Original article

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The Diagnostic Value of Electrocardiographic Criteria for Right Ventricular Hypertrophy

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AIM. To evaluate the diagnostic utility of current electrocardiographic criteria for right ventricular hypertrophy in residents of Saint Petersburg.
PATIENTS AND METHODS. This single-center retrospective case — control study included 212 patients. The main group consisted of 106 patients with echocardiographically confirmed RVH, and the control group consisted of 106 patients without RVH, matched by sex and age. The 30 ECG criteria were analyzed according to the AHA/ACCF/HRS guidelines and the National Guide to Functional Diagnostics.
RESULTS. Most criteria showed high specificity (average 90.8%) but low sensitivity (14.6%). The criterion (RI+SIII) — (SI+RIII)<15 mm demonstrated abnormally high sensitivity (86.8%) with low specificity (19.8%). Statistically significant differences were found for 10 criteria, the highest sensitivity among which was characterized by the T wave inversion in V_1-V_3 (sensitivity 32.1%, specificity 93.4%) and the combination of SI+QIII (sensitivity 34.9%, specificity 82.1%).
CONCLUSION. Existing ECG criteria are effective for confirming RVH when used independently, but cannot be used for screening due to their low sensitivity. It is advisable to develop algorithms for ECG diagnostics of RVH that take into account the results of evaluating combined criteria and the population characteristics of their use.

KEYWORDS: Right Ventricular Hypertrophy, Electrocardiography, Diagnostic Criteria, Sensitivity, Specificity, Predictive Value, Criteria Validation

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Диагностическая ценность электрокардиографических критериев гипертрофии правого желудочка

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ЦЕЛЬ. Оценить диагностическую эффективность 30 электрокардиографических (ЭКГ) критериев гипертрофии правого желудочка (ГПЖ) у пациентов Санкт-Петербурга.
ПАЦИЕНТЫ И МЕТОДЫ. Проведено одноцентровое ретроспективное исследование типа «случай — контроль» с включением 212 пациентов. Основную группу составили 106 пациентов с верифицированной по эхокардиографии ГПЖ, группу контроля — 106 пациентов без ГПЖ, сопоставимых по полу и возрасту. Анализировали 30 ЭКГ-критериев в соответствии с рекомендациями AHA/ACCF/HRS и Национального руководства по функциональной диагностике.
РЕЗУЛЬТАТЫ. Большинство критериев характеризовались высокой специфичностью (среднее значение 90,8%) при низкой чувствительности (14,6%). Критерий (RI+SIII) — (SI+RIII)<15 мм показал аномально высокую чувствительность (86,8%) при низкой специфичности (19,8%). Статистически значимые различия выявлены для 10 критериев, наибольшей чувствительностью среди которых характеризовались инверсия T в V_1-V_3 и комбинация SI+QIII (чувствительность 32,1% и 34,9%, специфичность 93,4% и 82,1% соответственно).
ЗАКЛЮЧЕНИЕ. Существующие ЭКГ-критерии при самостоятельном применении эффективны для подтверждения ГПЖ, но из-за низкой чувствительности не могут применяться для скрининга. Целесообразна разработка алгоритмов ЭКГ-диагностики ГПЖ, учитывающих результаты оценки комбинированных критериев и популяционные особенности их применения.

КЛЮЧЕВЫЕ СЛОВА: гипертрофия правого желудочка, электрокардиография, диагностические критерии, чувствительность, специфичность, прогностическая значимость, валидация критериев

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INTRODUCTION

Right ventricular hypertrophy (RVH) is a structural and functional adaptation of the myocardium which develops as a result of cardiac pathology, such as congenital and acquired valvular heart disease, or respiratory disorders accompanied by pulmonary hypertension, including chronic obstructive pulmonary disease, emphysema, and bronchial asthma [1]. According to the national guidelines on functional diagnostics, the anatomical criteria for diagnosing RVH include a right ventricular wall thickness exceeding 5 mm and myocardial mass exceeding 70 g [2]. Initially, myocardial hypertrophy serves as a compensatory mechanism, but prolonged overloading leads to fibrosis, resulting in systolic and diastolic dysfunction [3].

