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Investigation into the Early Modification of Left Ventricular Mass Following Mitral Valve Replacement and the Development of a Nomogram Prediction Model

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Abstract

Background: Mitral valve disease caused by rheumatic heart disease and mitral valve disease caused by degenerative valvular disease are common types of mitral valve disease. Mitral Valve Replacement surgery (MVR) is an effective treatment for mitral regurgitation. This study observed the changes of Left Ventricular Mass (LVM) and other indicators through mitral valve lesions caused by different types of lesions, and further observed the changes of left ventricular mass and other indicators after MVR. The effects of preoperative LVM and other indicators on postoperative ejection fraction reduction in patients with MVR were described, and the model was established as a risk factor.

Method: A retrospective study was conducted on the baseline data and perioperative echocardiographic data obtained during hospitalization of 80 patients with rheumatic or degenerative mitral valve disease from September 2022 to March 2023. The patients were divided into two groups, group A and Group B, according to the relevant perioperative indicators obtained by the formula of LVM, Left Ventricular Mass Index (LVMI) and Relative Ventricular Wall Thickness (RWT). Group A (rheumatic heart disease, n=50) and group B (degenerative valvular disease, n=30). The changes of left ventricle in two groups were observed. Then, the risk factors affecting the reduction of Ejection Fraction (EF) 3 months after surgery were screened by univariate and multivariate Logistic regression analysis, and the corresponding risk prediction model was established by using RStudio, and the model was evaluated and verified.

Results: The preoperative LVM, LVMI, left ventricular volume and left ventricular size in group A were lower than those in group B, and the differences were statistically significant ($P<0.05$), and there was no significant change in RWT between the two groups ($P>0.05$); The LVM, LVMI, left ventricular volume and left ventricular size of the whole patients at 1 week and 1 month after surgery were all regression compared with those before surgery, and the differences were statistically significant ($P<0.05$); There were no significant changes in LVM, left ventricular volume and left ventricular size 3 months after surgery compared with 1 month after surgery ($P>0.05$). Logistic regression analysis showed that left anterior and posterior atrial diameter (OR=1.399, 95% CI: 0.978~2.002) and left ventricular end-diastolic diameter (OR=1.269, 95% CI: 1.034~1.558), LVM (OR=1.129, 95% CI: 1.042~1.223) and serum creatinine (OR=1.114, 95% CI: 1.028~1.207) were independent risk factors for postoperative EF decline ($P<0.05$). A prediction model was established based on the risk factors, and the model was validated and evaluated. Based on this model, a column graph was established to observe the influence of each risk factor on the results.

Keywords: Left ventricular mass; Left ventricular mass index; Rheumatic valvular disease; Degenerative valvular disease; Mitral valve replacement surgery; Nomograph

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Introduction

The mitral valve is a complex anatomical structure, and its function is usually the coordination of the mitral lobe, mitral ring, papillary muscle and chordae tendinae [1,2]. Rheumatic heart disease is still a common cause of mitral valve insufficiency in developing countries, while mitral regurgitation is dominated by mucoid degeneration in developed countries [3-7]. Mitral valve replacement and repair surgery is a common treatment for mitral valve disease, and Doppler ultrasound is an important method to evaluate the function and structure of the heart.

Mitral valve replacement is a common type of heart surgery in which a patient's abnormal mitral valve is removed and replaced with a mechanical or biological valve. In terms of surgical techniques, the Chordal-sparing technique has certain advantages. Traditional mitral valve replacement surgery usually involves the complete removal of the patient's mitral valve and then replacement with a mechanical or biological valve. The preservation of chordae tendineae is to preserve part or all of the normal chordae tendineae as much as possible during the replacement process [8,9]. Through the MVR, we can rebuild the function of the valve, restore the normal working mechanism of the heart, and restore the hemodynamics to the original normal state, which can not only significantly reduce the symptoms of patients, improve the quality of life, but also stop the progression of valve disease.

However, after MVR, some patients may be at risk of reduced EF, which increases the rate of readmission and decreases the quality of life of patients [10]. LVM is an important indicator of heart health, which reflects Left Ventricular End Diastolic Volume, Overall relationship between LVEV, Left Ventricular Dimension (LVD), and Interventricular Septum Thickness (IVST). LVMI is the relationship between left ventricular mass and total Body Surface Area (BSA), which is a sensitive index to evaluate heart health and disease risk. LVM is affected by many factors, such as age, sex, height, weight and blood pressure. With age, the left ventricular muscle gradually thickens, leading to an increase in LVM. Gender is also an important factor, with LVM generally greater in men than in women. In addition, cardiovascular diseases such as hypertension and coronary heart disease can also lead to changes in LVM.

