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*Article*

# Continuous Cardiac Magnetic Resonance Imaging after Coronary Revascularization for Left Ventricular Dysfunction

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## Abstract

**Objective**: To determine the contribution of serial cardiac magnetic resonance imaging (MRI) following coronary revascularization (CR) to the clinical management of patients with left ventricular insufficiency. **Methods**: The study objects comprised the clinical data of 145 patients with CR undergoing CR surgery for left ventricular insufficiency in our hospital from January 2021 to January 2023. The patients were divided into the case (n = 35, left ventricular ejection fraction (LVEF) <50%) and control (n = 110, LVEF ≥50%) groups based on the LVEF recorded in the medical record system 6 months after surgery. Preoperative LVEF left ventricular end-diastolic volume (LVEDV), left ventricular end-systolic volume (LVESV), left ventricular end-diastolic volume index (LVEDVI), left ventricular end-systolic volume index (LVESVI), cardiac index (CI), and other cardiac magnetic resonance detection parameters were compared. Logistic regression analysis was performed to analyze the prognostic factors of patients undergoing CR after CR surgery for left ventricular insufficiency. The receiver operating characteristic curve was drawn, the sensitivity, specificity, and area under curve (AUC) were calculated, and the best prediction threshold was determined. The prognostic value of cardiac MRI in CR surgery for left ventricular dysfunction was observed. **Results**: Cardiac MRI revealed that the case group had higher LVEDV, LVESV, LVEDVI, LVESVI, and CI than the control group. However, the LVEF index was lower than that in the control group ($p < 0.05$). Logistic regression analysis was conducted for indicators with differences, and the results indicate LVEF as a protective factor for the postoperative efficacy of the patients, with an odds ratio (OR) <1. LVEDV, LVESV, LVEDVI, LVESVI, and CI were all risk factors for the postoperative efficacy of the patients, with an OR >1. The AUC values of LVEF, LVEDV, LVESV, LVEDVI, LVESVI, and CI were 0.698, 0.674, 0.654, 0.700, 0.572, and 0.812, respectively. The optimal threshold values were 53.57%, 112.33 and 68.5 mL, and 205.51, 163.99, and 2.14 L/m$^2$, and their corresponding sensitivities reached 0.618, 0.514, 0.654, 0.800, 0.371, and 0.829 for each index. The specificities were 0.800, 0.836, 0.771, 0.609, 0.836, and 0.645, which indicate that LVEF, LVEDV, LVESV, LVEDVI, LVESVI, and CI had a certain degree of predictive value for postoperative cardiac function recovery. **Conclusion**: LVEDV, LVESV, LVEDVI, LVESVI, CI, and LVEF are all factors affecting the clinical efficacy in patients undergoing CR after left ventricular insufficiency. In addition, cardiac MRI can effectively detect the above factors and effectively predict the postoperative efficacy among patients.

## Keywords

left ventricular dysfunction; coronary revascularization; cardiac magnetic resonance imaging; coronary heart disease

## Introduction

Coronary atherosclerotic heart disease, also referred to as coronary heart disease, is caused by stenosis or occlusion of the lumen; it results from atherosclerosis of coronary arteries, causes myocardial ischemia, hypoxia or necrosis of the body, failure to provide sufficient oxygenated blood to the heart, chest pain, palpitation, and other symptoms, and threatens the safety of patients [1–3]. Coronary revascularization (CR) is CR surgery; it helps patients with coronary artery stenosis or occlusion to undergo vascular reconstruction and restore their blood supply; this procedure effectively reduces the number of coronary heart disease attacks and efficiently improves the prognosis of patients [4–7]. Clinically, the surgery is usually divided into percutaneous coronary intervention and coronary artery bypass grafting [8]. For patients with left ventricular dysfunction after CR, as a result of complications, unreasonable rehabilitation plans, and other factors, the recovery of left ventricular function is affected, which leads to postoperative arrhythmias, coronary restenosis, and other conditions [9–11].

