Assessment value of ECG Cornell voltage for left ventricle hypertrophy in essential hypertension patients and its correlation with cardiovascular events

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ABSTRACT

Objective: To analyze the assessment value of ECG Cornell voltage for left ventricle hypertrophy in essential hypertension patients and its correlation with cardiovascular events.

Methods: A total of 118 cases of patients with essential hypertension who received inpatients treatment in our hospital from March 2013 to March 2015 were selected as the research subjects. According to ECG baseline, all included patients were divided into Cornell voltage increase group (increase ≥25%) 47 cases, no Cornell voltage change group (change < 25%) 36 cases and Cornell voltage decrease group (decrease ≥25%) 35 cases. Ultrasonic left heart indexes and serum indexes of three groups were compared, and the correlation between Cornell voltage and cardiovascular events was further analyzed. Results: Ultrasonic LVEDD, LVMI, IVSd, PWd and RWT values as well as serum uric acid, IMD, CysC, FGF23 and Hcy values of Cornell voltage decrease group were lower than those of no Cornell voltage change group and Cornell voltage increase group; ECG Cornell voltage levels in patients with essential hypertension were positively correlated with the incidence rate of cardiovascular events such as acute coronary events, sudden cardiac death and acute stroke. Conclusion: ECG Cornell voltage index can better identify the degree of left ventricle hypertrophy in patients with essential hypertension, and can be used as an independent predictor of cardiovascular events.

1. Introduction

Essential hypertension is the most common clinical chronic cardiovascular disease, and patients with poor control of blood pressure can have secondary myocardial hypertrophy and ventricular enlargement, eventually leading to cardiovascular events. Finding reasonable means to monitor the disease is the premise of early detecting disease progression and taking intervening measures, echocardiogram is the best way to detect cardiac remodeling change, but its operating process is relatively complex and repeated examination is difficult[1,2]. Electrocardiogram (ECG) is the primary examination of patients with hypertension and heart disease, the examination process is simple, strongly repeatable and less expensive, but it has the defects of low sensitivity and accuracy.

Many scholars believe that ECG Cornell voltage has a stronger correlation with left heart hypertrophy, and monitoring its change is expected to expand its clinical application value[3]. In the study, the assessment value of ECG Cornell voltage for left ventricle hypertrophy in essential hypertension patients and its correlation with cardiovascular events were mainly analyzed, hereby reported as follows.

2. Research subjects

2.1. Inclusion and exclusion criteria

A total of 118 cases of patients with essential hypertension who received inpatients treatment in our hospital from March 2013 to March 2015 were selected as the research subjects. Inclusion criteria: (1) conforming to the standards for patients with essential hypertension established by World Health Organization (WHO);
2) ECG bundle branch block, QRS duration was more than 0.12 s; 3) the patients and families learned about the research process and then signed the informed consent. Exclusion criteria: 1) pregnant or breastfeeding women; 2) patients with the abnormalities of the heart such as pericardial effusion, atrial fibrillation or atrioventricular block; 3) those with malignant tumor or diseases of the immune system; 4) those with history of major surgery within half a year; 5) those associated with mental illness and couldn't cooperate with treatment.

2.2. Grouping and general information

According to ECG baseline, all included patients were divided into Cornell voltage increase group (increase ≥25%) 47 cases, no Cornell voltage change group (change < 25%) 36 cases and Cornell voltage decrease group (decrease ≥25%) 35 cases. Cornell voltage increase group included 27 male cases and 20 female cases, they were (47.83±8.05) years old and the course of disease was (8.37±1.03) years; no Cornell voltage change group included 20 male cases and 16 female cases, they were (48.07±8.76) years old and the course of disease was (7.93±0.94) years; Cornell voltage decrease group included 20 male cases and 15 female cases, they were (47.93±7.94) years old and the course of disease was (8.05±0.83) years. Differences in gender, age, course of hypertension and other baseline information were not statistically significant among three groups (P>0.05).

3. Methods

3.1. Ultrasound cardiogram examination

Cardiac ultrasound was used to examine the patients’ left ventricle, patients lay on the left side, left ventricular end-diastolic short-axis section was selected, the left ventricular end-diastolic diameter (LVEDD), left ventricular mass index (LVMI), interventricular septum dimension (IVSd) and left ventricular posterior wall dimension (PWd) were measured, and the left ventricular wall thickness (RWT) was further calculated.