The normal and abnormal ranges of the left ventricular mass index help clinicians judge the heart health of patients. A left ventricular mass index in the normal range indicates good heart function, while an abnormal index can mean that the heart is overburdened and at increased risk for cardiovascular disease. Therefore, regular examination of the left ventricular mass index is of great significance for the prevention and early detection of heart disease.

Some previous studies focused more on the changes of left ventricular remodeling after aortic valve replacement [11], but there were few studies on the changes of LVM and other indicators after MVR and the differences in LVM among different types of valvular diseases.

This study explored the change trend of LVM, LVMI, left ventricular size and volume of 80 patients undergoing MVR in the perioperative period, and the influence of different causes on LVM, to explain the clinical significance behind it.

Materials and Methods

General information

Eighty patients with rheumatic or degenerative mitral valve disease from September 2020 to March 2022 underwent mitral valve replacement surgery at the same time.

Inclusion criteria: (1) Patients who visited the General Hospital of the Northern Theater Command of the China for rheumatic heart disease or degenerative valvular disease underwent MVR at the same time and recovered well after surgery, and regularly visited our hospital for follow-up without death; (2) The lesion type of the valve was determined by Doppler echocardiography and intraoperative observation, which was uniform and unobjectionable; (3) The results of the patient's perioperative echocardiography report are evaluated by the same doctor to determine the results; (4) The patient has signed the relevant informed consent.

Exclusion criteria: (1) Patients with aortic valve lesions or other valvular lesions; (2) The patient did not undergo MVR due to the condition and intraoperative echocardiography results, but underwent MVR; (3) Patients with atrial septal defect, ventricular septal defect and other types of congenital heart disease; (4) The patient's coronary angiography and coronary CT were not significantly abnormal, and there was no coronary artery bypass surgery at the same time. According to the type of lesion of the patients, the patients before surgery were divided into group A (mitral rheumatic diseases, n=50) and group B (degeneration, n=30) and there was no statistical difference in the general baseline data before surgery (P>0.05) (Table 1).

Research methods

Echocardiography of the heart was performed using Philips IE33 color Doppler sonography with a 2.25 MHz sensor and medical echocardiography ultrasound for each subject in the semi-recumbent and left position electronic instrument. Echograms were recorded using an echocardiogram window located in the third intercostal space at the left sternal margin. Measurements of wall thickness and chamber size were obtained only from echocardiograms in the semi-recumbent position. The left ventricular mass formula was calculated using the corrected Deiereux of the American Society of Echocardiography:

Left Ventricular Mass LVM (g) = 0.8 × 1.04 [(IVST + LVPWT + LVDd)3-LVDd3] +0.6; LVMI (g/m^2) = LVM/BSA [12]; Relative wall thickness RWT=(IVST+LVPWT)/LVDd [13]; Body surface area BSA (m^2) = 0.0061 × height (cm) + 0.0125 × weight (kg)-0.1529 [14]. LVPWTD was defined as left ventricular posterior wall thickness at diastolic phase. LVDd was defined as left ventricular diastolic diameter. All patients underwent mitral valve replacement under cardiopulmonary bypass. The median sternotomy was used in all patients, and the "chordae tendineae preservation" technique was used. All patients underwent Doppler ultrasound examination 3 days before operation, 1 week, 1 month and 3 months after operation, and the corresponding indexes were calculated by the obtained color Doppler ultrasound value and the above formula to observe the changes during the perioperative period.

Statistical methods

SPSS 26.0 software was used for statistical analysis. The count data were expressed as examples (percentage), and the comparison was performed by X^2 test. The measurement data of non-normal distribution were expressed as median (quartile), and the measurement data of normal distribution were expressed as mean ± standard deviation. The independent sample *t* test was used for normal data. The Wilcoxon signed rank test and two independent samples Mann-Whitney test were used for non-normal data comparison, and P<0.05 was considered statistically significant. GraphPad Prism 9 was used to draw the relevant line plots. Then the independent risk factors were screened by univariate Logistic regression, and the risk model was established by multivariate Logistic regression. The calibration curve was tested on RStudio, and the verification model was established by Bootstrap method to test the risk model. The Consistency index (C-index) was calculated and the Receiver Operating Characteristic curve (ROC) was made. In terms of P<0.05 was considered statistically significant.