Cardiac magnetic resonance imaging (MRI) refers to the diagnosis of heart and vascular diseases through MRI technology, which is noninvasive [12,13]. This procedure can be applied to patients of all ages with good soft tissue comparison resolution; a large scanning field of view and patient detection images can be obtained from various angles [14–16]. With the development of medical technology and the increase in clinical demand, cardiac MRI has been widely used in the diagnosis of heart-related diseases; it can be used to evaluate the cardiac status and myocardial tissue function of patients in a noninvasive manner and has a high value for clinical diagnosis [17,18]. After CR, cardiac MRI is used to detect left ventricular function indicators in patients, which is important for clinical prognosis [19,20]. Therefore, to predict the surgical prognosis of patients as early as possible and implement timely measures to improve their prognosis, we retrospectively analyzed the clinical data of 145 patients undergoing CR after CR surgery for left ventricular insufficiency in our hospital from January 2021 to January 2023. The following reports are presented to explore the evaluation value of cardiac MRI for clinical efficacy after CR.

# Objects and Methods

## *Research Objects*

Retrospective analysis included the clinical data of 145 patients undergoing CR after CR surgery for left ventricular insufficiency in our hospital from January 2021 to January 2023. The results of the 6-month follow-up examination recorded in the medical record system were based on left ventricular ejection fraction (LVEF). The patients were divided into the case (n = 35, LVEF $<$50%) and control (n = 110, LVEF $\geq$50%) groups. This study received approval from the Ethics Committee of our hospital. In addition, this work is a retrospective analysis, and patient identification data were hidden, Thus, no informed consent of patients is required. The inclusion criteria were as follows: (1) age $\geq$18 years old; (2) patients with clinical symptoms, such as chest tightness, shortness of breath, palpitations, and discomfort in the precardiac area, and those with LVEF $<$40% detected via heart color ultrasound and diagnosis with left ventricular insufficiency; (3) presence of surgical indications; (4) complete clinical data; (5) complete participation in this research fully; (6) CR surgery performed for the first time in all patients with left ventricular dysfunction; (7) complete clinical profile. The exclusion criteria included the following: (1) complications with serious organ dysfunction, such as liver and kidney; (2) condition combined with coagulation dysfunction; (3) cardiac MRI cannot be performed; (4) severe neurological diseases or cognitive disabilities; (5) severe arrhythmia; (6) other serious myocardial diseases.

## *Methods*

### Treatment Methods

All patients received routine treatment, such as anticoagulation after admission. CR diagnosis and treatment were performed based on the actual condition of patients. The specific operations were as follows: The patients underwent coronary angiography. Based on the degree and length of the detected lesion stenosis, balloon preexpansion stent or direct stent implantation was performed. The puncture diameter was that of the patient's left femoral artery. Puncture was performed in accordance with the Seldinger method, and a 6F sheath tube was used for placement. A total of 6000–8000 U low-molecular-weight heparin (Hangzhou Jiuyuan Genetic Engineering; 0.3 mL/3000 IU; batch number: Chinese medicine approval No. H19990035, Hangzhou, China) was used along the patient's arterial sheath. The patient's sheath was removed after surgery, and the patient was subjected to routine antibacterial and anti-infection treatment and pressure dressing.

### Cardiac MRI

Instrument. A 1.5T superconducting MRI instrument (National mechanical license 20173284719, SuperMark 1.5 T, Nanshan District, Shenzhen, China) was used, with a maximum gradient field of 45 mT/m and switching rate of 200 mT$\cdot$m$^{-1}\cdot$ms$^{-1}$. The instrument was also equipped with an 8-channel cardiac coil. a6-channel spinal coil, a magnetic resonance-compatible wireless vector cardioelectric gate control board, and a double-barreled Medard high-pressure syringe.

