Electrocardiography in the Diagnosis of Ventricular Hypertrophy in Patients with Chronic Renal Disease

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Summary

Background: Left ventricular hypertrophy (LVH) is an independent predictor of cardiovascular risk, and its characterization and prevalence in chronic renal disease (CRD) should be further studied.

Objective: To establish the diagnosis of LVH in patients with stage-5 CRD using six different electrocardiographic criteria, and to correlate them with left ventricular mass index (LVMI) as obtained by echocardiography.

Methods: Cross-sectional study including 100 patients (58 men and 42 women, mean age 46.2 ± 14.0 years) with CRD of all causes undergoing hemodialysis (HD) for at least six months. Electrocardiography (ECG) and echocardiography were performed in all patients, always up to one hour after the end of the HD sessions.

Results: LVH was detected in 83 patients (83%), of whom 56 (67.4%) had the concentric pattern and 27 (32.6%) the eccentric pattern of LVH. Diagnostic sensitivity, specificity and accuracy of all the electrocardiographic methods studied were higher than 50%. Using Pearson's linear correlation for LVMI, only the Sokolow-Lyon voltage criterion did not show a ≥ 0.50 coefficient. Calculation of the likelihood ratio, in turn, showed that ECG has a discriminatory power for the diagnosis of LVH in the population studied, with emphasis on the Cornell-product and Romhilt-Estes criteria. No correlation was observed between LVMI and QTc and QTc dispersion.

Conclusion: ECG is a useful, efficient, and highly reproducible method for the diagnosis of LVH in HD patients. In this population, the Cornell-product proved to be the most reliable criterion for the detection of LVH. (Arq Bras Cardiol 2009; 93(3) : 353-359)

Key Words: Kidney Diseases; Echocardiography; Electrocardiography; Renal Dialysis; Hypertrophy, Left Ventricular.

Introduction

LVH is an independent predictor of morbidity and mortality in the general population when diagnosed by either ECG or echocardiography[1,2].

Since the pioneering observations of the Framingham Heart Study, several epidemiological studies pointed out LVH as one of the most important risk factors for angina pectoris, myocardial infarction, heart failure, stroke and sudden death[3].

Little information is available on the population of patients with different stages of CRD. The PREVEND study used the Cornell product electrocardiographic criterion to analyze the presence of LVH in individuals with renal dysfunction, defined as a glomerular filtration rate (GFR) < 60mL/min/1.73 m^2 or microalbuminuria, and found a prevalence of 5.3%[4]. Studies using echocardiography, in turn, estimate the prevalence of LVH in patients with stage-5 CRD, that is, those with a GFR < 15 mL/min/1.73m^2 or undergoing renal replacement therapy, at between 40% and 74%[5].

LVH can be detected by ECG, chest radiography, echocardiography and magnetic resonance imaging. However, in the clinical practice, ECG and echocardiography are the most frequently used methods, not only for being more readily available, but mainly for the prognostic relationship that clearly predicts an increased cardiovascular risk when LVH is observed[3].

The main objective of this study was to establish the diagnosis of LVH in stage-5 CRD patients using six different electrocardiographic criteria, and to correlate them with LVMI as diagnosed by echocardiography.

Methods

Patients

From June 2006 to February 2007, 133 patients with stage-5 CRD of any cause, who were clinically stable and undergoing HD for at least six months were evaluated in *Fundação Hospital da Agroindústria do Açúcar e do Álcool de Alagoas* (Table 1).

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Table 1 – **Etiology of CRD in the sample study.**

Etiology of CRD	N = 100
Hypertensive nephrosclerosis (%)	40
Chronic glomerulonephritis (%)	33
Diabetic nephropathy (%)	11
Alport syndrome (%)	5
Polycystic renal disease (%)	4
Lupus nephropathy (%)	3
Hydronephrosis (%)	2
Schistosomal glomerulonephritis (%)	1
Renal tuberculosis (%)	1

CRD – chronic renal disease

The protocol was approved by the Human Research Ethics Committee of *Universidade Estadual de Ciências da Saúde de Alagoas* and a written informed consent was obtained from all patients, according to the principles of the Declaration of Helsinki. The exclusion criteria were: history of chronic or acute coronary syndrome (regardless of duration); heart valve disease; cardiomyopathy of any cause as diagnosed by transthoracic echocardiography; pericardial effusion; patients using pacemaker; right or left bundle branch block; ventricular pre-excitation syndromes; and any rhythm other than sinus rhythm, that is, any factor that could potentially interfere with the electrocardiographic analysis of LVH. Of the 133 patients screened, 33 were excluded. All the 100 patients selected were interviewed. On that occasion, casual blood pressure was taken, and ECG and transthoracic echocardiography were performed, always up to one hour after the end of the HD sessions.

