Clinical Significance and Prognostic Factors of Simultaneous Heart Valve Surgery and Coronary Artery Bypass Grafting in Treating Patients with Valvular Heart Disease Complicated by Coronary Heart Disease

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This study was designed to evaluate the clinical significance of simultaneous heart valve surgery and coronary artery bypass grafting for patients with valvular heart disease complicated by coronary heart disease and its influence on their prognosis. A total of 121 patients with valvular heart disease complicated by coronary heart disease who were surgically treated in our hospital from January 2013 to March 2017 were selected. The observation group (OG) (64 patients) underwent simultaneous valvular heart surgery and coronary artery bypass grafting. The control group (CG) (57 patients) underwent non-synchronous heart valve surgery and coronary artery bypass grafting. The operation, hospitalization, occurrence of adverse events and changes of cardiac function indexes of patients from the two groups were compared, and the factors affecting their prognosis were confirmed in multivariate analysis. The ventilator application time, postoperative ICU monitoring time, postoperative general ward time and total incidence of adverse events in the OG were lower than those in the CG (P<0.05). After treatment, the cardiothoracic ratio, left ventricular end-diastolic volume and BNP content in the two groups were markedly higher than before treatment, and the increase in the OG was more obvious (P<0.05); the left ventricular ejection fraction in both groups was markedly lower than that before treatment (P<0.05), and the decrease in the OG was more obvious (P<0.05). Multivariate analysis showed that hypertension, treatment methods, course of disease and age were independent risk factors affecting the prognosis of patients with valvular heart disease complicated by coronary heart disease. Simultaneous heart valve surgery and coronary artery bypass grafting can reduce the occurrence of adverse events and improve cardiac function indexes, which is worthy of clinical application. Hypertension, treatment methods, course of disease and age are independent risk factors affecting the prognosis of those patients.

Key words: simultaneous heart valve surgery and coronary artery bypass grafting, valvular heart disease, coronary heart disease, prognosis

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In recent years, the aging process of our country has gradually accelerated, which has prompted the prevalence rate of cardiovascular and cerebrovascular diseases to rise continuously in clinical practice, and the incidence of valvular heart disease complicated with coronary heart disease has gradually increased (1, 2). Coronary heart disease refers to the heart disease caused by coronary atherosclerosis, which is manifested as myocardial ischemia, hypoxia and even necrosis caused by organic coronary stenosis, obstruction and/or functional change (spasm). As a common cardiovascular and cerebrovascular disease, it has a long course of disease, many complications and older patients, which easily poses a threat to their quality of life and life safety (3-5). Valvular heart disease (VD) refers to the anatomical or functional abnormality of the valve structure,

which is manifested as stenosis and/or insufficiency of the valve orifice. Coronary heart disease complicated with heart valve disease is more general in heart diseases, and its clinical symptoms are more serious. The incidence in developed countries is as high as 20%-40% (6, 7). Therefore, finding an appropriate treatment for valvular heart disease complicated with coronary heart disease is particularly vital to improve patients' prognosis and quality of life (8).

At present, the treatment of coronary heart disease complicated with valvular heart disease is mainly surgical treatment, of which cardiac valve surgery and coronary artery bypass surgery are commonly used in treating those patients. Recently, some studies have found that one-time completion of heart valve surgery and coronary artery bypass surgery avoids secondary surgery of patients, thus reducing surgical trauma and improving disease treatment effect (9, 10). However, it has found that due to the long time-consuming operation and many postoperative complications, it is extremely easy to affect the recovery of patients' physical and mental health after operation (11).

Hence, this study compares and analyzes the simultaneous heart valve surgery and coronary artery bypass grafting and non-synchronous heart valve surgery for coronary heart disease complicated with valvular heart disease, and verifies the factors of poor prognosis of patients, so as to provide reference for clinical practice.

MATERIALS AND METHODS

General Information

A total of 121 patients with valvular heart disease complicated by coronary heart disease who were surgically treated in our hospital from January 2013 to March 2017 were selected, and they were divided into observation group (OG) (64 patients) and control group (CG) (57 patients) according to treatment methods. Patients in the OG underwent valvular heart surgery and coronary artery bypass grafting at the same time, while patients in the CG underwent heart valve surgery and non-simultaneous coronary artery bypass grafting. All patients and their families had been informed, and they consented to this study and signed an informed consent form. Inclusion criteria: All patients were diagnosed as valvular heart disease complicated with coronary heart disease by ultrasound, coronary angiography and pathological examination. They all met the indications for simultaneous heart valve surgery and coronary artery bypass grafting. Exclusion criteria: patients with severe concretio pericardii, infectious diseases, liver and kidney and other important organ dysfunction; patients with a history of malignant tumor and thoracic surgery; patients with mental disorders; pregnant and lactating patients; patients with severe coagulation dysfunction; patients with active internal hemorrhage, thrombocytopenia, arteriovenous malformation and aneurysm; patients with other organic diseases.