The most common causes of RVH are conditions that lead to pulmonary hypertension, such as chronic obstructive pulmonary disease, valvular heart disease, and pulmonary embolism, as well as congenital heart defects that involve shunting. In some cases, RVH may also be caused by primary myocardial involvement, such as arrhythmogenic right ventricular cardiomyopathy, or by multifactorial mechanisms [4]. Early detection of RVH is important for the timely diagnosis of these conditions and diseases. This allows for the initiation of a more comprehensive diagnostic workup, including more specific imaging techniques, which can help to reduce the risk of complications, disability, and death.

Among the instrumental methods for diagnosing RVH (echocardiography, magnetic resonance imaging, computed tomography, radionuclide ventriculography), electrocardiography (ECG) remains the most widely available tool, allowing signs of RVH to be identified at the initial stage of evaluation, thereby guiding further diagnostic investigation and facilitating timely therapy. To date, more than 30 ECG criteria for RVH have been developed. They are presented in various combinations in current national [2, 5] and AHA/ACCF/HRS guidelines [6]. The value of ECG for diagnosing RVH is supported by data from national and international studies. RVH has been shown to be a predictor of cardiovascular mortality [7], and its severity determines outcomes after cardiac surgery [8]. A close relationship has been shown between the left and right ventricles in patients with coronary artery disease without a myocardial infarction [9]. One of the ECG criteria for right ventricular hypertrophy (RVH) — the QR complex in lead V_1 — has been identified as a prognostic marker for severe right heart involvement in patients with pulmonary hypertension [10].

AHA/ACCF/HRS guidelines [6] highlight the need for further validation of existing criteria and the development of new ones that take into account local population characteristics. Despite the long history of ECG-based diagnosis, there have been no large-scale validation studies in Russia on RVH ECG criteria that consider the specific features of the Russian population.

Objective: To evaluate the diagnostic utility of current electrocardiographic criteria for right ventricular hypertrophy in residents of Saint Petersburg.

MATERIALS AND METHODS

A single-center, retrospective case — control study analyzed data from 212 patients. The study was conducted at the City Consultative and Diagnostic Center No. 1, Saint Petersburg, in 2023. The study complied with ethical standards, including the Declaration of Helsinki (as amended in 2000) and the "Rules of Clinical Practice in the Russian Federation" (Order No. 266 of the Ministry of Health of the Russian Federation, June 19, 2003). All participants gave informed consent and agreed to the processing of their personal data.

The main group comprised 106 patients with RVH verified by echocardiography. Inclusion criteria were: age ≥18 years; presence of a 12-lead ECG recorded in accordance with the Russian Society of Cardiology guidelines [11]; confirmation of RVH by echocardiography within 1 month before or after the ECG (right ventricular wall thickness > 0.5 cm and/or right ventricular diameter > 42 mm); and availability of a cardiologist's report. Exclusion criteria were: ventricular pacing, ventricular rhythm and arrhythmias, and complete left bundle branch block. An example of ECGs from a patient with RVH is shown in Figure 1.

A control group was assembled using a 1:1 matching process with the main group. For each patient with echocardiographically confirmed RVH, we identified all potential control subjects without RVH who had undergone echocardiography during the same