Electrocardiography

Twelve-lead resting ECG was performed with the patient in the supine position; the recording speed was 25 mm/s, and calibration was standardized at 1 mV/cm (Dixtal equipment, model EP3®, Brazil). The electrocardiographic tracings were analyzed by one single observer, who was an experienced cardiologist with no connection with the performance of the echocardiograms. All measurements were taken manually, and noted down as follows: amplitude (mm) of P wave, R waves in aV_L, S in V_3, S in V_1, R in V_5 or V_6, and larger R and S waves in the horizontal plane; duration (ms) of P wave, of QRS complex, of ventricular activation, of QT interval corrected by Bazzet's formula (mean of the 12 leads); and of QT dispersion (QT maximum – QT minimum). Six electrocardiographic criteria for the diagnosis of LVH were also evaluated: 1) Sokolow-Lyon voltage (SV_1 + RV_5 or $V_6 \geq 35$ mm)[6]; 2) Sokolow-Lyon product (SV_1 + RV_5 or V_6 X QRS duration ≥ 3000 mm.ms for women and ≥ 4000 mm.ms for men)[7]; 3) Cornell voltage (RaV_L + $SV_3 \geq 20$ mm for women and ≥ 28 mm for men)[8]; 4) Cornell product (RaV_L + SV_3 X QRS duration ≥ 2440 mm.ms, add 6 mm for women)[9]; 5) Romhilt-Estes point score: larger R or S amplitude ≥ 30 mm in the horizontal plane or ≥ 20 mm in the frontal plane, or strain pattern in V_5 or V_6 (if on digitalis, it is worth only one point) or left atrial enlargement according to Morris index (three points); ÂQRS electrical axis higher than minus 30 degrees (two points); QRS duration ≥ 90 ms in V_5 or V_6 or ventricular activation time ≥ 50 ms in V_5 or V_6 (one point). Using this score, LVH is diagnosed when the sum of points is ≥ 5[10]; 6) Perugia score: LVH is diagnosed by the presence of one or more of the following findings – Cornell criterion, considering the limit of ≥ 20 mm for women and ≥ 24 mm for men, Romhilt-Estes score and strain pattern[11]. The study of reproducibility of the method was carried out by the same observer at two different timepoints, so that the first reading could not be recalled and identified, and by an independent observer who was a PhD Cardiologist with a vast experience in electrocardiography; this study was based on the analysis of 30 randomly chosen tracings for the assessment of the Sokolow-Lyon voltage, Romhilt-Estes and QT interval variables.

Echocardiography

The studies were performed by two echocardiographers accredited by the Department of Echocardiography of the Brazilian Society of Cardiology strictly following the standards established by the Guideline for Indications and Use of Echocardiography in the Clinical Practice[12]. We should underscore that none of these two observers had any relation with the analysis of the ECG tracings. The patients were placed in the left lateral position and a Caris® ultrasound scanner (Esaote-Biomédica, Italy) equipped with a 2.5 MHz transducer was used. The usual views were used to obtain a full study in the M, two-dimensional, and pulsed Doppler modes, with simultaneous continuous ECG recording. According to the recommendations of the American Society of Echocardiography / European Association of Echocardiography[13], interventricular septal (IVSD) thickness and left ventricular posterior wall (LVPWD) thickness were obtained at diastole, and LV mass, in grams, was calculated using the formula: LV mass = 0.8 X $\{1.04\ [(IVSD + EDLVD + LVPWD)^3 - (EDLVD)^3]\} + 0.6$ g[14], where IVSD is the diastolic interventricular septal thickness, EDLVD is the end-diastolic LV diameter, and LVPWD is the diastolic left ventricular posterior wall. LV mass was corrected for the body surface area. Echocardiographic diagnosis of LVH was made when LVMI was > 88 g/m² for women and > 102 g/m² for men[13]. The relative LV wall thickness (RWT) was also calculated using the formula RWT = 2 X LVPWD/EDLVD, where LVPWD is the diastolic LV posterior wall and EDLVD is the end-diastolic LV diameter.