Treatment Methods

Operation of the patients in the OG was performed under general anesthesia (GA), conventional median thoracotomy and moderate and low temperature cardiopulmonary bypass. Internal mammary artery and great saphenous vein are removed for standby. Intubation establishes extracorporeal circulation. We blocked ascending aorta, antegrade perfusion (for patients without aortic valve disease) or direct perfusion through coronary artery opening (for those with aortic valve disease) was performed till cardiac arrest. Soon afterwards, combined with angiographic findings, the vessel shape should be detected, and the appropriate anastomosis site should be selected. The great saphenous vein should be anastomosed at the distal end of the coronary artery, and the proximal end should be free for standby. The anastomosis should not be carried out for the time being. After aortic blocking-up, intracardiac lesions such as left atrial thrombectomy, mitral valve replacement, aortic valve replacement, tricuspid valvuloplasty and ventricular aneurysm resection were treated. Antegrade perfusion+coronary sinus retrograde perfusion+coronary artery bridge perfusion were applied to protect myocardium during the operation. Left internal mammary artery-anterior descending branch anastomosis and proximal end anastomosis of venous bridge were performed after cardiac operations such as valve surgery were completed. Operation in the CG: The patients in the CG underwent non-synchronous heart valve surgery and coronary artery bypass grafting with the same procedure as that in the OG. Coronary artery bypass grafting was performed on them (249.86±38.67) d after coronary artery bypass grafting.

Outcome Measures

The operation and hospitalization conditions of patients in the two groups were observed: Ventilator intubation time, ICU monitoring time of cardiac surgery and hospitalization time of postoperative general wards were recorded; the changes of cardiac function indexes in both groups after operation were observed: The changes of cardiothoracic ratio, BNP, left atrial diameter and left ventricular ejection fraction 6

months after operation were recorded; the major adverse events of patients in the two groups were observed, including perivalvular leakage and permanent pacemaker implantation.

Statistical Treatment

SPSS20.0 was used for statistical analysis. The measurement data were expressed as x±s, inter-group comparisons were performed by t test, the counting data were expressed as percentages, and inter-group comparisons were performed by χ^2 test. Multivariate logistics regression was used to analyze the prognostic factors of patients with valvular heart disease complicated by coronary heart disease. A p value lower than 0.05 was considered to be statistically significant difference.

RESULTS

Comparison of Clinical Data of Patients between The Two Groups

The prevalence rate of gender, age, BMI, previous history of cerebrovascular diseases and pulmonary hypertension of patients in the two groups: Cardiac function classification, course of atrial fibrillation, left atrial diameter, left ventricular end-diastolic volume, left ventricular ejection fraction, lesions, pulmonary hypertension, number of branch bridges and other clinical data were compared, the difference was not statistically significant (P>0.05), as shown in Table I.

Table I
Comparison of clinical data of patients in the two groups

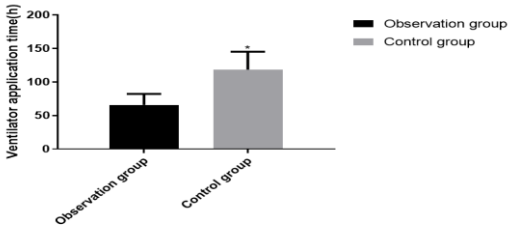
Category	Observation group (OG) (n=64)	Control group (CG) (n=57)	t/χ^2	P
Gender			0.350	0.554
Male	36 (56.25)	29 (50.88)		
Female	28 (43.75)	28 (49.12)		
Age (years)	55.17±7.34	53.46±8.25	1.207	0.230
BMI (kg/m^2)	24.35±1.46	23.95±1.87	0.191	0.909
Co-morbidity			0.385	0.943
Hypertension	39 (60.94)	32 (56.14)		
Diabetes	24 (37.5)	20 (35.09)		
Hyperlipidemia	29 (45.31)	27 (47.37)		
Cerebrovascular disease	21 (32.81)	15 (26.32)		
NYHA cardiac function classification before operation			0.191	0.909
Grade II	31 (48.44)	29 (50.88)		
Grade III	21 (32.81)	19 (33.33)		
Grade IV	12 (18.75)	9 (15.79)		
Course of atrial fibrillation	142.34±13.29	146.21±4.12		