Check Mode. Prior to examination, all patients were inserted with a 22 G indentation needle in the elbow vein and kept in the supine position. Scanning was performed as follows: (1) Plain scan, coronal, sagittal and axial orientations were selected for positioning, and based on these orientations, long- (four-, three-, and two-chamber heart) and short-axis positioning images were selected. Dynamic film images of long (four-, three-, and two-chamber heart) and short (continuous level from valve opening to apex) axes, dynamic film images of coronal left ventricular outlet and sagittal right ventricular outflow tract, and weighted lipid images of long axis (four-, three-, and two-chamber heart) and left ventricular base, middle, and apex segments were obtained. (2) At the same time as the infusion of exogenous gadolinium contrast agents, dynamic perfusion scan sequence was performed in the four chambers of the heart the four short axis levels of the base, middle, and apex of the left ventricle for approximately 60–80 cardiac cycles, depending on the observation of secondary perfusion of the left ventricle. (3) After the scan, the gadolinium contrast agent was injected continuously at a dose of 0.2 mmol/kg body weight. After 10 min, the 200–400 ms reversal period was detected, and the optimal reversal time was observed on the images of the middle segment of left ventricular short axis. Then, the phase-sensitive reversal recovery weighted sequence was implemented. Delay-enhanced scan was performed at the same position as the long- and short-axis films. The complete sequence had a scanning time of approximately 45–55 min.

### Follow-Up Visit

Cardiac magnetic resonance detection was performed before CR in all patients undergoing CR surgery for left ventricular insufficiency. Cardiac MRI was used in postoperative follow-up to evaluate postoperative cardiac function recovery among patients based on their LVEF index. LVEF $<$50% indicates a poor postoperative cardiac function recovery, which was observed in the case group. LVEF $\geq$50% implies good recovery of cardiac function in the patients, as observed in the control group.

### *Observation Indicators*

Comparisons were conducted on preoperative LVEF left ventricular end-diastolic volume (LVEDV), left ventricular end-systolic volume (LVESV), left ventricular end-diastolic volume index (LVEDVI), left ventricular end-systolic volume index (LVESVI), cardiac index (CI), and other cardiac magnetic resonance detection parameters. LVEDV and LVESV are crucial parameters for heart function assessment. LVEDV represents the maximum compared volume of blood in the left ventricle at the end of diastole when it is filled, and LVESV denotes the volume of blood remaining in the left ventricle at the end of systole. For an accurate assessment of left ventricular function, LVEDVI and LVESVI were adjusted for the body surface area. These indices consider individual differences in size and normalize volumes based on the patient's body surface area. This normalization improved the comparisons between individuals. CI is another essential parameter used to evaluate cardiac output relative to the body surface area. This index is calculated by dividing the cardiac output (the volume of blood pumped by the heart per minute) by the body surface area. In consideration of the differences in the body size of individuals, the CI provides a standardized measure of cardiac function. Logistic regression analysis was carried out to analyze the prognostic factors of patients with left ventricular dysfunction after CR. The receiver operating characteristic curve (ROC) curve was plotted, the sensitivity, specificity, area under the curve (AUC), and Jorden index were calculated, and the best prediction threshold was determined. We observed the predictive value of cardiac MRI detection indexes for the prognosis of CR after CR surgery for left ventricular insufficiency. Logistic regression analysis was employed to identify factors affecting the prognosis of patients with left ventricular insufficiency following CR. To evaluate the model's accuracy, we constructed an ROC curve, which illustrated a trade-off between sensitivity and specificity across various thresholds. The AUC and Jorden index were calculated to evaluate the model's overall performance. The most accurate prediction results were ensured through the establishment of an optimal prediction threshold on the ROC curve. Complicated liver, kidney, and other severe organ dysfunctions, severe arrhythmias, and other serious myocardial diseases may potentially interfere with outcome variables, which would have led to measurements being influenced by nonsurgical effects. These conditions can also affect the healing process. Therefore, we excluded the patient group with these conditions from the study.

### *Statistical Methods*

Statistical analysis was performed on IBM SPSS Statistics for Windows version 27.0 (IBM Corp. Armonk, NY, USA). Age and body mass index were measured, and the results conforming to normal distribution were expressed as ($\bar{x} \pm$ s). Findings with nonnormal distribution were statistically analyzed after the variables had been converted to exhibit normal distribution, and a $t$-test was adopted. Gender, monthly income, educational level, smoking history, drinking history, family genetic history, combined underlying diseases, and cardiac function classification were represented as [n (%)], and $\chi^2$ test was applied for comparison. $p < 0.05$ was considered statistically significant. Binary logistic regression analysis was performed, with $p < 0.05$ indicating statistical significance. Prognostic indicators were analyzed as test variables and postoperative follow-up efficacy as a state variable. The ROC curve was drawn, the sensitivity, specificity, and AUC were calculated, and the best predictive threshold value was determined to observe the prognostic value of cardiac MRI in CR surgery for left ventricular dysfunction.