From the calculation of RWT, two geometric patterns of LVH could be established: a concentric pattern, when RWT was ≥ 0.42 and an eccentric pattern, when RWT ≤ 0.42[13]. The LV systolic function was evaluated by means of the LV fractional shortening and LV ejection fraction as obtained using the Teicholz method. The analysis of reproducibility of the method was carried out in 30 randomly chosen participants who had their LV mass calculated using Devereux's formula[14]. The same echocardiographic study was evaluated by one observer at two different timepoints, like in the electrocardiographic analysis. The study was then read by another observer who was blind to the readings of the first observer.

Anthropometric measurements

Weight and height were measured, always up to one hour after the end of the dialysis sessions. Body surface area, in m^2, was calculated according to Mosteller's equation (0.20247 X weight$^{0.425}$ X height$^{0.725}$)[15]. Body mass index was calculated by dividing weight (Kg) by the square height (m).

Statistical analysis

Continuous variables were expressed as means and standard deviation and categorical variables as percentages. Association between LVMI and the other variables of interest was made using the Pearson's correlation coefficient. For this study, only Pearson's coefficient ≥ 0.50 was considered significant. The ROC curve was used to analyze the sensitivity, specificity and accuracy of the six electrocardiographic criteria studied, except for Perugia score (categorical variable). Fisher's exact test was used for the comparison of sensitivities of the electrocardiographic methods studied, according to the geometric patterns of LVH. Student's t test was used to compare the LVMI between men and women. The likelihood ratio for the electrocardiographic criteria was also calculated. The assessment of reproducibility of the two methods used was made by three independent observers in different occasions, using Lin's concordance coefficient. In all comparisons, 95% confidence intervals and $p < 0.05$ were considered statistically significant.

Results

Of the 100 patients who completed the study, 58 were males (58%) and 42 were females (42%), with mean age of 46.2 ± 14.0 years (ranging from 18 to 78 years) and mean HD time of 50.7 ± 46.5 months (ranging from 6 to 225 months, median of 33.5 months). Demographics and clinical characteristics of the patients are shown in Table 2, and electrocardiographic findings in Table 3.

The prevalence of LVH on echocardiography was 83%; 56 (67.4%) and 27 (32.6%) of these patients had concentric and eccentric LVH, respectively. The mean LVMI in the population studied was 154.9 ± 57.3 g/m^2. In relation to gender, the mean LVMI was 159.9 ± 57.0 g/m^2 in men and 148.0 ± 57.6 g/m^2 in women ($p = 0.306$). Values of the echocardiographic variables studied are shown in Table 4.

Studies of sensitivity, specificity and accuracy of the six electrocardiographic criteria assessed in the general population are shown in Table 5. Sensitivities, specificities and p values, according to the geometric patterns of LVH in the general population (concentric LVH: LVMI = 178.2 ± 54.8 g/m^2 and eccentric LVH: LVMI = 152.0 ± 38.2 g/m^2 - $p = 0.028$) are shown in Table 6. Among the 17 (17%) patients who did not present LVH, the mean LVMI was 82.9 ± 13.6 g/m^2.

The areas under the ROC curves for the Sokolow-Lyon voltage, Sokolow-Lyon product, Cornell voltage, Cornell product and Romhilt-Estes continuous variables were 0.85, 0.85, 0.85, 0.83 and 0.80, respectively.

Using Pearson's correlation for continuous variables, we observed a ≥ 0.50 coefficient between LVMI and the following variables in the general population: Sokolow-Lyon product, Cornell voltage, Cornell product, and Romhilt-Estes. When applied to gender, Pearson's correlation was ≥ 0.50 between LVMI and all the electrocardiographic

Table 2 – Demographics / clinical characteristics.

Variable	N = 100
Age (years)	46.2 ± 14.0
Gender M/F	58/42
Skin color W/B/Mu	42/35/23
Body surface area (m^2)	1.6 ± 0.1
Body surface index (Kg/m^2)	22.7± 3.7
Time of hemodialysis (months)	50.7 ± 46.5
Systemic hypertension (%)	90
Diabetes mellitus (%)	14
Cigarette smoking (%)	4
Systolic blood pressure (mm Hg)	138.2 ± 21.1
Diastolic blood pressure (mm Hg)	78.1± 8.2
Antihypertensive drugs	
- one	35
- two	24
- three	15
- four	1

M - male; F - female; W – white; B – black; Mu – mullato

Table 3 – Electrocardiographic findings.

