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# Prognostic Value of Cardiac Color Doppler Ultrasound in Patients with Chronic Heart Failure

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**Abstract:** *Objective:* To investigate the value of cardiac color Doppler ultrasound (CDUS) in determining the clinical characteristics and assessing the prognosis of patients with chronic heart failure (CHF). *Methods:* 200 patients with CHF admitted to our hospital from January 2021 to June 2023 were selected as the study subjects, and these 200 patients were followed up for 6 months, with 159 cases in the surviving group and 41 cases in the deceased group, and examined with a diagnostic CDUS instrument (model GEVividE95ACUSONSC2000). The detection rate of chronic heart failure and cardiac function indexes of the two groups were observed. *Results:* The deceased group showed a chronic heart failure detection rate of 92.68%, which was significantly higher than the surviving group (76.73%; $P < 0.05$). Moreover, the cardiac function indexes of both groups were significantly different ($P < 0.05$). *Conclusion:* By performing cardiac ultrasonography on patients with CHF, their cardiac function can be clearly understood and the changes can be timely detected during treatment, hence physicians can formulate a more reasonable treatment plan for patients and improve their quality of life.

**Keywords:** Cardiac color Doppler ultrasound; Chronic heart failure; Prognosis; Detection rate

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## 1. Introduction

Chronic heart failure (CHF) is a group of clinical syndromes caused by a variety of heart diseases and characterized by stagnation of the pulmonary and/or physical circulation, resulting in damage to the myocardium and/or a decline in its function, which is unable to meet the needs of the body's daily activities, and cardiac distress and dyspnea are the most common symptoms of patients with CHF, and an important indication for patients to seek medical attention [1]. However, due to the relatively late development of cardiac Doppler technology, some patients do not receive cardiac ultrasound examinations in time, thus missing the best time for treatment [2,3]. Chronic heart failure is associated with a variety of factors, such as changes in myocardial structure and function, and chronic heart failure reduces the pumping capacity of the ventricles after filling, reduces the amount of heart output per beat, and impairs the heart's function, which has a serious impact

on the patient's physical and mental health. Early symptoms of chronic heart failure lack specificity, and the accuracy of diagnosis at this time is not high, which can lead to a delay in the best treatment time. Therefore, it is of great clinical value to effectively evaluate CHF patients at the early diagnostic stage to understand their disease progression and prognosis. In recent years, with the continuous progress of ultrasound imaging technology, cardiac ultrasound, as a noninvasive, convenient, and fast detection means, has been widely used in the diagnosis and treatment of cardiovascular diseases [4,5]. In this study, the value of cardiac ultrasound in evaluating the prognosis of patients with CHF was explored by performing ultrasonography on patients with chronic heart failure, comparing the detection rate of chronic heart failure and cardiac function indexes in the survival group and the death group after 6 months of follow-up, to provide a reliable basis for the clinic.

## 2. Materials and methods

### 2.1. General information

The 200 CHF patients admitted to the Xishan People's Hospital of Wuxi City from January 2021 to June 2023 were selected as the study subjects, among which 125 were male patients and 75 were female patients, aged 37–79 years, with an average age of 64.21±8.53 years, and these 200 patients were followed up for 6 months, with 159 cases in the surviving group and 41 cases in the deceased group. There were 104 males and 55 females in the surviving group, aged 38–73 years, with an average age of 65.36±8.24 years, while 21 males and 20 females in the deceased group, aged 37–79 years, with an average age of 66.16±8.89 years, and there was no statistically significant difference in the general data of gender and age between the two groups ($P > 0.05$). The value of cardiac color Doppler ultrasound in assessing the prognosis of patients with chronic heart failure

Inclusion criteria: (1) Patients have been clinically diagnosed with chronic heart failure and meet the relevant diagnostic criteria; (2) Patients should be 18 years old and above, with no upper age limit; (3) According to the cardiac function classification standard of the New York Heart Association (NYHA), patients' cardiac function should be in the range of II-IV; (4) the cardiac color Doppler ultrasound images are clear, which can accurately assess the structure and function of the heart; (5) patients or their legal representatives should sign an informed consent to participate in this study; (6) patients should have the conditions for long-term follow-up, including stable residence and contact information. The patients or their legal representatives should sign an informed consent form to participate in the study; the patients should have the conditions for long-term follow-up, including stable residence and unobstructed contact information.