## Results

### *Comparison of General Data between the Two Groups*

The case and control groups showed no statistically significant differences in terms of gender, age, monthly income, education level, smoking history, alcohol consumption history, family genetic history, comorbid underlying diseases, cardiac function class, and body mass index. Thus, the two groups were comparable, as illustrated in Table 1.

### *Comparison of Cardiac MRI Parameters*

Cardiac MRI showed the higher LVEDV, LVESV, LVEDVI, LVESVI, and CI in the case group compared with the control group. However, the LVEF indexes were lower than those in the nonexposed group ($p < 0.05$) (Table 2).

**Table 1. Comparison of general data between the two groups.**

| Indicators | | n | The case group (n = 35) | The control group (n = 110) | $\chi^2/t$ | $p$ |
|---|---|---|---|---|---|---|
| Gender (n, %) | Male | 91 | 23 (65.71) | 68 (61.82) | 0.172 | 0.678 |
| | Female | 54 | 12 (34.29) | 42 (38.18) | | |
| Age (years) | | | 48.54 ± 4.95 | 48.56 ± 4.88 | 0.011 | 0.992 |
| Monthly income (n, %) | ≤$690.91 | 53 | 13 (37.14) | 40 (36.36) | 0.007 | 0.934 |
| | >$690.91 | 92 | 22 (62.86) | 70 (63.64) | | |
| Educational level (n, %) | High school and below | 60 | 15 (42.86) | 45 (40.91) | 0.042 | 0.839 |
| | College degree or above | 85 | 20 (57.14) | 6 (59.09) | | |
| Smoking history (n, %) | Yes | 103 | 26 (74.29) | 77 (70.00) | 0.237 | 0.626 |
| | No | 42 | 9 (25.71) | 33 (30.00) | | |
| Drinking history (n, %) | Yes | 90 | 21 (60.00) | 69 (62.73) | 0.084 | 0.772 |
| | No | 55 | 14 (40.00) | 41 (37.27) | | |
| Family genetic history (n, %) | Yes | 23 | 5 (14.29) | 18 (16.36) | 0.086 | 0.769 |
| | No | 122 | 30 (85.71) | 92 (83.64) | | |
| Combined underlying diseases (n, %) | Yes | 49 | 11 (31.43) | 38 (34.55) | 0.115 | 0.734 |
| | No | 96 | 24 (68.57) | 72 (65.45) | | |
| heart function grade (n, %) | Stage I | 40 | 8 (22.86) | 32 (29.09) | 0.517 | 0.472 |
| | Stage II~III | 105 | 27 (77.14) | 78 (70.91) | | |
| Body mass index (kg/m$^2$) | | | 22.15 ± 2.23 | 22.16 ± 2.22 | 0.023 | 0.982 |

**Table 2. Comparison of cardiac MRI parameters.**

| Group | n | LVEF (%) | LVEDV (mL) | LVESV (mL) | LVEDVI (mL/m$^2$) | LVESVI (mL/m$^2$) | CI (L/m$^2$) |
|---|---|---|---|---|---|---|---|
| The case group | 35 | 48.49 ± 8.51 | 110.25 ± 12.12 | 74.15 ± 7.51 | 217.12 ± 23.15 | 153.25 ± 20.98 | 2.35 ± 0.23 |
| The control group | 110 | 54.45 ± 9.68 | 102.75 ± 11.25 | 69.75 ± 7.02 | 201.88 ± 21.72 | 148.22 ± 18.72 | 2.06 ± 0.23 |
| $t$ | - | 3.262 | 3.371 | 3.176 | 3.558 | 3.482 | 3.290 |
| $p$ | - | 0.001 | 0.001 | 0.002 | 0.001 | 0.001 | 0.001 |

Note: LVEF, left ventricular ejection fraction; LVEDV, left ventricular end-diastolic volume; LVESV, left ventricular end-systolic volume; LVEDVI, left ventricular end-diastolic volume index; LVESVI, left ventricular end-systolic volume index; CI, cardiac index.