Table 1: Baseline data of patients in 2 groups according to lesion type.

	Rheumatic valvular disease (n=50)	Degenerative valvular disease (n=30)	p
Gender (male)/example (%)	22 (44.00)	16 (53.33)	0.325
Age	59 (52-64)	57 (53-64)	0.584
Diabetes suffered/case (%)	4 (8.00)	1 (3.33)	0.404
Suffering from hypertension/case (%)	13 (26.00)	14 (46.67)	0.058
Serum creatinine (μmol/L)	67.96 ± 16.03	69.50 ± 13.12	0.394
European rating (%)	1.32 (1.16-1.53)	1.18 (1.09-1.53)	0.178
Perioperative use of temporary pacemakers/case (%)	21 (42.00)	15 (50.00)	0.486
Tricuspid valve plasty/case at the same time (%)	22 (44.00)	17 (56.67)	0.273
Mitral valve Biovalve/case (%)	18 (36.00)	12 (0.40)	0.721
Aortic sinus (mm)	28.22 ± 3.18	30.90 ± 3.08	0.726
Aortic sinus duct junction (mm)	24.50 ± 3.15	26.57 ± 3.24	0.991
Left atrial anteroposterior diameter (mm)	50.50 (48.00-57.25)	53.62 (47.00-60.00)	0.834
Pulmonary artery internal diameter (mm)	23.00 (21.00-26.00)	23.50 (21.00-25.25)	0.723
SPAP (mmHg)	46.50 (39.75-58.00)	53.37 ± 15.27	0.306
EF	0.57 (0.54-0.58)	0.56 (0.55-0.57)	0.809
FS	0.29 (0.27-0.30)	0.30 (0.27-0.30)	0.524

SPAP: Systolic Pulmonary Artery Pressure; EF: Ejection Fraction; FS: Fraction Shortening

Results

Rheumatic heart disease and degenerative valvular disease differ significantly from the overall heart geometry before surgery

According to the patient's lesion type, the patient's cardiac Doppler echocardiogram value before surgery was compared, the LVM and LVMI of mitral valve lesion caused by rheumatic heart disease and degenerative valvular disease were smaller than that of the LVMI, and the difference was statistically significant (P<0.05), and the volume of the left ventricle of mitral valve lesion caused by rheumatic heart disease and degenerative valvular disease was reduced (P<0.05), the size of the left ventricle was significantly changed compared with the mitral valve lesion caused by degenerative valvular disease, and the diameter of the left ventricle in rheumatic heart disease was lower than that of degenerative valvular disease. However, the RWT did not change significantly between the two groups, and the difference was not statistically significant (P>0.05) (Table 2).

The geometry of the patient's left ventricle has regressed

The left ventricular mass, left ventricular mass index, left ventricular volume and internal diameter of the patients decreased before and 1 week after surgery, and the differences were statistically significant (P<0.05; Table 3); The left ventricular mass, left ventricular mass index, left ventricular volume and inner diameter of patients decreased before and one month after surgery, and the differences were statistically significant (P<0.05; Table 4); There were no significant changes in left ventricular mass, left ventricular volume and inner diameter 1 month after surgery compared with 3 months after surgery (P>0.05; Table 5).

Trends in left ventricular mass in patients undergoing mitral valve replacement

The LVM in the perioperative period was gradually decreasing, and the LVM changed significantly before surgery compared with 1 week after surgery, and the quality change trend of left ventricle 1 month after surgery and 3 months after surgery was less obvious than before. The LVM was the most unstable 1 month after surgery, the area of change was large, the degree of dispersion was high, and the LVM tended to be stable 3 months after surgery (Figure 1).

Trends in LVM undergoing mitral valve replacement surgery for different lesion types

In patients with degenerative valvular disease, the LVM changed significantly and decreased significantly 1 week before and after surgery, and the LVM showed a gentle increase between 1 week postoperative and 1 month after surgery, and the LVM decreased compared with the previous period between 1 month after surgery and

Table 2: Changes in the structure of the left ventricle are seen before surgery depending on the type of lesion in the patient.