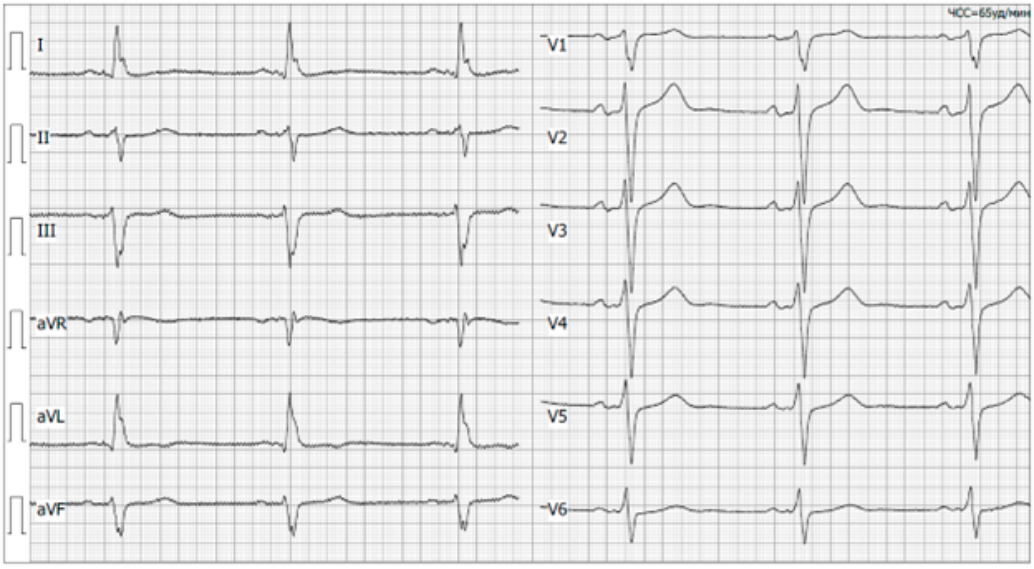

Figure 1. *Electrocardiogram of a 59-year-old male from the main study group. Multiple criteria for RVH are present, including an S wave in V_5 > 10 mm, S wave in V_6 > 3 mm, S waves in V_5 and V_6 ≥ 0.7 mV, an R/S ratio in V_5 < 0.75, and an R/S ratio in V_5 and V_6 ≤ 1.0.*

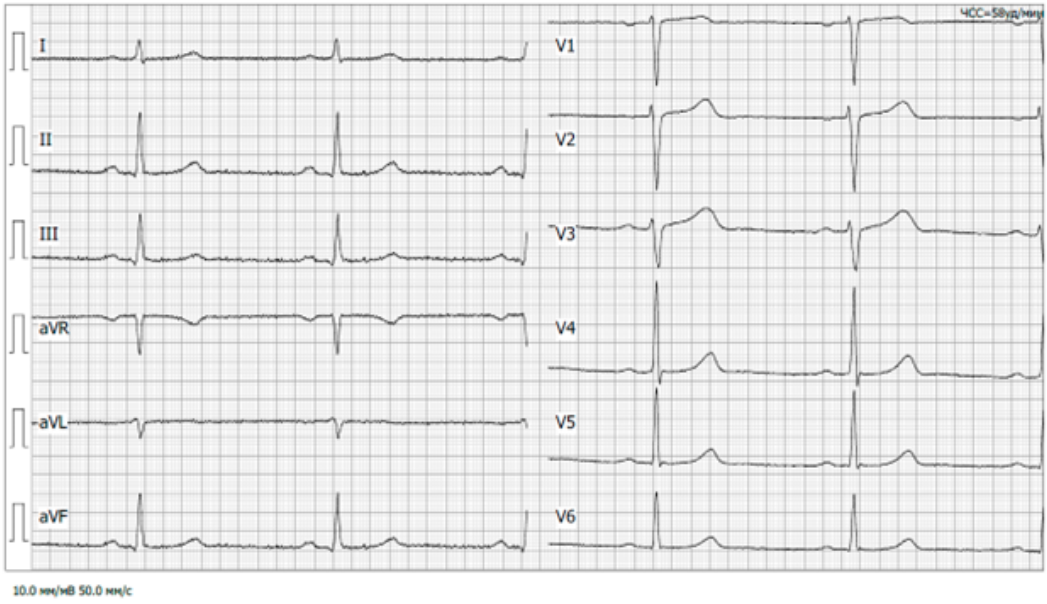

Figure 2. *Electrocardiogram of a 43-year-old female from the comparison group in whom RVH was excluded by echocardiography. The Lewis index (RI + SIII) – (SI + RIII) < 15 mm is clearly present.*

time period. From this pool of potential controls, one control subject was randomly selected after matching for sex and age (±5 years) and applying identical exclusion criteria. The matching process was performed

without taking into account data of any other clinical characteristics, such as hypertension or aortic valve disease, which were deliberately excluded from the matching algorithm. Figure 2 shows an example of an ECG of a patient with no RVH.