### *Analysis of Multiple Factors Affecting the Clinical Effect of Surgery*

Logistic regression analysis was performed on indicators with differences, and the results reveal LVEF as a protective factor for the postoperative efficacy of the patients, with an odds ratio (OR) <1. LVEDV, LVESV, LVEDVI, LVESVI, and CI were all risk factors for the postoperative efficacy in the patients, with OR >1 (Table 3).

### *Predictive Value of Cardiac MRI Parameters for Postoperative Efficacy*

As shown in Table 4 and Fig. 1, LVEF yielded the following: AUC, 0.698; optimal threshold, 53.57%; sensitivity of optimal threshold point, 0.618; specificity, 0.800. With an LVEF of 53.57% as the standard, a 69.80% probability was obtained for the accurate prediction of the therapeutic effect. LVEDV achieved the following: AUC, 0.674; optimal threshold, 112.33 mL; sensitivity of optimal threshold, 0.514; specificity, 0.836. Thus, with an LVEDV index of 112.33 mL as the standard, the treatment effect was accurately predicted with a probability of 67.40%. The following findings were obtained for LVESV: AUC, 0.654; optimal threshold, 68.50 mL; sensitivity of optimal threshold point, 0.654; specificity, 0.771. Therefore, with an LVESV index of 68.50 mL as the standard, the therapeutic effect can be accurately predicted with a 65.40% probability. The following were observed for LVEDVI: AUC, 0.700; optimal threshold, 205.51 mL/m$^2$; sensitivity of optimal threshold point, 0.800; specificity, 0.609. Thus, with an LVEDVI of 205.5 mL/mL$^2$ as the standard, the accurate prediction of the treatment effect had a probability of 70.00%. LVESVI had the following values: AUC, 0.572; optimal threshold, 163.99 mL/m$^2$; sensitivity of optimal threshold point, 0.371; specificity, 0.836. Therefore, with an LVESVI of 163.99 mL/m$^2$ as the standard, the therapeutic effect was accurately predicted with a probability of 57.20%. CI yielded the following results: AUC, 0.812; optimal threshold, 2.14 L/m$^2$; sensitivity of optimal threshold point, 0.829; specificity, 0.645. Thus, with a CI of 2.14 L/m$^2$ as the standard, a probability of 81.20% was calculated for the accurate prediction of treatment effects.

**Table 3. Analysis of multiple factors affecting the clinical results of surgery**

| Item | $\beta$ value | SE | $z$ value | Wald$\chi^2$ | $p$ value | OR value | OR value 95% CI |
|---|---|---|---|---|---|---|---|
| LVEF | –0.117 | 0.034 | –3.415 | 11.664 | 0.001 | 0.890 | 0.832~0.951 |
| LVEDV | 0.081 | 0.028 | 2.840 | 8.066 | 0.005 | 1.084 | 1.025~1.146 |
| LVESV | 0.111 | 0.040 | 2.739 | 7.501 | 0.006 | 1.117 | 1.032~1.209 |
| LVEDVI | 0.019 | 0.011 | 1.711 | 2.929 | 0.087 | 1.020 | 0.997~1.043 |
| LVESVI | 0.028 | 0.015 | 1.835 | 3.366 | 0.067 | 1.029 | 0.998~1.060 |
| CI | 5.681 | 1.397 | 4.066 | 16.530 | 0.000 | 293.261 | 18.961~4535.761 |

SE, standard error; OR, odds ratio; CI, confidence interval.

**Table 4. Predictive value of cardiac MRI parameters for postoperative efficacy.**

| Feature | AUC value | Sensitivity | Specificity | Optimal threshold |
|---|---|---|---|---|
| LVEF | 0.698 | 0.618 | 0.800 | 53.57 |
| LVEDV | 0.674 | 0.514 | 0.836 | 112.33 |
| LVESV | 0.654 | 0.771 | 0.473 | 68.50 |
| LVEDVI | 0.700 | 0.800 | 0.609 | 205.51 |
| LVESVI | 0.572 | 0.371 | 0.836 | 163.99 |
| CI | 0.812 | 0.829 | 0.645 | 2.14 |

AUC, area under curve.

