The Application of Echocardiography in the Diagnosis of Heart Disease

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Abstract: Objective: To explore the application value of echocardiography in the diagnosis of hypertension-related heart disease. Methods: 88 suspected hypertension-related heart disease patients admitted to our hospital from January 2022 to February 2023 were randomly divided into a control group (n=44) and a study group (n=44) using a random number table. The control group underwent routine electrocardiogram examination, while the study group underwent echocardiography examination. The diagnostic detection rates, sensitivity, specificity, missed diagnosis rate, and misdiagnosis rate of the two examination methods were compared. Results: The detection rates of left ventricular hypertrophy, left atrial enlargement, myocardial ischemia, aortic dilation, and diffuse interventricular septal thickening in the study group were 81.82%, 88.64%, 47.73%, 79.55%, and 90.91%, respectively. In the control group, the detection rates of left ventricular hypertrophy, left atrial enlargement, myocardial ischemia, aortic dilation, and diffuse interventricular septal thickening were 61.36%, 40.91%, 29.55%, 31.82%, and 63.64%, respectively. The detection rates in the study group were significantly higher than those in the control group, and the differences were statistically significant ($P<0.05$). The sensitivity and specificity of echocardiography in diagnosing hypertension-related heart disease were higher than those of routine electrocardiography, and the missed diagnosis rate and misdiagnosis rate were lower than those of routine electrocardiography ($P<0.05$).

Conclusion: The application of echocardiography in the diagnosis of hypertension-related heart disease can effectively improve the accuracy, sensitivity, and specificity of diagnosis, reduce the missed diagnosis rate and misdiagnosis rate, and provide a reliable reference for the formulation of clinical treatment plans. It has a high application value.

Keywords: Echocardiography; Hypertension-Related Heart Disease; Diagnostic Value; Cardiac Function

Introduction

Echocardiography, also known as cardiac ultrasound, is a non-invasive imaging technique that uses high-frequency sound waves to produce images of the heart. It has become an important tool in the diagnosis of various heart diseases. Echocardiography can provide information about the size, shape, and function of the heart, as well as the movement of the heart valves and blood flow through the heart. It can also detect abnormalities such as congenital heart defects, valve disorders, and heart muscle diseases. Compared to other imaging techniques such as computed tomography (CT) and magnetic resonance imaging (MRI), echocardiography is relatively inexpensive and does not involve exposure to ionizing radiation. It can be performed in real-time, allowing the physician to observe the heart in motion. Overall, echocardiography has a high sensitivity and specificity for detecting heart disease. It is particularly useful in detecting left ventricular hypertrophy, left atrial enlargement, and aortic dilation. Additionally, echocardiography can be used to monitor the progression of heart disease and to evaluate the effectiveness of treatments.

1. Materials and Methods

1.1 General Information

88 suspected hypertensive heart disease patients admitted to our hospital from January 2022 to February 2023 were selected as the study population. Patients with a history of coronary artery bypass surgery, myocardial infarction, and mental disorders were excluded. The 88 patients were randomly divided into a control group (n=44) and a study group (n=44). The male-to-female ratio in the control group was 29/15, with an age range of 39-75 years (54.63 ± 4.57) and a BMI index ranging from 12.83-20.46 kg/m2. The male-to-female ratio in the study group was 26/18, with an age range of 40-73 years (54.79 ± 5.03) and a BMI index ranging from 13.16-21.37 kg/m2. There were no significant differences in baseline data such as gender and age between the two groups ($P > 0.05$), indicating comparability.

1.2 Methods

The control group underwent a routine electrocardiogram (ECG) examination using a Nihon Kohden 91300 device from Kenz, Japan. Patients were guided to lie on their backs during the examination, and a 12-lead ECG was performed after the equipment was calibrated. The study group underwent color Doppler echocardiography examination using a GE Vivid E9 device. The ultrasound probe frequency was set between 2 and 4.0 MHz, and patients were guided to maintain a supine position during the examination. Multiple angles were scanned starting from the left sternal edge, and the four-chamber and five-chamber apical views of the heart and the left ventricular long-axis view were carefully observed. The left ventricular wall thickness, interventricular septal thickness, and internal diameters of the aorta, left atrium, and left ventricle were recorded in detail. Both groups of patients were examined by an experienced specialist physician.

1.3 Observation indicators

The detection rates of left ventricular hypertrophy, left atrial enlargement, myocardial ischemia, aortic dilation, and diffuse interventricular septal thickening were compared between the two groups. The sensitivity, specificity, missed diagnosis rate, and misdiagnosis rate of the two examination methods were analyzed.