Exclusion criteria: (1) Patients are in acute heart failure episodes or have a recent history of acute heart failure episodes; (2) Patients have severe valvular disease, such as rheumatic heart disease, congenital valvular anomalies, etc.; (3) Patients have a history of previous cardiac surgery, such as cardiac valve replacement, cardiac transplantation, etc.; (4) Patients suffer from active malignant tumors or have a life expectancy of less than one year; (5) Patients have severe hepatic or renal insufficiency, which may affect the cardiac function and prognosis; (5) Patients with severe mental disorders that prevent them from cooperating with the study or providing accurate follow-up information; (6) Female patients who are pregnant or breastfeeding; (7) Patients with known hypersensitivity to ultrasound contrast agents.

### 2.2. Methods

Color ultrasound diagnostic instrument (instrument model: GEVividE95ACUSONSC2000) was used for the examination, the probe frequency was 3.5 MHz, and the apical four-chamber view was taken to observe the cardiac structure and size changes when the body position was left-lateral recumbency or right-lateral recumbency. The patient's heart rate was used as a reference index, and the patient was kept in a quiet state,

then the measurement and recording of ultrasound parameters began. Cardiac function was evaluated by the following parameters: left ventricular ejection fraction (LVEF; %), left ventricular end-diastolic internal diameter (LVIDd; mm), and left ventricular end-systolic internal diameter (LVIDs; mm).

### 2.3. Observation indicators

Detection rates of chronic heart failure and cardiac function indexes of the two groups were recorded. Positive diagnostic criteria included LVEF of less than 50%, LVIDd of more than 55 mm, and LVIDs of more than 40 mm.

### 2.4. Statistical analysis

The results of the study were imported into SPSS 22.0 software to analyze the data. Count data were expressed as percentages, and the $\chi^2$ test was used for comparison between groups. Measurement information was expressed as mean ± standard deviation (SD), and a *t*-test was used for comparison between groups. The result difference was considered significant at $P < 0.05$.

## 3. Results

### 3.1. Detection rate

The detection rate of chronic heart failure was higher in patients in the deceased group as compared to the surviving group ($P < 0.05$), as shown in **Table 1**.

**Table 1.** Comparison of detection rates between the two groups

| Group | Number of examples | Number of cases detected | Detection rate |
|---|---|---|---|
| Deceased Group | 41 | 38 | 92.68 |
| Surviving Group | 159 | 122 | 76.73 |
| $\chi^2$ | | | 5.145 |
| *P* | | | 0.023 |

### 3.2. Indicators of cardiac function

The data of the cardiac function indexes of the patients in the surviving group differed from those of the deceased group ($P < 0.05$), as shown in **Table 2**.

**Table 2.** Comparison of cardiac function indices in the two groups

| Group | Number of examples | LVEF (%) | LVIDd (mm) | LVIDs (mm) |
|---|---|---|---|---|
| Deceased Group | 41 | 37.62 ± 3.78 | 55.57 ± 5.43 | 47.68 ± 5.07 |
| Survival Group | 159 | 60.49 ± 8.13 | 40.56 ± 4.11 | 21.06 ± 4.14 |
| *t* | | 17.506 | 19.438 | 34.986 |
| *P* | | 0.000 | 0.000 | 0.000 |

## 4. Discussion

CHF is a group of clinical syndromes caused by myocardial hypocontractility and/or increased cardiac filling pressure, resulting in ventricular filling or blood return obstruction [6]. In China, the incidence of CHF shows a trend of youthfulness, and the incidence is increasing with the development of the social economy and the

aging of the population. Heart failure is one of the most common complications in the late stages of coronary heart disease, hypertension, and other diseases, seriously threatening the life and health of patients. Therefore, early diagnosis and timely treatment of CHF patients are very necessary. Cardiac ultrasound can provide cardiologists with accurate and reliable information to help clinicians determine the condition of patients and formulate appropriate treatment plans, which is of great clinical value. By comparing the clinical characteristics and prognosis of the two groups of patients, we found that cardiac ultrasound has a certain application value in the prognostic assessment of CHF patients, which can help to improve the prognosis of patients.