The study protocol included analysis of demographic data (age, sex), clinical diagnoses, echocardiographic parameters, and ECG parameters (right ventricular wall thickness and basal diameter). The ECGs were recorded using the Kardiometr-MT device with standard settings that comply with the methodological recommendations "Recording of Resting 12-Lead Electrocardiogram in Adults and Children" from 2023 [11]. Thirty ECG criteria for RVH were evaluated in accordance with AHA/ACCF/HRS guidelines [6] and the National Guidelines on Functional Diagnostics [2].

Measurements were performed manually by two independent trained cardiologists using a digital caliper tool integrated into the ECG software; any discrepancies were resolved by consensus. For amplitude criteria, the voltage was measured from the isoelectric line (TP segment) to the peak of the respective deflection, with a minimum of three consecutive complexes averaged. Duration criteria (e.g. QRS duration) were measured from the onset to the termination of the corresponding deflection. The presence of specific patterns (e.g., QR in V_1, RSR' in V_1, ST-T changes) was assessed visually by the same readers.

Statistical analysis was performed using MS Excel and Jamovi 2.3.38. Sensitivity, specificity, and positive and negative predictive values (PPV, NPV) were calculated with confidence intervals. The χ^2 test with Yates' continuity correction was used to compare groups, and a p-value < 0.05 was considered statistically significant.

RESULTS

The study included 212 patients evaluated at the City Consultative and Diagnostic Center No. 1, Saint Petersburg, in 2023. The main group consisted of 106 patients: 65 (61.3%) men and 41 (38.7%) women, mean age 65 ± 12 years. The control group comprised 106 patients matched for sex and age: mean age 65 ± 12 years, 65 (61.3%) men and 41 (38.7%) women.

Analysis of disease prevalence showed the following differences between groups: patients with RVH had congenital heart defects more frequently than control group (9.4% vs. 0.9%; $p = 0.006$) and acquired mitral and/or tricuspid valve disease (12.3% vs. 1.9%; $p = 0.004$), whereas the control group had a significantly higher prevalence of hypertension (86.7% vs. 65.1% in the RVH group; $p < 0.001$) and aortic valve disease (8.5% vs. 0%; $p = 0.003$). No significant differences were observed in the frequency of coronary artery disease, post-infarction or post-myocarditic cardiosclerosis, or chronic lung disease. One patient with primary pulmonary hypertension was included in the main group; the difference between groups in the number of patients with a history of pulmonary embolism approached significance (7.6% in the main group vs. 2% in the control group, $p = 0.052$).

For each criterion listed in the AHA/ACCF/HRS guidelines [6] and the National Guidelines on Functional Diagnostics [2], the prevalence in the main and control groups was calculated, and statistical significance was assessed using the χ^2 test.

Criteria from the National Guidelines on Functional Diagnostics [2] were present in 63 (57.6%) patients in the main group, with a mean of 2.7 criteria per patient. The point to note is that in the control group, at least one criterion for RVH was identified in 97 patients (89.8%), with an average of 3.1 criteria per patient. Within this set, the most frequently observed criteria were $RV_1 + SV_5 \geq 1.05$ mV (21.7%), R/S ratio in $V_1 \geq 1.0$ (17.0%), S wave amplitude in leads V_5–$V_6 \geq +0.7$ mV (17.9%), and reduced R wave amplitude in V_5 or $V_6 < 0.5$ mV (15.1%).