	Rheumatic valvular disease (n=50)	Degenerative valvular disease (n=30)	p
LVM (g)	142.60 (118.67-172.68)	239.92 (197.18-279.44)	<0.001
LVMI (g/m²)	84.52 (76.38-104.65)	135.05 (119.63-159.34)	<0.001
RWT	0.42 ± 0.06	0.41 ± 0.09	0.458
Left ventricular end-diastolic volume (ml)	93.50 (80.75-110.50)	151.52 (120.00-182.50)	<0.001
Left ventricular end-systolic volume (ml)	40.50 (34.00-49.50)	67.45 (51.00-84.00)	<0.001
Left ventricular end-diastolic diameter (mm)	4.50 (4.20-4.80)	5.46 (5.00-6.05)	<0.001
Left ventricular end-systolic inner diameter (mm)	3.20 (3.00-3.43)	38.62 (34.00-43.50)	<0.001

The data in the table are comparisons between rheumatic and degenerative valvular disease, **P<0.01
LMV: The Left Ventricular Mass; LVMI: Left Ventricular Mass Index; RWT: Relative Wall Thickness

Table 3: Changes of left ventricular structure before surgery and 1 week after surgery.

	pre-operation	1 week after surgery	P
LVM (g)	167.83 (123.30-231.41)	164.15 (142.49-193.96)	0.004**
LVMI (g/m²)	104.01 (78.56-131.54)	97.86 (85.25-115.41)	0.006**
Left ventricular end-diastolic volume (ml)	108.00 (83.50-145.00)	102.50 (85.25-124.50)	<0.001**
Left ventricular end-systolic volume (ml)	47.50 (35.00-65.00)	45.00 (36.25-57.00)	0.005**
Left ventricular end-diastolic diameter (mm)	40.75 (43.00-54.80)	46.5 (43.00-50.80)	<0.001**
Left ventricular end-systolic inner diameter (mm)	34.0 (30.00-38.80)	33.00 (30.30-36.00)	0.007**

The data in the table are compared between 1 week before operation and 1 week after operation, **P<0.01
LMV: The Left Ventricular Mass; LVMI: Left Ventricular Mass Index

Table 4: Changes of left ventricular structure before and 1 month after surgery.

	Pre-operation	1 month after surgery	P
LVM (g)	167.83 (123.30-231.41)	154.33 (127.81-187.54)	<0.001**
LVMI (g/m²)	104.01 (78.56-131.54)	89.99 (80.46-89.99)	<0.001**
Left ventricular end-diastolic volume (ml)	108.00 (83.50-145.00)	98.54 (80.25-110.50)	<0.001**
Left ventricular end-systolic volume (ml)	47.50 (35.00-65.00)	43.64 (34.00-50.75)	<0.001**
Left ventricular end-diastolic diameter (mm)	40.75 (43.00-54.80)	45.50 (42.00-48.00)	<0.001**
Left ventricular end-systolic inner diameter (mm)	34.0 (30.00-38.80)	32.75 (30.00-35.00)	0.001**

The data in the table are compared between 1 month before operation and 1 week after operation, **P<0.01
LMV: The Left Ventricular Mass; LVMI: Left Ventricular Mass Index

Table 5: Changes of left ventricular structure 1 month after surgery and 3 months after surgery.

	1 month after surgery	3 months after surgery	P
LVM (g)	154.33 (127.81-187.54)	142.71 (132.11-171.36)	0.066
LVMI (g/m²)	89.99 (80.46-89.99)	51.72 (45.40-60.24)	<0.001**
Left ventricular end-diastolic volume (ml)	98.54 (80.25-110.50)	98.50 (82.00-111.50)	0.986
Left ventricular end-systolic volume (ml)	43.64 (34.00-50.75)	46.83 (34.00-49.75)	0.527
Left ventricular end-diastolic diameter (mm)	45.50 (42.00-48.00)	45.50 (42.00-48.00)	1
Left ventricular end-systolic inner diameter (mm)	32.75 (30.00-35.00)	32.45 (30.00-34.75)	0.483

The data in the table are compared between 1 month before operation and 1 week after operation, **P<0.01
LMV: The Left Ventricular Mass; LVMI: Left Ventricular Mass Index

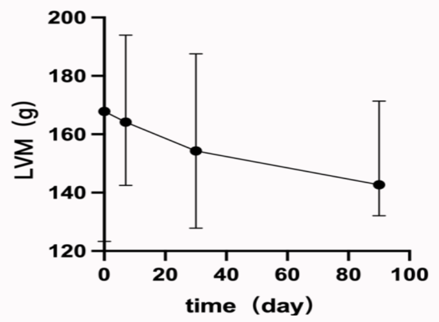

Figure 1: Perioperative changes in left ventricular mass.