1.4 Statistical analysis

Measurement data were expressed as ($x \pm s$), and t-tests were used for between-group mean comparisons. Count data were expressed as frequency (n) or composition ratio (%), and the chi-square test was used for comparisons. Data analysis was conducted using SPSS 22.0 statistical software, with $P < 0.05$ indicating statistical significance.

2. Results

2.1 Comparison of the detection rates of left ventricular hypertrophy and left atrial enlargement between the two groups

The detection rates of left ventricular hypertrophy, left atrial enlargement, myocardial ischemia, aortic dilation, and diffuse interventricular septal thickening were significantly higher in the study group than in the control group, and the differences were statistically significant ($P < 0.05$). See Table 1 for details.

Table 1 Comparison of the detection rates of left ventricular hypertrophy and left atrial enlargement between the two groups (n, %)

Group	Number of cases	LV hypertrophy	LA enlargement	myocardial ischemia	aortic dilatation	diffuse thickening of the interventricular septum
Research	44	36(81. 82)	39(88. 64)	21(47. 73)	35(79. 55)	40(90. 91)
control	44	27(61. 36)	18(40. 91)	13(29. 55)	14(31. 82)	28(63. 64)

2.2 Comparison of sensitivity, specificity, missed diagnosis rate, and misdiagnosis rate between the two diagnostic methods

The sensitivity and specificity of echocardiography in diagnosing hypertensive heart disease were both higher than those of conventional electrocardiography, and the missed diagnosis rate and misdiagnosis rate were lower than those of conventional electrocardiography ($P < 0.05$). See Table 2 for details.

Table 2. Comparison of sensitivity, specificity, missed diagnosis rate, and misdiagnosis rate between the two diagnostic methods (n, %).

Examination Method	Number of cases	Sensitivity	Specificity	Missed Diagnosis Rate	Misdiagnosis Rate
Echocardiography Conventional	44	95. 00(38 /40)	75. 00(3 /4)	5. 00(2 /40)	25. 00(1 /4)
Electrocardiography	44	65. 79(25 /38)	50. 00(3 /6)	34. 21(13 /38)	33. 33(2 /6)

3. Discussion

Hypertensive heart disease is mostly caused by long-term high blood pressure, which leads to increasing left ventricular load. Echocardiography, with its high-resolution advantage, can clearly display soft tissue organs in the human body, providing assurance for obtaining precise left ventricular imaging quality and ensuring the reliability and accuracy of results for examining wall thickening and chamber enlargement. Myocardial load changes are an early response to hypertensive heart disease, initially manifested by an increase in systolic wall stress, but wall thickening stress can show a decrease during overcompensation. Therefore, for ordinary hypertensive heart disease patients, the presence of wall thickening does not necessarily indicate good systolic wall function. During echocardiography, peak stress, left ventricular end-systolic and end-diastolic volume, peak velocity ratio, left ventricular ejection fraction, and end-systolic wall stress are key parameters for diagnosing systolic heart function. However, some studies have shown that compared to peak stress, left ventricular end-systolic and end-diastolic volume and peak velocity ratio can more intuitively reflect a patient's systolic heart function, while end-systolic wall stress generally shows a negative correlation with left ventricular shortening fraction. Most hypertensive heart disease patients have an increased afterload, which is generally accompanied by increased systolic pressure and decreased left ventricular shortening fraction. The results of this study showed that the detection rates of left ventricular hypertrophy, left atrial enlargement, myocardial ischemia, aortic dilation, and diffuse interventricular septal thickening were significantly higher in the study group than in the control group, with statistically significant differences ($P <0.05$); the sensitivity and specificity of echocardiography in diagnosing hypertensive heart disease were higher than those of conventional electrocardiography, and the missed diagnosis rate and misdiagnosis rate were lower than those of conventional electrocardiography ($P <0.05$). This suggests that echocardiography can effectively determine whether a patient's heart function indicators are abnormally expressed and then make a clear diagnosis. This is due to several advantages of echocardiography in diagnosing hypertensive heart disease: (1) this examination can be performed under zero radiation, painless, and non-invasive conditions, and can clearly display the patient's left ventricular diastolic and systolic

function, left heart structure, blood flow status, etc.; (2) echocardiography has ultra-high resolution for soft tissue structures in the human body, which can clearly display the patient's body tissue and cardiac section, and can repeatedly investigate the progress of the disease, making it an important means to diagnose hypertensive heart disease and assess prognosis in real-time; (3) through the observation of the patient's echocardiographic imaging results, it is convenient for the examiner to calculate the left ventricular diastolic function index data, which more accurately and clearly reflects the changes in heart disease. In summary, the application of echocardiography in diagnosing hypertensive heart disease can effectively improve diagnostic accuracy, sensitivity, specificity, and reduce missed diagnosis and misdiagnosis rates, and is worth promoting widely.

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