Criteria from the AHA/ACCF/HRS guidelines [6] were identified in 102 (96.2%) patients with RVH, with a mean of 3.6 criteria per patient. The most prevalent were: (RI + SIII) — (SI + RIII) < 15 mm (86.8%), the combination SI + QIII (34.9%), T-wave inversion in leads V_1–V_3 (32.1%), increased S wave amplitude in $V_6 > 3$ mm (20.8%), and $RV_1 + SV_5$–$V_6 > 10.5$ mm (17.9%). Combined use of all these criteria identified RVH in 102 cases (96.2%).

The least prevalent (less than 5% in the main group) were: decreased R/S ratio in $V_6 < 0.4$, decreased (R/S in V_5)/(R/S in V_1) < 0.04, R/S V_5 to R/S V_1 ratio ≤ 0.4, and low R wave amplitude in V_5–$V_6 < 3$ mm.

Statistical analysis using the χ^2 test revealed significant differences between the main and control

groups for 10 parameters: rightward QRS axis deviation > 100°, ST-segment depression in leads V_1–V_3, reduced R wave amplitude in V_5–V_6 < 0.5 mV, increased S wave amplitude in V_5–V_6 ≥0.7 mV, tall R wave in aVR > 4 mm, QR-type QRS complex in V_1, complete right bundle branch block, S wave dominance over R wave in leads I, II, and III, the combination SI + QIII, and T-wave inversion in V_1–V_3.

Sensitivity, specificity, PPV, and NPV were calculated for each criterion. The results are presented in three tables, which group the criteria according to their electrophysiological basis: amplitude and voltage measurements in the chest leads (Table 1), R/S ratio indices (Table 2), and limb-lead, axis, morphologic, and repolarisation parameters (Table 3).

Among amplitude-based criteria in the precordial leads eleven criteria (Table 1), sensitivity was generally low, exceeding 20% only for deep S waves in lead V_6 (> 3 mm; 20.7%) and the combined index $RV_1 + SV_5$ ≥ 1.05 mV (21.7%). Exceptions with particularly low sensitivity (< 5%) included decreased R-wave amplitude in V_5–V_6 (< 3 mm; 2.8%). Specificity in this group was high throughout, ranging from 84.9% ($RV_1 + SV_{5,6}$ > 10.5 mm and $RV_1 + SV_5$ ≥ 1.05 mV) to 99.0% (R $V_{5,6}$ < 3 mm). PPV values varied widely, from 54.3% to 79.2%, whereas NPV remained in a narrow range (50.5–53.7%).

The second group included eight indices derived from R-to-S wave ratios in the precordial leads (Table 2). Sensitivity was modest across all criteria in this category, ranging from 0.94% for R/S ratio in V_6 < 0.4 and (R/S in V_5)/(R/S in V_1) < 0.04 to 17.9% for R/S ratio in V_1 ≥ 1.0. In contrast, specificity was uniformly high, reaching 100% for the two ratio products [(R/S in V_5)/(R/S in V_1) < 0.04 and (R/S V_5)/(R/S V_1) ≤ 0.4]. PPV for criteria with 100% specificity approached 100%, while NPV remained close to 50% for all criteria.

The third heterogeneous group of twelve criteria (Table 3) demonstrated the widest spread of diagnostic value. The index (RI + SIII) — (SI + RIII) < 15 mm stood out with an exceptionally high sensitivity of 86.8%, but meanwhile had the lowest specificity (19.8%). Aside from this outlier, sensitivity values were generally low, ranging from 6.6% (P-wave amplitude in lead II > 2.5 mm) to 34.9% (SI + QIII). The