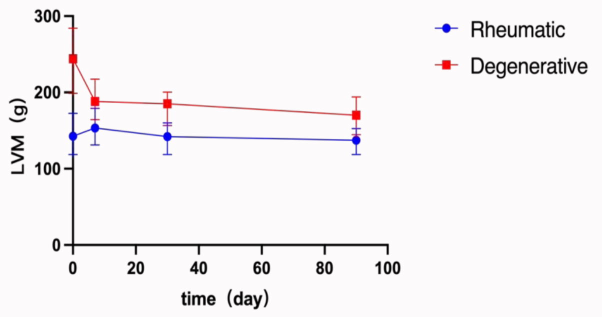

Figure 2: Comparison of left ventricular mass by lesion type.

3 months after surgery, but the decline was not obvious and tended to be stable. In patients with rheumatic heart disease, the quality of the left ventricle increased one week after surgery compared with the preoperative period, decreased in one month after surgery compared with one week after surgery, and stabilized less at three months after surgery than one month after surgery (Figure 2).

Univariate analysis of baseline data between patients with decreased and normal EF after MVR

Univariate logistic regression was performed on the baseline data of the two groups, and there were statistically significant differences in age, history of hypertension, serum creatinine, left anterior and posterior atrial diameter, left ventricular end-diastolic diameter, LVM and LVMI (P<0.05), (Table 6).

Multivariate logistic regression analysis results

According to the EF of the patient 3 months after the MVR, 0.50 was divided into 2 groups, in which the EF<0.5 was defined as the group with declining EF value, and the EF ≥ 0.50 was defined as the group with normal EF. Binary Logistic regression was performed on age, history of hypertension, serum creatinine, left anterior and posterior atrial diameter, left ventricular end-diastolic diameter,

Table 6: Results of univariate analysis of baseline data between the two groups.

Single factor	EF value decreased i	Normal EF value	X^2	P
n	34	46		
Gender (male)	20 (58.82)	17 (36.96)	3.695	0.055
Age (years)	61.50 (55.75, 65)	57.00 (50.00, 61.00)	5.778	0.016
BSA	1.67 (1.57, 1.81)	1.63 (1.55, 1.82)	1.786	0.181
Diabetes	5 (15.71)	10 (21.74)	0.628	0.428
Hypertension	22 (64.71)	15 (32.61)	7.792	0.005
Serum creatinine	77.50 (65.50, 104.00)	71.00 (55.00, 86.40)	5.778	0.016
Left anterior and posterior atrium diameter (mm)	48.79 ± 9.31	42.18 ± 3.69	12.34	<0.001
Left ventricular end-diastolic diameter (mm)	50.50 (44.00, 58.50)	46.00 (42.00, 52.00)	5.008	0.025
Left ventricular end systolic diameter (mm)	34.50 (31.50, 40.50)	32.50 (30.00, 37.00)	3.411	0.065
LVM (g)	245.22 ± 72.02	145.02 ± 28.31	20.79	<0.001
LVMI (g/m^2)	135.93 (123.76, 163.74)	82.87 (76.23, 104.44)	21.883	<0.001
RWT	0.39 (0.34, 0.43)	0.43 (0.38, 0.46)	1.341	0.247

The data in the table are the single factor regression results between the group with declining EF value and the group with normal EF value. 0.05, **P<0.01
BSA: Body Surface Area; LMV: The Left Ventricular Mass; LVMI: Left Ventricular Mass Index; RWT: Relative Wall Thickness

Table 7: Result analysis of multivariate Logistic regression.

Factor	Regression coefficient	Standard error	Wald	P	OR	95% confidence	interval
Left anterior and posterior atrium diameter (mm)	0.336	0.183	3.374	0.066	1.399	0.978	2.002
Left ventricular end-diastolic diameter (mm)	0.238	0.105	5.184	0.023	1.269	1.034	1.558
LVM	0.121	0.041	8.841	0.003	1.129	1.042	1.223
Serum creatinine	0.108	0.041	6.975	0.008	1.114	1.028	1.207
Constant	-57.859	20.659	7.843	0.005	0		

The data in the table are the single factor regression results between the group with declining EF value and the group with normal EF value. 0.05, **P<0.01
LMV: The Left Ventricular Mass