The results of this study showed that the detection rate of chronic heart failure in the deceased group was 92.68%, which was higher than the surviving group of 76.73% ($P < 0.05$). This indicates that cardiac ultrasound has a significant detection rate of chronic heart failure in patients with CHF and that the adoption of active and effective therapeutic measures can effectively improve the quality of life of the patients. At the same time, the cardiac function indexes of patients in the surviving group were different from those of the deceased group ($P < 0.05$), and echocardiographic indexes have a certain reference value in the prognostic evaluation of CHF patients. Cardiac color Doppler ultrasound, as a noninvasive imaging method, demonstrated its unique effect in assessing the prognosis of patients with CHF.

Xie *et al*. [7] found that cardiac color Doppler ultrasound can accurately assess the patient's heart size, ventricular wall thickness, ventricular chamber size, and other morphological indicators, which can provide a basis for determining cardiac function and prognosis. Doppler technology can assess the systolic and diastolic function of the heart, including ejection fraction, ventricular filling velocity, and other indicators, which are essential for predicting the prognosis of patients with chronic heart failure. The monitoring of blood flow velocity and direction can assess the kinetic status of blood flow in the heart, such as the blood flow velocity and regurgitation of the mitral valve and aortic valve, which can help determine the degree of impairment of cardiac function and prognosis. Color Doppler ultrasound of the heart can also indirectly assess the changes in intracardiac pressure, such as the pulmonary artery pressure and the end-diastolic pressure of the left ventricle, which can provide references to assess the prognosis of the patients. Lu *et al*. [8] found that ultrasound can detect myocardial lesions, such as myocardial hypertrophy, myocardial thinning, etc., which helps to reveal the etiology and pathophysiological process of chronic heart failure, valvular lesions are one of the common causes of chronic heart failure, and ultrasound can accurately identify valvular stenosis, closure insufficiency, etc., which can provide a basis for the choice of treatment and prognosis assessment, and cardiac color Doppler ultrasound can be used to monitor the patient's response to response to treatment, such as drug therapy, cardiac resynchronization therapy, etc., which helps to adjust the treatment plan and optimize the prognosis. Through regular ultrasound examination, the progress and regression of patients' conditions can be monitored, providing important information for clinical decision-making. Kang *et al*. [9] found that the combination of ultrasound indexes and other clinical information can be used to risk-stratify patients, identify high-risk and low-risk patients, and provide a basis for the development of personalized treatment strategies and prognosis prediction. Through regular cardiac color Doppler ultrasound examination, the treatment effect and prognosis improvement of patients can be assessed. For example, indicators such as the improvement of ejection fraction and the slowing down of ventricular enlargement after treatment indicate that the treatment is effective and the prognosis of patients is expected to improve. Cardiac color Doppler ultrasonography has a high degree of operability and reproducibility, which makes it of practical value in the prognostic assessment of patients with chronic heart failure.

In summary, cardiac ultrasound examination of CHF patients can provide a clear understanding of their cardiac function and timely detection of changes in their condition during treatment, as well as the development

of a more reasonable treatment plan for patients to improve their quality of life. By accurately evaluating cardiac structure, function, and hemodynamic parameters, and monitoring changes in the condition, it provides an important basis for clinical decision-making and helps to optimize patient treatment and prognosis management. However, ultrasound technology has certain limitations and is not able to clearly observe important information such as heartbeat and blood flow, so it is not able to make accurate judgments on some congenital heart diseases, heart valve diseases, and myocardial infarction. In addition, the lack of precision in ultrasound diagnosis may lead to missed or misdiagnosis, resulting in delayed or aggravated conditions.

No correlation between heart rate and prognosis was observed in this study, probably due to the use of diagnostic color ultrasound, which has relatively high detection data. Some studies have shown that the systolic anterior wall myocardial resistance index (ECRI) and the right ventricular end-diastolic volume/left ventricular end-diastolic volume ratio (RV/LV ratio) can be used as independent risk factors for determining the mortality rate in patients with chronic heart failure [10]. ECRI can be used to predict cardiac death, but its role in chronic heart failure is unclear. In addition, this study only assessed LVEF, LVIDd, LVIDs, and survival rate, which lacks the assessment of other indexes such as level of cardiac function, hemodynamic index, and atrial size. Therefore, it is necessary to further expand the sample size for analysis. Although cardiac ultrasound is now commonly used in clinical practice to diagnose CHF and to adjust the treatment plan according to its results, the accuracy of ultrasound diagnosis still needs to be improved.

## Disclosure statement

The authors declare no conflict of interest.

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