Table 1

Diagnostic value of ECG Criteria for RVH derived from precordial leads

Criterion	Sensitivity, % (95% CI)	Specificity, % (95% CI)	PPV, % (95% CI)	NPV, % (95% CI)
R in V_1 > 6 mm	12.3 (6.7–20.0)	90.6 (83.3–95.4)	56.5 (37.4–73.9)	50.8 (48.4–53.1)
S in V_5 > 10 mm	5.7 (2.1–11.9)	96.2 (90.6–98.9)	60.0 (30.4–83.8)	50.5 (49.0–52.0)
S in V_6 > 3 mm	20.7 (13.5–29.7)	85.9 (77.7–91.9)	59.5 (44.6–72.7)	52.0 (48.9–55.1)
S V_1 < 2 mm	9.4 (4.6–16.7)	92.5 (85.7–96.7)	55.6 (33.9–56.9)	50.5 (48.5–52.6)
R $V_{5,6}$ < 3 mm	2.8 (0.6–8.1)	99.0 (94.9–99.9)	75.0 (24.1–96.6)	50.5 (49.6–51.4)
$RV_1 + SV_{5,6}$ > 10.5 mm	17.9 (11.2–26.6)	84.9 (76.7–91.1)	54.3 (39.3–68.6)	50.9 (47.9–53.8)
$RV_1 + SV_5$ ≥ 1.05 mV	21.7 (14.3–30.8)	84.9 (76.7–91.1)	59.0 (44.6–71.9)	52.0 (48.8–55.2)
RV_1 ≥ 0.7 mV	10.4 (5.3–17.8)	92.5 (85.7–96.7)	57.9 (36.6–76.7)	50.8 (48.7–52.9)
R in V_5, V_6 < 0.5 mV	15.1 (8.9–23.4)	95.3 (89.3–98.5)	76.2 (54.9–89.4)	52.9 (50.6–55.1)
S in leads V_5, V_6 ≥ 0.7 mV	17.9 (11.2–26.6)	95.3 (89.3–98.5)	79.2 (59.6–90.7)	53.7 (51.3–65.2)
Max R $V_{1,2}$ + max S I, aVL — S V_1 > 6 mm	11.3 (5.9–18.9)	92.5 (85.7–96.7)	60.0 (38.9–77.9)	51.0 (44.9–53.2)

CI — confidence interval, NPV — negative predictive value, PPV — positive predictive value

Table 2

Diagnostic value of ECG Criteria for RVH derived from R/S ratio indices

Criterion	Sensitivity, % (95% CI)	Specificity, % (95% CI)	PPV, % (95% CI)	NPV, % (95% CI)
R/S ratio in $V_1 > 1.0$	17.0 (10.4–25.5)	88.7 (81.1–94.0)	60.0 (43.2–74.7)	51.6 (48.9–54.4)
R/S ratio in $V_1 \geq 1.0$	17.9 (11.2–26.6)	89.6 (82.2–94.7)	63.3 (46.4–77.5)	52.2 (49.5–54.9)
R/S ratio in $V_5 < 0.75$	5.7 (2.1–11.9)	98.1 (93.4–99.8)	75.0 (38.3–93.6)	50.9 (49.6–52.3)
R/S ratio in $V_6 < 0.4$	0.9 (0.02–5.1)	99.1 (94.9–99.9)	50.0 (43.1–56.9)	50.0 (49.3–50.7)
(R: S in V_5) / (R: S in V_1) < 0.04	0.9 (0.02–5.1)	100 (96.6–100)	100 (2.5–100)	50.2 (49.8–50.7)
(R/S V_5) / (R/S V_1) ≤ 0.4	2.8 (0.6–8.1)	100 (96.6–100)	100 (29.2–100)	50.7 (49.9–51.5)
R/S ratio in V_1 > R/S ratio in $V_{3,4}$	13.2 (7.4–21.2)	92.5 (85.7–96.7)	63.6 (43.4–80.0)	51.6 (49.3–53.9)
R/S ratio in V_5, $V_6 \leq 1.0$	12.3 (6.7–20.1)	93.4 (86.9–97.3)	65.0 (43.6–81.7)	51.6 (49.4–53.7)
R/S ratio in $V_1 > 1.0$	17.0 (10.4–25.5)	88.7 (81.1–94.0)	60.0 (43.2–74.7)	51.6 (48.9–54.4)

CI — confidence interval, NPV — negative predictive value, PPV — positive predictive value