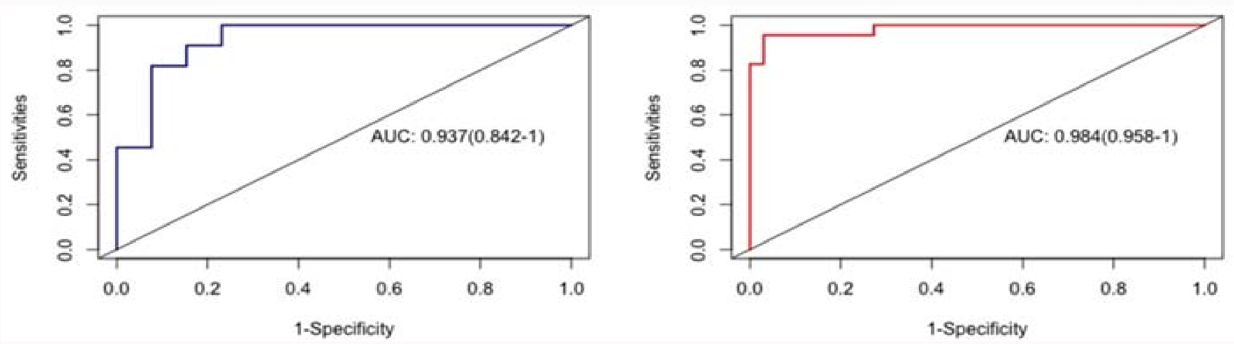

Figure 3: Comparison of left ventricular mass by lesion type. The blue on the left is the modeling set, and the red on the right is the validation set.
AUC: Area under the Curve

LVM and LVMI by comparing general data, and left anterior and posterior atrial diameter was selected (OR=1.399, 95% CI: 0.978~2.002), left ventricular end-diastolic diameter (OR=1.269, 95% CI: 1.034~1.558), LVM (OR=1.129, 95% CI: 1.042~1.223), serum creatinine (OR=1.114, 95% CI: 1.028~1.207) was an independent risk factor for postoperative EF decrease and was statistically significant (P<0.05), (Table 7).

Modeling and validation of preoperative risk factors affecting postoperative ejection fraction reduction in patients

Independent risk factors were screened out according to the multi-factor regression table and a preoperative risk factor model was constructed. In order to ensure the accuracy of the model, the validation set was established by using the validation method of multiple sampling internal data, and the comparison between the two was different. The results showed that the C-index of the modeling set and validation set were 0.937 (95% CI: 0.842~1.000) and 0.984 (95% CI: 0.958~1.000); the area under ROC curve (AUC) of the two groups were 0.937 and 0.984, respectively (Figure 3, where the blue on the left is the modeling set and the red on the right is the verification set). The corrected curves and standard curves of the two are well fitted (Figure 4, modeling set is on the left, verification set is on the right); Therefore, a nomogram model was drawn for the prediction of postoperative EF decline by risk factors before operation, and the probability of postoperative EF decline was calculated by assigning scores to various risk factors and comparing the total value of each patient, as shown in Figure 5.

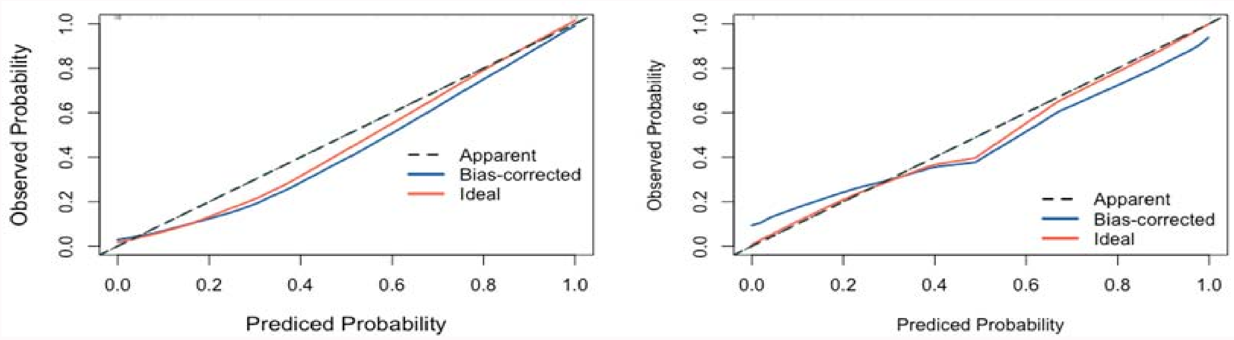

Figure 4: Calibration curves for modeling set and validation set. The left side is the modeling set and the right side is the validation set.