(months)				
Left atrial diameter /mm	51.47± 6.53	52.88 ± 7.24	1.126	0.262
Left ventricular end-diastolic volume /ml	55.63±7.84	5	0.953	0.343
Lesions			1.003	0.606
Mitral valve disease	33 (51.56)	27 (47.37)		
Aortic valve disease	20 (31.25)	16 (28.07)		
Mitral and aortic valve disease	11 (17.19)	14 (24.56)		
Pulmonary hypertension			1.135	0.287
Yes	25 (39.06)	17 (29.82)		
No	39 (60.94)	40 (70.18)		
Number of bridges				
Single bridge	31 (48.44)	25 (43.86)	0.382	0.826
Double bridges	20 (31.25)	18 (31.58)		
Multiple bridges	13 (20.31)	14 (24.56)		

Comparison of Surgical Conditions of Patients between The Two Groups

The application time of ventilator in the OG was remarkably lower than that in the CG, and the difference was statistically significant ($P < 0.05$), as shown in Figure 1.

Figure 1
Comparison of surgical conditions of patients between the two groups.

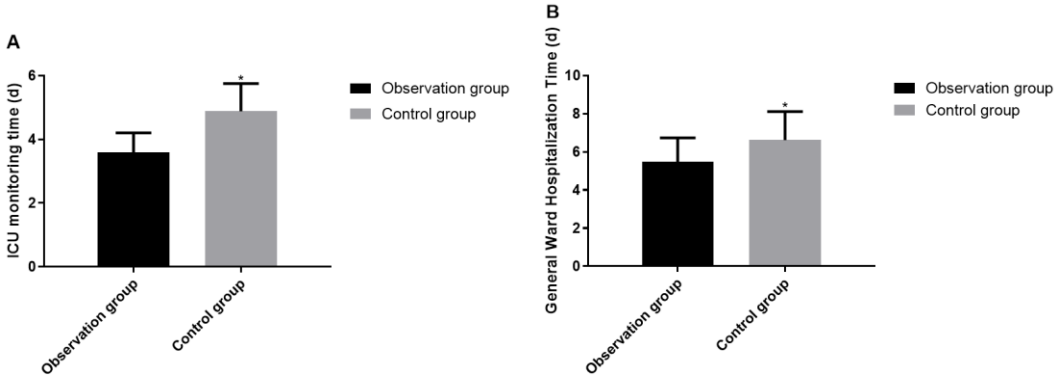


Note: * compared with the observation group (P < 0.05).

Comparison of Hospitalization of Patients between The Two Groups

The postoperative ICU monitoring time and postoperative general ward time in the OG were shorter than those of the CG, with statistically significant difference (P < 0.05), as shown in Figure 2.

Figure 2
Comparison of operation conditions of patients between the two groups: ICU monitoring time after operation.



Note: * compared with the observation group (P < 0.05).

Comparison of Cardiac Function Indexes between The Two Groups 6 Months after Operation

There was no significant difference between the two groups before treatment (P > 0.05). After treatment, the cardiothoracic ratio, left ventricular end-diastolic volume and BNP content in both groups were dramatically higher than those before treatment; those in the OG were dramatically higher than those in the CG, and the difference was statistically significant (P < 0. 05); the left ventricular ejection fraction in both groups was dramatically lower than that before treatment (P < 0. 05); the left ventricular ejection fraction in the OG was dramatically higher than that in the CG. More details were shown in Table II.

Table II
Comparison of cardiac function indexes between the two groups 6 months after operation

Category	Cardiothoracic ratio	Left ventricular end-diastolic volume /ml	BNP /μg·ml $^{-1}$	Left ventricular ejection fraction /%
Observation group (OG) (n=64)	0.54±0.09	52.56±6.28	145.67±11.24	54.89±5.87
Control group (CG) (n=57)	0.66±0.11	58.44±6.32	170.42±9.56	48.93±4.57
t value	7.144	5.126	12.960	6.177
P	<0.01	<0.01	<0.01	<0.01

Comparison of Postoperative Adverse Events between The Two Groups

As to postoperative adverse events between the two groups, the total incidence of major adverse cardiovascular events in the OG was lower than that in the CG, and the difference was statistically significant (P < 0.05) More details were shown in Table III.