Table 3

Diagnostic value of limb-lead, axis, morphologic, and repolarisation ECG criteria for RVH

Criterion	Sensitivity, % (95% CI)	Specificity, % (95% CI)	PPV, % (95% CI)	NPV, % (95% CI)
R aVR > 4 mm	13.2 (7.4–21.2)	96.2 (90.6–98.9)	77.8 (54.4–91.1)	52.6 (50.5–54.7)
R in aVR ≥ 0.5 mV	9.4 (4.6–16.7)	96.2 (90.6–99.0)	71.4 (44.7–88.5)	51.5 (49.7–53.3)
(RI + SIII) — (SI + RIII) < 15 mm	86.8 (78.8–92.6)	19.8 (12.7–28.7)	51.9 (48.9–54.9)	60.0 (44.7–73.6)
SI + QIII	34.9 (25.9–44.8)	82.1 (73.4–88.9)	66.1 (54.6–76.0)	55.8 (51.7–59.8)
S > R in I, II, III	7.6 (3.3–14.3)	100 (96.6–100)	100 (63.1–100)	52.0 (50.6–53.3)
Marked right QRS axis deviation (> 100°)	8.5 (4.0–15.5)	100 (96.6–100)	100 (66.4–100)	52.2 (50.8–53.7)
P-wave amplitude in lead II > 2.5 mm	6.6 (2.7–13.5)	96.2 (90.6–99.0)	63.6 (34.6–85.3)	50.8 (49.2–52.3)
Intrinsicoid deflection in V_1 > 0.035 s (QRS duration < 0.12 s)	11.3 (6.0–18.9)	83.0 (74.5–89.6)	40.0 (25.3–56.8)	48.4 (45.6–51.1)
QR-type QRS in V_1	12.3 (6.7–20.1)	99.1 (94.9–99.9)	92.9 (63.4–99.0)	53.0 (51.2–54.9)
RSR' in lead V_1 (QRS duration > 0.12 s)	17.9 (11.2–26.6)	93.4 (86.9–97.3)	73.1 (54.4–86.1)	53.2 (50.7–55.8)
T-wave inversion in V_1–V_3	32.1 (23.3–41.8)	93.4 (86.9–97.3)	82.9 (69.3–91.3)	57.9 (54.4–61.3)

CI — confidence interval, NPV — negative predictive value, PPV — positive predictive value

highest sensitivity (>30%) was observed for T-wave inversion in V_1–V_3 (32.1%) and SI+QIII (34.9%), both of which maintained high specificity (93.4% and 82.1%, respectively). Four criteria achieved specificity of 100%: S>R in leads I, II, III, marked right QRS axis deviation >100°, (R/S V_5)/(R/S V_1) ≤0.4, and ST segment depression in V_1–V_3; their sensitivity, however, did not exceed 13.2%. PPV in this group was highly variable (40.0–100%), while NPV showed a modest elevation for T-wave inversion in V_1–V_3 (57.9%) and for (RI+SIII) — (SI+RIII)<15 mm (60.0%).

Across all three tables, mean sensitivity of the analyzed criteria was 14.6% (±14.9), and mean specificity was 90.8% (±14.3). PPV for individual ECG criteria ranged from 40.0% to 100%, whereas NPV remained in a narrow interval (48.4%–60.0%). The highest NPV levels were noted for (RI+SIII) — (SI+RIII)<15 mm (60.0%) and for T-wave inversion in V_1–V_3 (57.9%). The criterion (RI+SIII) — (SI+RIII)<15 mm substantially diverged from the rest, combining the highest sensitivity with the lowest specificity and a relatively favourable NPV. The overall pattern confirmed that the majority of ECG signs of RVH possess high specificity but limited sensitivity.