Equations

(1) LVM (g) = 0.8 × 1.04 [(IVST + LVPWT + LVDd)3-LVDd3] + 0.6

(2) LVMI (g/m²) = LVM/BSA

(3) RWT = (IVST+LVPWT)/LVDd

(4) BSA (m²) = 0.0061 × height (cm) + 0.0125 × weight (kg)-0.1529

Discussion/Conclusion

MVR is a type of heart surgery primarily used to treat mitral valve diseases, including mitral stenosis and mitral insufficiency [15]. The history of this procedure dates back to the early 20th century, but the real development and successful application dates back to after the mid-20th century. However, with the development of technology, MVR has gradually become an important treatment option [16,17]. In this procedure, a patient's damaged or diseased mitral valve is replaced with an artificial valve to restore heart function. The important role of MVR is to solve the problems of heart failure and arrhythmia caused by mitral valve disease, so as to improve the quality of life and extend the life span of patients. This procedure has become one of the main treatments for severe mitral valve disease, offering patients an effective treatment option. Left ventricular end-diastolic volume and left ventricular end-diastolic diameter have always been the common concerns of surgeons and sonographers, but the quality of left ventricle in MVR is easy to be neglected in clinical work. After MVR, LVM may change, including left ventricular remodeling, left ventricular hypertrophy and left ventricular dilation. These changes may have an impact on the survival rate of postoperative patients and the incidence of cardiovascular events. There are many indicators such as perioperative left ventricular geometry, and LVM is often ignored as an indicator [18]. In this study, we mainly focused on the difference between different lesion types, left ventricular mass, and the change trend of postoperative LVM. LVM can represent the comprehensive evaluation of perioperative heart geometry and size, and left ventricular adaptation to chronic volume overload occurs with the gradual enlargement of ventricles and the increase of LVM [19]. Chronic severe volume overload can change the shape of the left ventricle and increase the mass of the left ventricle, which is also related to the size and volume of the left ventricle. In the above patients, the increase of the mass of the left ventricle often indicates that the patient has congestive heart failure. For congestive heart failure, centrifugal dilation of the heart is often accompanied by abnormal cardiac conduction bundles. The coordination of the heart and the effectiveness of pumping blood are affected. It has been reported in relevant literature that patients with congestive heart failure are more prone to arrhythmia [18,20], which seriously affects the quality of life of patients.

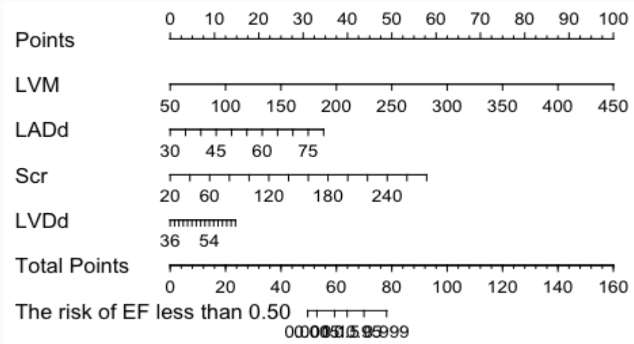

Figure 5: A risk model for predicting the decline in EF after surgery.
LMV: The Left Ventricular Mass; LADd: Left Anterior and Posterior Atrium Diameter; Scr: Serum creatinine; LVDd: Left Ventricular End-Diastolic Diameter

As can be seen from the above table, there is a significant difference in the heart structure changes caused by rheumatic heart disease and degenerative valvular disease. The left ventricular mass of patients with rheumatic heart disease is lighter than that of patients with degenerative valvular disease, and the end-diastolic volume and end-systolic volume of left ventricle in rheumatic heart disease are smaller than those in degenerative valvular disease. This may be due to the fact that mitral valve damage caused by rheumatic heart disease is not only regurgitation, but also narrowing caused by coiled fusion of the lobes [21-23]. However, degenerative valvular disease is mainly caused by left ventricular centrifugal dilation due to enlarged valve ring, poor valve quality, and myelopathic valve insufficiency [24,25]. These results suggest that isolated dilatation caused by valve insufficiency alone has a greater effect on LVM increase. The LVM of the patient before and after MVR has obvious changes, and the LVM, the size and volume of the left ventricle of the patient after surgery have all changed. As can be seen from the above picture, mitral valve function is restored to normal. For patients with rheumatic heart disease, the LVM shows an upward trend one week after surgery; for patients with degenerative valvular disease, LVM shows an upward trend one week after surgery. LVM showed an obvious downward trend, which may be due to mitral valve damage and insufficiency accompanied by certain stenosis in rheumatic heart disease. After the patient's mitral stenosis was removed after surgery, the LVM of the patient showed an upward trend. After the patient's degenerative valvular disease was removed, the left ventricular mass decreased. Mitral stenosis decreases the LVM, while mitral regurgitation increases the LVM. As can be seen from the above table and picture, the overall postoperative LVM of patients is decreased, and the LVM regression of left ventricle after surgery is accompanied by changes in the volume and size of left ventricle. For LVM regression, it is also accompanied by the process of the myocardium reaching the optimal initial length from congestive heart failure cardiomyocytes. The LVM and volume and size of the left ventricle were not significantly changed, indicating that the geometry of the left ventricle tended to stabilize during the postoperative period.