Variable	N = 100
P duration (ms)	96.5 ± 17.7
P-wave morphology (NL/P/BP/N/%)	36/5/56/3
QRS duration (ms)	98.2 ± 13.5
QTc (ms)	442.5 ± 25.4
QTc dispersion (ms)	68.5 ± 28.1
Sokolow-Lyon-voltage (mm)	37.4 ± 14.8
Sokolow-Lyon-product (mm.ms)	3787.6 ± 1809.9
Cornell-voltage (mm)	23.3 ± 10.5
Cornell-product (mm.ms)	2584.0 ± 1309.2
Romhilt-Estes (points)	4.1 ± 3.4
Perugia (%)	63

NL – normal; P – peaked; BP – biphasic; N – notched

criteria assessed and QTc in the male population. Among women, the correlation was ≥ 0.50 only between LVMI and the Cornell voltage and Cornell product criteria. Since Perugia score is a categorical variable, Pearson's correlation cannot be used with LVMI (Table 7).

As can be observed in Table 8, calculation of the likelihood ratio demonstrates that all electrocardiographic methods assessed show the discriminatory power of ECG in the diagnosis of LVH in the population studied, with special emphasis to the Cornell product and Romhilt-Estes criteria.

In relation to the analysis of reproducibility, the intraobserver concordance level for the Sokolow-Lyon voltage, Romhilt-Estes and QT interval electrocardiographic variables was 0.99, 0.97, and 0.96, respectively. The interobserver concordance for the same variables was 0.99, 0.79, and 0.94, respectively. For the LV mass variable, as obtained by echocardiography, the intra and interobserver concordance levels were 0.97 and 0.98, respectively.

Table 4 – Electrocardiographic findings.

Variable	N = 100
EDLVD (mm)	51.1 ± 6.8
IVS (mm)	12.4 ± 2.8
LVPW (mm)	11.7 ± 2.3
LV mass (g)	255.1 ± 98.8
LV mass index (g/m^2)	154.9 ± 57.3
EF (%)	66.7 ± 5.6

EDLVD – end-diastolic LV diameter; IVS – interventricular septum; LVPW – LV posterior wall; EF – LV ejection fraction

Discussion

LVH usually leads to increased amplitude of the QRS complex, with a subsequent leftward and posterior shift of the electrical forces, thus resulting in deep S waves in right precordial leads. On the other hand, the greater cross-sectional ventricular activation caused by LVH results in increased QRS duration and intrinsecoid deflection (interval between the beginning of the inscription and maximum point of the QRS complex in left precordial leads)[3,17].

ECG is undoubtedly a less sensitive test than transthoracic echocardiography for the diagnosis of LVH. However, when LVH is detected by ECG, the patient's prognosis is very

Table 5 – Sensitivity, specificity and accuracy of the electrocardiographic criteria studied in the general population.

General population (n=100)	Sensitivity%(CI)	Specificity%(CI)	Accuracy%(CI)
Sokolow-Lyon voltage	61.4(0.506-0.711)	82.3(0.589-0.938)	65.0(0.538-0.734)
Sokolow-Lyon product	56.6(0.453-0.675)	88.2(0.636-0.985)	62.0(0.517-0.715)
Cornell voltage	50.6(0.394-0.618)	88.2(0.636-0.985)	57.0(0.467-0.669)
Cornell product	57.8(0.465-0.686)	94.1(0.713-0.999)	64.0(0.538-0.734)
Romhilt-Estes	53.0(0.423-0.633)	94.1(0.730-0.989)	60.0(0.507-0.706)
Perugia	72.3(0.614-0.816)	82.4(0.566-0.962)	74.0(0.643-0.823)

CI – confidence interval

Table 6 – Sensitivity, specificity and p values of the electrocardiographic criteria studied, according to the patterns of LVH.

Variable	Concentric LVH (n=56)		Eccentric LVH (n=27)		p
	Sensitivity (CI)%	Specificity (CI)%	Sensitivity (CI)%	Specificity (CI)%	
Sokolow-Lyon voltage	53.5 (0.407-0.659)	100.0 (0.438-1.000)	77.7 (0.592-0.893)	78.5 (0.524-0.924)	0.0531*
Sokolow-Lyon product	51.8 (0.390-0.643)	100.0 (0.438-1.000)	66.7 (0.478-0.813)	85.7 (0.600-0.959)	0.2418*
Cornell voltage	46.4 (0.340-0.593)	100.0 (0.438-1.000)	59.2 (0.407-0.754)	85.7 (0.600-0.959)	0.3502*
Cornell product	57.1 (0.441-0.692)	100.0 (0.438-1.000)	59.2 (0.407-0.754)	92.8 (0.685-0.987)	1.0000*
Romhilt-Estes	55.3 (0.424-0.676)	100.0 (0.438-1.000)	59.2 (0.407-0.754)	92.8 (0.685-0.987)	0.8154*
Perugia	71.4 (0.585-0.815)	100.0 (0.438-1.000)	74.0 (0.553-0.868)	78.5 (0.524-0.924)	1.0000*