DISCUSSION

This study has found that the majority of the ECG criteria for RVH have low sensitivity and high specificity in a sample of patients from St. Petersburg. These results are consistent with the findings from large-scale international studies. For example, in the Multi-Ethnic Study of Atherosclerosis (MESA) [7], which included 4062 participants without clinically manifest cardiovascular disease, traditional ECG criteria also demonstrated high specificity (≥95%) but low sensitivity (<10%) for detecting RVH diagnosed by cardiac magnetic resonance imaging.

Among residents of Saint Petersburg, the highest sensitivity was observed for the criteria classified as "additional" in the AHA/ACCF/HRS guidelines [6]: the combination of SI+QIII (34.9%) and T-wave inversion in leads V_1-V_3 (32.1%). Previously, it was assumed that the most reliable ECG signs of RVH were changes in QRS morphology and R- and S-wave amplitudes in the precordial leads [5,12]. Several amplitude-based criteria also showed relatively high sensitivity: deep S waves in V_6>3 mm (20.75%) and RV_1+SV_5 ≥ 1.05 mV (21.7%). These findings are consistent with those reported by Butler et al. for patients with mitral stenosis [12].

The criterion (RI+SIII) — (SI+RIII)<15 mm, which showed the highest sensitivity (86.8%) and low specificity (19.8%), raises doubts about its diagnostic usefulness and indicates the need for further research to determine its clinical applicability. Similar findings have been reported previously by Whitman et al. in the MESA-RV study, who found a sensitivity of 80.4% and a specificity of 16.8% for this criterion [13]. An alternative approach to using this criterion has been suggested [14], but the current guidelines have not altered its formulation.

The remaining ECG criteria for right ventricular hypertrophy in the Saint Petersburg sample had a high specificity (over 80%), which is consistent with the results from studies in other populations [12, 13]. These criteria also had high PPV values, while NPV showed a narrower range. The diagnostic criteria presented in the National Guidelines on Functional Diagnostics [2] also exhibited high specificity and low sensitivity; however, differences in wording prevent direct comparison of their diagnostic performance with international data.

STUDY LIMITATIONS

The single-center design, retrospective nature, and a relatively small sample size limit the generalizability of the results to the broader population and may introduce certain sources of bias. Potential differences in comorbidities between the groups may affect the diagnostic performance of ECG criteria, as various underlying conditions (chronic obstructive pulmonary disease, pulmonary hypertension, congenital heart defects) can influence electrophysiological changes differently.

CONCLUSION

For individual electrocardiographic criteria used to diagnose right ventricular hypertrophy among residents of St. Petersburg, sensitivity ranged from 0.94% to 86.8%, specificity ranged from 19.8% to 100%, positive predictive value ranged from 40% to 100.0%, and negative predictive value ranged from 48.4% to 60.0%.

Four criteria demonstrated 100% specificity: S > R in leads I, II, III; marked right QRS axis deviation (> 100°); (R/S V_5)/(R/S V_1) ≤ 0.4; and ST depression in leads V_1–V_3, however, their sensitivity ranged from 2.8% to 13.2%. Their PPV reached 100%, allowing confident rule-in of RVH when present. Therefore, the presence of any of these signs strongly confirms RVH and can be used as a bedside rule-in tool. The QR pattern in lead V_1, with a specificity of 99.1% and a PPV of 92.9%, may serve as an additional high-specificity marker.

The criterion (RI + SIII) — (SI + RIII) < 15 mm had a low specificity of 19.8% and a positive predictive value of 51.9%, indicating the need for further investigation into its usefulness for diagnosing right ventricular hypertrophy.

Given the uncertain utility of the Lewis index, to confidently rule out RVH, a combination of three criteria with the highest sensitivity should be considered: SI + QIII (34.9%), T-wave inversion in V_1–V_3 (32.1%), $RV_1 + SV_5$ ≥ 1.05 mV (21.7%). The absence of all three signs in a patient with a low pre-test probability of RVH provides a reasonable rule-out.

Future research could include the prospective validation of proposed criteria combinations, the development of machine-learning algorithms that combine multiple ECG parameters, and an evaluation of how different etiological factors affect the magnitude of ECG signs of right ventricular hypertrophy.

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