As for clinical work, the volume and size of the left ventricle and the overall geometry of the patient appear significant changes within 1 week after surgery. At this time, more attention should be paid to the treatment of the patient's cardiac capacity and timely adjustment should be made. For congestive heart failure caused by degenerative valvular disease, preoperative attention should be paid to arrhythmias and conduction tract abnormalities caused by increased LVM caused by long-term changes in left ventricular volume and accompanying functional changes caused by changes in left ventricular structure. For rheumatic heart disease, when the problems caused by the mitral valve are removed after surgery, attention should also be paid to the changes in capacity requirements caused by the changes in the patient's early heart [26].

For the long-term complications of MVR surgery, in addition to bleeding and thrombosis caused by improper use of mechanical anticoagulant drugs related to valve materials and valve degeneration after biological valve surgery, there are also some relevant factors surrounding patient prognosis, such as: Infection in valve replacement surgery, fat liquefaction of surgical wounds, poor incision healing, Alsaddiqe et al. [27,28]. An additional complication is that patients still have symptoms of heart failure after surgery. Heart failure after MVR refers to a condition in which the heart cannot effectively pump blood to various parts of the body due to functional problems of the heart after MVR [29,30]. If a patient already has chronic heart disease before surgery, they may still be at risk of heart failure after surgery, as surgery does not always fully correct the structural and functional problems of the heart [31,32].

Developing heart failure after MVR can have a range of effects on patients' quality of life and long-term health. The patient's quality of life is reduced, daily activities may be limited, and the patient may feel unable to perform some routine tasks. Patients are at increased risk of readmission, which not only imposes a physical and psychological burden on the patients themselves, but also increases medical costs. The patient's heart function deteriorates, and the presence of heart failure may lead to further deterioration of heart function. Excessive heart burden may cause damage to the heart muscle, forming a vicious circle, and eventually lead to a gradual decline in the function of the heart, and even a threat to life.

In this study, an evaluation model was established by comparing some patients with decreased EF and normal EF after surgery. Some clinically relevant indicators were used to predict the probability of heart failure after MVR, and a column graph was drawn to assign scores related to risk factors affecting the prognosis of patients. From this study, it can be seen that the anteroposterior diameter of the left atrium, the end diastolic diameter of the left ventricle, LVM, and blood creatinine have certain effects on the recovery of patients. In addition to simply describing the size of the patient's left atrium, the left anterior and posterior diameter can also roughly predict the duration of the patient's disease and the severity of the lesion [33,34]. The left ventricular end-diastolic diameter can not only describe the size of the left ventricle, but also reflect the short-term cardiac volume change. LVM mainly reflects the overall morphology of the patient's heart. LVM is a comprehensive index to describe the heart, but its role is often ignored by clinicians. In addition to reflecting the kidney function of patients, the serum creatinine value changes due to prerenal renal failure in patients with valvular heart disease accompanied by a decrease in forward blood flow. For the above risk factors, clinicians can intervene in many ways. For patients who may be associated with postoperative EF decline, in terms of left atrial size should give education to patients with mitral valve disease, so that they can receive surgical intervention as soon as possible. In terms of left ventricular end-diastolic diameter and LVM, the study can give the patient volume control before surgery if the condition permits. In terms of serum creatinine, we can try to alleviate the kidney function of the patient through drugs or volume. By improving these risk factors, we can clinically reduce the risk of postoperative EF reduction.

In this study, patients were scored based on these indicators by assigning score values to the column chart, and postoperative EF decline could be assessed by preoperative risk factors. According to the prediction model, medical staff can give corresponding preventive measures to the high-risk population, and improve the prognosis of patients has certain guiding significance for clinical.

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