**p = non-significant; LVH – left ventricular hypertrophy; CI – confidence interval*

Table 7 – Pearson's correlation coefficients between LVMI and each of the other variables of interest.

Variable	General population	Male gender	Female gender
	Coefficient (CI)	Coefficient (CI)	Coefficient (CI)
Sokolow-Lyon voltage	0.46*(0.291-0.603)	0.51* (0.287-0.677)	0.37*(0.075-0.606)
Sokolow-Lyon product	0.50*(0.337-0.634)	0.56* (0.352-0.715)	0.38*(0.087-0.614)
Cornell voltage	0.61*(0.476-0.724)	0.66* (0.484-0.784)	0.56*(0.315-0.742)
Cornell product	0.61*(0.470-0.720)	0.69* (0.525-0.805)	0.54*(0.290-0.729)
Romhilt-Estes	0.50*(0.345-0.640)	0.51* (0.300-0.685)	0.45*(0.180-0.669)
QTc	0.28*(0.096-0.457)	0.51* (0.292-0.680)	0.02†(-0.279-0.328)
QTc dispersion	0.02†(-0.168-0.224)	-0.15†(-0.401-0.103)	0.18†(-0.123-0.465)

**p < 0.05; †p = non-significant; LVMI – left ventricular mass index; CI – confidence interval*

Table 8 – Likelihood ratio of the electrocardiographic criteria studied

Criterion assessed	Positive LR (CI)	Negative LR (CI)
Sokolow-Lyon voltage	3.5 (1.48-12.70)	0.4 (0.33-0.69)
Sokolow-Lyon product	4.8 (1.66-26.32)	0.5 (0.36-0.69)
Cornell voltage	4.3 (1.47-23.58)	0.5 (0.42-0.77)
Cornell product	9.8 (2.26-170.29)	0.4 (0.33-0.60)
Romhilt-Estes	9.0 (2.06-156.30)	0.5 (0.38-0.66)
Perugia	4.1 (1.76-14.88)	0.3 (0.22-0.52)

LR – likelihood ratio; CI – confidence interval

poor, with proved increased cardiovascular morbidity and mortality. As previously described, there is a higher risk of angina pectoris, myocardial infarction, stroke, heart failure and sudden death[17].

The Framingham study, with a 30-year follow-up, clearly demonstrated that in the presence of electrocardiographic LVH, there was an increased risk for coronary events by 3.0 to 5.8 times; for stroke by 3.2 to 7.0 times; and for heart failure by up to 17.5 times. Particularly in relation to heart failure, the risk of developing this condition was higher in the presence of an ECG consistent with LVH than in the presence of enlarged heart as observed on chest radiography[18].

LVH manifestations on ECG related to strain-pattern ventricular repolarization changes (ST-segment depression with upward convexity associated with asymmetrical T-wave inversion in left limb and precordial leads) seem to indicate both the presence of LVH and myocardial ischemia. According to the Framingham study, this pattern increases the risk of cardiovascular complications by 5.8 times in men and 2.4 times in women[17]. In the LIFE study, the ECG strain pattern observed in 971 out of 8854 patients evaluated over a period of five years increased the cardiovascular mortality by 2.2 times, the risk of myocardial infarction by 2.1 times, and the risk of stroke by 1.7 times[19].

ECG is a low-cost, highly reproducible test, and despite the known limitations regarding its diagnostic sensitivity, it has been widely used in population-based studies assessing the prevalence of LVH, and its regression or persistence with pharmacological intervention, especially in hypertensive patients[20-22].

On the other hand, we cannot disregard that the majority of the electrocardiographic criteria used for the detection of LVH was validated in populations with a high prevalence of cardiovascular diseases. The obvious consequence is a poor performance of these criteria when applied to samples with a low prevalence of these diseases.