3.2. Serum index detection

3ml of fasting peripheral venous blood was drawn from two groups

3.3. Cardiovascular events

Patients were followed up for 1 year, acute coronary events, sudden cardiac death, acute stroke and other cardiovascular events were recorded, and the correlation between Cornell voltage and above cardiovascular events was assessed.

3.4. Statistical methods

Data obtained in the study was analyzed by SPSS 23.0 software, comparison among groups was by variance analysis, pair-wise comparison between groups was by LSD method, correlation analysis was by Pearson test and P<0.05 was set as the standard of statistical significance in differences.

3. Results

3.1. Left ventricular hypertrophy-related indexes

Left ventricular hypertrophy-related indexes LVEDD, LVMI, IVSd, PWd and RWT were significantly statistically different among three groups (P<0.05), and pair-wise comparison by LSD showed that ultrasonic LVEDD, LVMI, IVSd, PWd and RWT values of Cornell voltage decrease group were lower than those of no Cornell voltage change group and Cornell voltage increase group (P<0.05), and ultrasonic LVEDD, LVMI, IVSd, PWd and RWT values of no Cornell voltage change group were lower than those of Cornell voltage increase group (P<0.05), shown in Table 1.

3.2. Serum indexes

Differences in serum uric acid, IMD, CysC, FGF23 and Hcy values were statistically significant among three groups (P<0.05), and pair-wise comparison by LSD showed that serum uric acid, IMD, CysC, FGF23 and Hcy values of Cornell voltage decrease group were lower

<table>
<thead>
<tr>
<th>Groups</th>
<th>LVEDD (mm)</th>
<th>LVMI (g/m²)</th>
<th>IVSd (cm)</th>
<th>PWd (cm)</th>
<th>RWT (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cornell voltage increase</td>
<td>6.09±0.82</td>
<td>137.62±14.28</td>
<td>1.45±0.18</td>
<td>1.76±0.19</td>
<td>0.65±0.08</td>
</tr>
<tr>
<td>No Cornell voltage change</td>
<td>5.12±0.71</td>
<td>124.74±14.09</td>
<td>1.91±0.23</td>
<td>1.38±0.21</td>
<td>0.44±0.06</td>
</tr>
<tr>
<td>Cornell voltage decrease</td>
<td>4.37±0.48</td>
<td>116.37±13.29</td>
<td>0.83±0.07</td>
<td>1.09±0.12</td>
<td>0.36±0.05</td>
</tr>
<tr>
<td>F</td>
<td>5.839</td>
<td>8.394</td>
<td>7.293</td>
<td>7.742</td>
<td>5.271</td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>
than those of no Cornell voltage change group and Cornell voltage increase group ($P<0.05$), and serum uric acid, IMD, CysC, FGF23 and Hcy values of no Cornell voltage change group were lower than those of Cornell voltage increase group ($P<0.05$), shown in Table 2.

3.3. Correlation between Cornell voltage and cardiovascular events

<table>
<thead>
<tr>
<th>Groups</th>
<th>Uric acid (μmol/L)</th>
<th>IMD (ng/L)</th>
<th>CysC (mg/L)</th>
<th>FGF23 (ng/L)</th>
<th>Hcy (μmol/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cornell voltage increase</td>
<td>509.37±56.21</td>
<td>86.09±9.52</td>
<td>1.41±0.27</td>
<td>146.32±28.95</td>
<td>17.28±2.31</td>
</tr>
<tr>
<td>No Cornell voltage change</td>
<td>419.42±48.36</td>
<td>68.35±7.12</td>
<td>1.18±0.21</td>
<td>119.07±23.47</td>
<td>14.6±1.62</td>
</tr>
<tr>
<td>Cornell voltage decrease</td>
<td>342.84±40.32</td>
<td>40.17±3.85</td>
<td>0.91±0.08</td>
<td>70.46±8.23</td>
<td>13.01±1.48</td>
</tr>
</tbody>
</table>

$F$ values were $0.05$ for all comparisons, and specific data was shown in Table 3.

4. Discussion

Primary hypertension patients with left ventricular hypertrophy are with significantly increased risk of cardiovascular events, so the monitoring of left heart function in patients with essential hypertension should be strengthened. Electrocardiogram (ECG) is the most common method for clinical left heart hypertrophy screening, and in the published standardized analysis and recommendations of ECG, all kinds of diagnostic criteria are based on the analysis of single ECG features, have relatively low sensitivity and can’t reflect the dynamic changes of the cardiac function and the degree of myocardial hypertrophy change, which restricts its clinical application value. Cornell voltage index is the RaVL+SV3 lead QRS wave amplitude, and when left heart hypertrophy occurs, left posterior superior depolarization face and its comprehensive vector correspondingly increase, manifested as increased aVL lead R wave and deepened V3 lead S wave in ECG. Research shows that the correlation between Cornell voltage index and left ventricular hypertrophy is more than or not weaker than traditional combined lead voltage standard, so Cornell voltage in 118 patients with essential hypertension was examined in the study, and its assessment value for left ventricle hypertrophy and the correlation with cardiovascular events were mainly judged.