Table III
Comparison of major postoperative cardiovascular adverse events between patients in the two groups

Category	Observation group (OG) (n=64)	Control group (CG) (n=57)	χ^2 value	P
Perivalvular leakage	1 (1.56)	12 (21.05)		
Permanent pacemaker implantation	2 (3.13)	9 (15.79)		
Death	1 (1.56)	7 (12.28)		
Total incidence	4 (6.25)	28 (49.12)	28.49	<0.01

Univariate Analysis on Prognosis of Patients

According to whether cardiovascular adverse events occurred within 12 months after operation, patients with cardiovascular adverse events were divided into group A, and those without cardiovascular adverse events were divided into group B. Univariate analysis was conducted by collecting the clinical data of patients in both groups. It was found that there was no difference between the two groups of patients in terms of gender, smoking history, exercise habits, place of residence, lesions and RBC (P > 0.05), while there was statistical difference in age, cardiac function classification, diabetes, course of disease, treatment methods and hypertension (P < 0.05), as shown in Table IV.

Table IV
Univariate analysis on prognosis of patients

Factor	Group A (n=32)	Group B (n=89)	t/χ^2 value	P
Gender				
Male	18 (56.25)	47 (52.81)	0.112	0.738
Female	14 (43.75)	42 (47.19)		
Age (years)			5.27	0.022
≥ 60	23 (71.88)	43 (48.31)		
< 60	9 (28.13)	46 (51.69)		
Smoking history			0.24	0.624
Yes	12 (37.5)	26 (29.21)		
No	30 (93.75)	53 (59.55)		
Exercise habits			0.035	0.851
Yes	15 (46.88)	40 (44.94)		
No	17 (53.13)	49 (55.06)		
Place of residence			1.313	0.252
Cities and towns	21 (65.63)	48 (53.93)		
Countryside	11 (34.38)	41 (46.07)		
Cardiac function classification			14.33	<0.01
Grade II	7 (21.88)	53 (59.55)		
Grade III	18 (56.25)	22 (24.72)		
Grade IV	7 (21.88)	14 (15.73)		
Course of disease (years)			2.47	0.014
< 9	17 (53.13)	68 (76.4)		
≥ 9	15 (46.88)	21 (23.6)		
Diabetes			3.155	<0.01
Yes	19 (59.38)	25 (28.09)		
No	13 (40.63)	64 (71.91)		

Hypertension				
Yes	22 (68.75)	49 (55.06)	6.786	<0.01
No	10 (31.25)	40 (44.94)		
Lesions			0.728	0.695
Mitral valve disease	14 (43.75)	46 (51.69)		
Aortic valve disease	10 (31.25)	26 (29.21)		
Mitral and aortic valve disease	8 (25)	17 (19.1)		
Treatment methods			2.086	0.037
Simultaneous cardiac valve replacement and coronary artery bypass grafting	4	60		
Simultaneous cardiac valve replacement and coronary artery bypass grafting	28	29		
RBC (×1012/L)	4.36 ±0 .46	4 .52 ±0 .71	1.187	0.238

Multivariate Analysis on Prognosis of Patients

We assigned values to the items with difference (P < 0 .05) in univariate analysis (Table V and Table VI), and then chose forward: LR for multivariate logstic regression analysis. The results revealed that hypertension, treatment methods, course of disease and age were independent risk factors affecting the prognosis of those with valvular heart disease complicated by coronary heart disease.

Table V
Assignment table

Factor	Assignment
Age	≥ 60 =1，=0
Hypertension	Yes =1, no =0
Diabetes	Yes =1, no =0
Treatment methods	Simultaneous cardiac valve replacement and coronary artery bypass grafting =1; non-simultaneous cardiac valve replacement and coronary artery bypass grafting =0
Cardiac function classification	Grade II =0, Grade III =1, Grade IV =2
Course of disease (years)	< 9=1，≥ 9=0