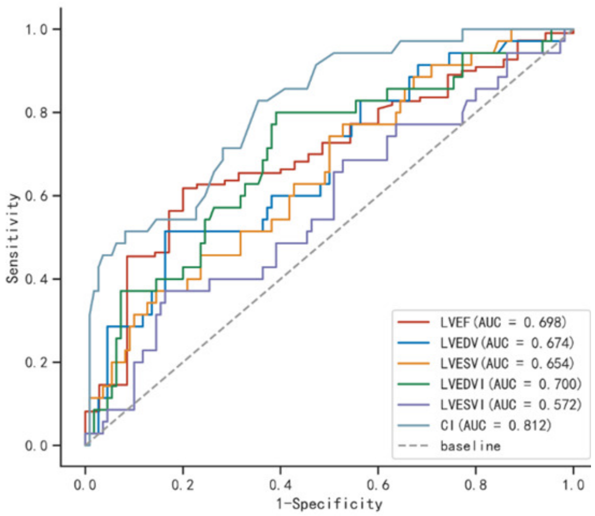


**Fig. 1. Predictive value of cardiac MRI parameters for postoperative efficacy.**

## Discussion

Cardiac MRI is an innovative noninvasive imaging technology with a good resolution and can detect patients from all directions and angles; this process is very important for the potential survival benefits of revascularization and can be used in the effective prediction of the survival of patients with ischemic cardiomyopathy [21–23]. The above research results show that cardiac MRI can be effectively applied in the evaluation of the cardiac function indicators of patients. Although the subjects in this research were inconsistent with those of above studies, cardiac MRI revealed that LVEDV, LVESV, LVEDVI, LVESVI, and CI were higher in the case group than in the control group. However, the LVEF index was lower than that of the control group ($p < 0.05$), which indicates that cardiac MRI can effectively detect ventricular remodeling, volume, and systolic function. According to the above data, CR surgery for left ventricular dysfunction affects various cardiac function indexes of patients, which can effectively reflect the recovery level of cardiac function in patients. LVEDV, LVESV, LVEDVI, LVESVI, CI, and LVEF are important evaluation indicators of cardiac function. Cardiac MRI is performed from all aspects of the heart, and expansive full-volume three-dimensional cardiac structure databases can be obtained without using geometric shape assumptions. Furthermore, evaluation of the postoperative cardiac function recovery of patients was conducted based on the size, shape, and function of the heart cavity [24–26].