As a result of the non-pathological factors such as day-to-day ECG variation, there is no standard conclusion about left ventricular voltage. ROC curve analysis confirms that the Cornell voltage decrease by 25.5% is the best demarcation point of the diagnosis, both sensitivity and specificity are high at the moment, so a variation amount of 25% was used as the grouping standard for all patients with primary hypertension to divide them into Cornell voltage increase group (increase ≥25%), no Cornell voltage change group (change<25%) and Cornell voltage decrease group (decrease ≥25%) [8]. Echocardiogram is the most intuitive and accurate means to judge patients’ left ventricular hypertrophy and function, and detection of left ventricular hypertrophy-related indexes in all groups in the study showed that with the increase of Cornell voltage, the left ventricular end-diastolic diameter (LVEDD), left ventricular mass index (LVMI), interventricular septum dimension (IVSd), left ventricular posterior wall dimension (PWd) and left ventricular wall thickness (RWT) values increased, indicating that the blood pressure of Cornell voltage decrease group was lower than those of other two groups, and the degree of left ventricular hypertrophy was less. Research has confirmed that the Chinese older male Cornell voltage value is associated with left ventricular anterior wall thickness, and the correlation is stronger than Sokolow-Lyon voltage value, the study results also confirmed this theory, and once again it indicates that Cornell voltage can directly reflect the degree of left ventricular hypertrophy in patients with hypertension[7].

Left ventricular hypertrophy abnormal cardiac function in patients with primary hypertension may be accompanied by the change of a series of serological indexes, which is an effective way to judge the severity of hypertension and target organ damage[8,9]. Uric acid is the metabolite of purine compound through the kidney, and hyperuricemia can enhance vasoconstriction and lead to hypertension. Intermedin (IMD) is a member of calcitonin gene family and belongs to important cardiovascular protective factor[10]. Studies have shown that IMD levels rise with elevated blood pressure levels, which may be related to compensatory IMD secretion by myocardial cells so as to reduce the damage of hypertension to the body. Cystatin C (CysC) can inhibit the endogenous cysteine protease activity and protect cells from endogenous protease hydrolysis. CysC can increase left ventricular
wall and interventricular septum thickness and cause left ventricular hypertrophy[11,12]. Fibroblast growth factor 23 (FGF23) is a member of polypeptide hormone fibroblast growth factor family, and its main physiological function is to reduce blood phosphorus. High blood FGF23 can lead to hyperphosphatemia and high parathyroid hormone levels and 1,25(OH)2D3 deficiency, and it is an independent risk factor for cardiovascular events[13]. In the study, serum levels of the above factors of three groups were tested and the results showed that as Cornell voltage increased, serum uric acid, IMD, CysC, FGF23 and Hcy value increased, and the severity of left ventricular hypertrophy and target organ damage increased.

Patients with poorly controlled hypertension have increased cardiac afterload, the resulting left ventricular hypertrophy is usually characterized by increased left ventricular wall thickness, it will further lead to left ventricular cavity enlargement and ventricular remodeling, and the incidence rate of cardiovascular events sharply increases[14]. Echocardiogram is with low prices and high repeatability, and is the most reasonable means for clinical monitoring of the changes in patients with hypertension. In the study, the correlation between ECG Cornell voltage and cardiovascular events in patients within 1-year follow-up was further analyzed, and results showed that ECG Cornell voltage levels in patients with essential hypertension were positively correlated with acute coronary events, sudden cardiac death, acute stroke and other cardiovascular events, which indicated the accurate forecasting effect of ECG Cornell voltage on the prediction of cardiovascular events in patients with essential hypertension, and showed that it could be used as a routine monitoring method to detect abnormal cardiac function in time and provide the conditions for early intervention[5,16].

To sum up, it is concluded as follows: ECG Cornell voltage index can better identify the degree of left ventricle hypertrophy in patients with essential hypertension, can be used as an independent predictor of cardiovascular events, and is worth popularization and application in clinical practice in the future.

References