrophic cardiomyopathy group, the Sokolow-Lyon index had sensitivity of 48.9% and specificity of 100%, while the Cornell product showed sensitivity of 44.7% and specificity of 66.7%. In ischemic heart disease and arterial hypertension, Sokolow-Lyon sensitivity was 22.2% with 100% specificity, while Cornell sensitivity was 22.2% with 97.4% specificity. Combined criteria had sensitivity of 47.9% and specificity of 80.0% in hypertrophic cardiomyopathy, compared with 28.4% and 97.5% in ischemic heart disease and arterial hypertension. Patients with ECG-defined hypertrophy had greater myocardial mass and wall thickness, whereas left ventricular cavity dimension did not differ significantly. For hypertrophic cardiomyopathy diagnosis,

the three tested ECG sets showed sensitivity of 38%, 47%, and 56%, specificity of 89%, 94%, and 88%, and diagnostic accuracy of 74%, 80%, and 78%, respectively.

Conclusions: ECG criteria for left ventricular hypertrophy demonstrated high specificity but limited sensitivity across studied cardiac conditions. The Sokolow-Lyon index reached 100% specificity and showed the highest sensitivity among the individual criteria, although false-negative findings remained frequent. ECG detected hypertrophy less often than echocardiography, particularly in ischemic heart disease and arterial hypertension. Combining ECG signs improved sensitivity for identifying hypertrophic cardiomyopathy, with sensitivity reaching 56%, specificity 88%, and diagnostic accuracy 78% for the broadest criterion set. The presence of ECG hypertrophy was associated mainly with increased myocardial wall thickness rather than ventricular cavity size. These findings support the use of ECG as an initial screening method, followed by echocardiographic verification when hypertrophy is suspected.

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