Logistic regression analysis was carried out for the indicators with differences, and the results reveal LVEF as a protective factor for the postoperative efficacy of the patients, with an OR <1. LVEDV, LVESV, LVEDVI, LVESVI, and CI were all risk factors for the postoperative efficacy of the patients, with an OR >1. LVEF, LVEDV, LVESV, LVEDVI, LVESVI, and CI accurately predicted treatment outcomes at 69.80%, 67.40%, 65.40%, 70.00%, 57.20%, and 81.20% of the time, respectively. (1) LVEF refers to the ratio of ejection volume between the systolic and diastolic periods of the heart and is an important indicator for cardiac function measurement among patients. Chen *et al.*'s study [27] of patients indicated that the LVEF index showed a positive correlation with cardiac function. The increase in LVEF index in patients implied the improvement in cardiac function after surgery. The decrease in LVEF index after surgery indicated a decreased cardiac function and subsequent poor prognosis after surgery. This result further proves that LVEF index is a protective factor for the postoperative efficacy of patients, and its detection can effectively predict postoperative clinical efficacy among patients. (2) LVEDV indicates the filling amount of the left ventricle at the end of the diastolic period. When patients suffer from aortic valve insufficiency, the blood returned through the aortic valve will form LVEDV, which will increase the levels of its indicators, and the LVEDVI will rise accordingly, which will increase ventricular pressure, cause pulmonary congestion in patients, and result in dyspnea and chest tightness in patients. Das *et al*. [28] showed that continuous cardiac magnetic resonance detection of patients with left ventricular remodeling resulted in a substantial increase in the LVEDV index of patients with adverse remodeling; in addition, the ROC curve showed a high predictive value for patients with adverse remodeling. Although the subjects in the above study are inconsistent with those in the present work, LVEDV was proven as a predictive risk factor for cardiac function recovery, which led to a high risk of postoperative adverse outcomes in patients. In this study, cardiac MRI was used to detect LVEDV and LVEDVI in patients, and ROC curve data further confirmed that this index can effectively reflect the recovery of cardiac function after CR and has a certain predictive value for postoperative efficacy. (3) LVESV represents the largest anterior and posterior diameter of the heart during diastole, and cardiac MRI can effectively determine the presence of an abnormal cardiac systolic function in patients. In this study, the LVESV of patients in the exposed group increased considerably, which indicates that patients may suffer from coronary artery stenosis, viral infection, and other conditions. As a result, the patients would exhibit a poor cardiac function recovery. LVESVI refers to the LVESV/body surface area, which indicates a positive correlation between the two parameters. The LVESVI of patients LVESVI increased accordingly. Vinter *et al*. [29] stated that the detection of patients via cardiac MRI shows the great predictive value of LVESV for patient survival; in addition, the decrease in LVESV index leads to the increase in plasma B-type natriuretic peptide level in patients, which implies a serious ventricular systolic dysfunction (which is a high-risk factor related to clinically adverse outcomes). (4) CI is an evaluation index for the cardiac function of patients, and it represents the ability of the heart to function. An abnormal CI indicates that the heart is under heavy load and constantly working. Once the heart loses its ability to withstand pressure, cardiac function will suffer from poor recovery, which will result in heart failure and other adverse conditions [30]. Moreover, the data obtained in this study further indicate that this index is a risk factor for postoperative adverse outcomes and has a high predictive value for postoperative adverse outcomes of patients.

The present study still encountered limitations, including the small number of cases and the reliance on a single data source. Therefore, future studies should consider the use of larger sample sizes, multicenter participation, and long-term follow-up to improve the generalizability of findings. Furthermore, this study excluded a comprehensive range of measured variables in the analysis due to limitations in data acquisition. Future research should be aimed at the screening and inclusion of additional variables to further analyze and identify more predictive factors. Finally, this study employed a relatively short follow-up period. Although conclusions can be drawn based on existing data, an extended follow-up period will provide clear insights into causal relationships and yield robust results. Although we recognize the limitations of research, each study still inevitably produced confounding variables. The control of confounding variables in this article began with the selection of the study population and was continued until the selection of closely matching case and control groups in terms of demographic background and the use of ROC curves for further model evaluation.

## Conclusion

LVEDV, LVESV, LVEDVI, LVESVI, CI, and LVEF are all important factors affecting the clinical efficacy in patients undergoing CR surgery, and the detection of these indicators via cardiac MRI can effectively predict postoperative efficacy among patients. In clinical practice, the monitoring and evaluation of these indicators can assist clinicians in the accurate assessment of patients' recovery and outcomes postsurgery. Prompt monitoring of these indicators will enable healthcare professionals to adapt treatment plans and develop personalized care strategies to optimize patients' recovery and survival rates. Furthermore, the findings of this study provide valuable insights into future research directions. Conducting more thorough investigations on the mechanisms underlying the influence of these cardiac function indicators on the clinical outcomes of coronary artery reconstruction surgery and the creation of precise prediction models and treatment approaches will increase the surgical success rate and overall quality of patient survival.


## Availability of Data and Materials

Data to support the findings of this study are available upon reasonable request from the corresponding author.



## Author Contributions

JD and WS performed the research; WS provided help and advice on the experiments; JC and JD contributed to the analysis and interpretation of data. All authors contributed to editorial changes in the manuscript and read and approved the final manuscript. All authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

## Ethics Approval and Consent to Participate

This study has been approved by the ethics committee of West China Hospital, Sichuan University, approval no.: 2024555. All respondents gave informed consent and have signed an informed consent agreement.

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## Conflict of Interest

The authors declare no conflict of interest.

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