Table VI
Multivariate analysis

Factor	B	S.E,	Wals	Sig.	Exp (B)	95% C.I. Lower limit	95% C.I. Upper limit
Hypertension	1.464	0.641	3.872	0.034	3.323	1.34	11.821
Treatment methods	1.371	0.787	3.311	0.027	2.251	0.877	9.215
Course of disease (years)	0.075	0.021	13.798	0.022	1.128	1.024	1.186
Age	1.672	0.663	6.611	0.015	5.388	1.455	12.733

DISCUSSION

Coronary heart disease and valvular heart disease are public diseases in China (12). The causes of coronary heart disease include rheumatism, congenital malformation, ischemia, degenerative diseases, infection and so on. The lesions of valvular heart disease occur on a single valve or multiple valves take place simultaneously (13, 14). Although the two diseases are different in physiology and pathology, they interact and influence each other. Valvular heart disease causes heart enlargement, myocardial remodeling, and reduces cardiac reserve function. Combined with moderate coronary artery disease will aggravate myocardial ischemia and hypoxia, aggravate myocardial damage, and lead to deterioration of the disease (15, 16). Recent investigations have shown that the morbidity of valvular heart disease complicated with coronary heart disease is increasing year by year (17).

From the current clinical treatment of valvular heart disease complicated with coronary heart disease, heart valve replacement and coronary artery bypass grafting are the main treatment methods (18, 19), but many patients with valvular heart disease complicated by coronary heart disease are often older, various physiological functions gradually decline, and at the same time,

they are combined with a variety of basic diseases, such as diabetes, hypertension, etc (20, 21). Therefore, for patients with valvular heart disease complicated by coronary heart disease, the implementation of heart valve replacement and coronary artery bypass grafting still faces many difficulties (22, 23). This study compared and analyzed the situation of simultaneous heart valve surgery and coronary artery bypass grafting as well as non-simultaneous heart valve surgery in treating coronary heart disease and valvular heart disease. The results signified that the ventilator application time in the OG was remarkably lower than that in the CG, the ICU monitoring time and postoperative general ward time were markedly lower than those in the CG. Comparing the postoperative cardiac function indexes of patients in the two groups, it was found that the cardiothoracic ratio, left ventricular end-diastolic volume and BNP in the OG were dramatically lower than those in the CG, and the blood fraction was higher than the CG. This showed that simultaneous heart valve surgery and coronary artery bypass grafting was better than non-simultaneous treatment for hospitalization and improvement of cardiac function indexes. We also analyzed the adverse reactions of patients in the two groups. The results revealed that the total incidence of major cardiovascular adverse events in the OG was lower than that in the CG. Zhou and others (24) studied that coronary artery bypass grafting combined with heart valve replacement in treating coronary heart disease complicated with valvular heart disease achieved obvious efficacy, and less adverse reactions occurred during the same period of operation, which was similar to our study. This indicated that simultaneous heart valve surgery and coronary artery bypass grafting was a more ideal treatment.

At the end of the study, we also analyzed the risk factors affecting the prognosis of patients with valvular heart disease complicated by coronary heart disease, and found that hypertension, treatment methods, course of disease and age were independent risk factors affecting their prognosis. Li and others verified that (25) age and history of hypertension and coronary heart disease greatly increased the combined rate of coronary heart disease in patients with rheumatic heart disease, which was similar to our research and age, hypertension, course of disease and potential to become a clinical indicator for evaluating the prognosis of those with valvular heart disease and coronary heart disease.

In this research, the subjects were screened strictly according to the inclusion and exclusion criteria. There was no significant difference between the clinical basic data of the two groups, which ensured the reliability of the research results. Nevertheless, there are still some limitations in this study. We have not made an in-depth discussion on the correlation between other corresponding clinical indicators and valvular heart disease complicated with coronary heart disease, which needs to be further discussed in the follow-up tests.

To sum up, simultaneous heart valve surgery and coronary artery bypass grafting shortens ventilator application time, reduces hospitalization time, decreases adverse events and improves cardiac function indexes for patients with coronary heart disease and valvular heart disease, which is worthy of clinical application. Hypertension, treatment methods, course of disease and age are independent risk factors affecting their prognosis.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the present study are available from the corresponding author on reasonable request.

AUTHORS' CONTRIBUTIONS

SQ and JS conceived and designed the study, collected, analyzed and interpreted the experiment data, drafted this paper, and revised the manuscript critically for important intellectual content. Both authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Ethics Committee of The Second Hospital of Shandong University. Signed written informed consents were obtained from the patients and/or guardians.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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