We should point out that no overwhelming predominance of one gender over the other was observed in the study sample, which was comprised, on average, of young individuals (age from 46.2 ± 14.0 years) who had normal BMI (mean of 22.7 ± 3.7 Kg/m^2), and only four were smokers (4%). This observation is important to contextualize the study population according to the four factors that most interfere with the electrocardiographic diagnosis of LVH: gender (higher sensitivity in men); age (sensitivity increases among the oldest); weight (lower sensitivity in obese individuals); and smoking (lower sensitivity in smokers)[23].

Alfakih et al[24] conducted a study in 288 hypertensive patients and assessed four of the electrocardiographic methods

used in the present study. They found values of sensitivity and specificity for the Sokolow-Lyon voltage, Sokolow-Lyon product, Cornell voltage and Cornell product criteria of 28.7% and 92.1%; 36.8% and 91.4%; 21.3% and 94.8%; 31.1% and 91.4%, respectively. The better performance of the six electrocardiographic criteria assessed in the present study, all with sensitivity and accuracy higher than 50%, and specificity ranging from 78.5% to 100%, may be attributed to the clinical profile of the study sample, which was comprised of severely ill patients whose LVMI was very high.

Verdecchia et al[22] studied a new electrocardiographic method for the diagnosis of LVH, the Perugia score from the PIUMA study, and found a 17.8% prevalence of LVH. Using the Cornell voltage, Romhilt-Estes and Sokolow-Lyon voltage criteria, they found a prevalence of LVH of 9.1%, 5.2% and 13%, respectively.

In our study, in turn, the performance of the Perugia score, used for the first time in CRD patients, was excellent, with sensitivity of 72.3%, specificity of 82.4%, and accuracy of 74%, which can also be explained by the high prevalence of LVH.

Pearson's correlation demonstrated that only the Sokolow-Lyon voltage criterion did not show a coefficient ≥ 0.50 in the general population. Among women, only the Cornell voltage and Cornell product showed coefficients ≥ 0.50. This may have resulted from the lower LVMI and lower predominance of the concentric pattern of LVH in women. Calculation of the likelihood ratio, in turn, demonstrated that all electrocardiographic criteria assessed had different and significant degrees of strength for the detection of LVH, perhaps also as a reflex of the severity of the disease in the group studied. However, the combination of the results of Pearson's correlation and likelihood ratio shows that the Cornell product was the most reliable criterion for the detection of LVH in the sample assessed.

Stewart et al[25] found a positive correlation of QTc interval, QTc dispersion and LVH with the degree of deterioration of the renal function. On the other hand, Covic et al[26] conducted a study including 68 non-diabetic patients with stage-5 CRD and demonstrated that the process of HD prolongs QTc interval, but not QTc dispersion, in patients without manifest heart disease. Conversely, Drighil et al's study[21] of 49 patients with stage-5 CRD demonstrated that QTc dispersion increased, whereas the QTc interval remained stable after HD sessions. In our sample of dialysis patients, the QTc interval remained above the upper normal limit (>440ms) and QTc dispersion was high (normal range between 50-60 ms[27]). This observation may bear clinical relevance in view of the high rate of sudden death among this population. It is important to point out that no correlation was found between QTc and QTc dispersion and LVMI. This lack of correlation suggests that changes in QTc and QTc dispersion are more related to metabolic factors than to LVH itself.

Finally, we should note that the cut-off point used to define LVH in men and women in the present study was based on echocardiographic studies. It is important to point out that there are studies in the literature that used specimens obtained in autopsies as the gold-standard for correlation[10,28]. However, distortions are more likely to occur in such situations since, depending on the time elapsed and clinical condition of the patient before death, the bias can be relevant. In our midst, Rodrigues et al[29] studied hearts from autopsies of healthy individuals who died of accidental causes and suggested the presence of LVH when the left ventricular mass is higher than 218g or 128 g/m in men and 148 g or 88 g/m in women.

Study limitations

Given that this study sample was comprised of severely ill patients whose clinical profile and long time of dialysis already correlate with a high prevalence of LVH, perhaps our findings should not be extrapolated to the general population.

Conclusion

ECG is a useful, efficient and highly reproducible method for the diagnosis of LVH in patients with stage-5 CRD undergoing HD. In this population, the Cornell product proved to be the most reliable criterion for the detection of LVH. Despite presenting lower sensitivity than echocardiography, the usefulness of ECG is stressed by its ability to detect electrophysiological changes such as QTc and QTc dispersion, which can be correlated with the high frequency of sudden death among this population.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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