The Heart Surgery Forum #2004-1154
8 (4), 2005 [Epub July 2005]
doi:10.1532/HSF98.20041154

Online address: http://cardenjennings.metapress.com/link.asp?id=112496

Operative Mortality after Valvular Reoperations

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ABSTRACT

Background: To determine the incidence and risk factors of mortality and morbidity in valvular reoperations.

Methods: Between January 1993 and December 2003, 309 valvular reoperations were performed. The reasons for reoperations were reconstructive surgery in first operation (110 patients, 35.5%), prosthetic valve endocarditis (12 patients, 3.8%), periprosthetic leakage (32 patients, 10.3%), new valve degenerations (12 patients, 3.8%), bioprosthetic dysfunction (92 patients, 29.7%), acute thrombotic stuck valve (30 patients, 9.7%), and pannus formation (21 patients, 6.7%). Mitral valves were replaced in 235 patients, aortic valves were replaced in 32 patients, 24 patients had aortic and mitral valve replacements, 2 patients had mitral and tricuspid valve replacements, and reconstruction of periprosthetic leakage was held in 16 patients. 264 patients had elective surgery, whereas 45 were operated on emergeny basis.

Results: Hospital mortality was 14.23%. Mortality rate was found to be 10.6% for elective cases and 35.5% for emergency cases. Permanent pacemaker was required in 12 patients, 3 patients had cerebrovascular events, and mediastinitis was observed in 1 patient. Multivariate analysis demonstrated that age >60 (P = .006; OR 7.3, 95% CI 1.7-30.1), emergency surgery (P = .001; OR 8.1, 95% CI 2.4-27.7), preoperative cerebrovascular accident (P = .003; OR 11.8, 95% CI 2.4-58.7), and concomitant ascending aorta replacement (P < .001; OR 27.4, 95% CI 6-127) were independent risk factors.

Conclusion: Valvular reoperations can be carried out with acceptable morbidity and mortality in elective operations but mortality rates are still very high in emergent cases.

INTRODUCTION

Valvular reoperations have been increasing gradually in open heart surgery. Because initial successful valvular operations are potential candidates for reoperations due to different underlying lesions such as prosthetic valve endocarditis, paravalvular leakage, or bioprosthetic dysfunction. On the other hand, mortality rate in reoperations, which is higher compared to primary valvular interventions, shows differences in subgroups of the patients.

In this study, we evaluated valvular reoperations performed between January 1993 and December 2003. Preoperative patients characteristics, underlying lesions, valve positions and additional procedures were collected retrospectively. Multivariate analysis was made to determine the risk factors affecting the hospital mortality.

MATERIALS AND METHODS

Between January 1993 and December 2003, a total of 3587 valvular operations were performed in Kosuyolu Heart and Research Hospital. This number includes mitral, aortic, or both valve reconstructions, mechanical and bioprosthetic valve replacements with or without coronary bypass artery grafting (CABG). A total of 309 patients (8.9%) underwent valvular reoperation at the same period. Mean age of the study population at reoperations was 42.06 ± 13.25 years (64.7% male, 35.3% female).

Reasons for reoperations were categorized into 7 groups:

1) Reconstructive surgery in previous operation, which are closed mitral comissurotomy (CMC), open mitral comissurotomy (OMC), and the other mitral and aortic reconstructions.

2) Prosthetic valve endocarditis (PVE): diagnosis supported by positive cultures and echocardiography besides clinical status.

3) Paravalvular leakage (PVL): moderate to severe periprosthetic leak defined by echocardiography, leading to clinical deterioration without infection.

4) Acute thrombotic stuck valve: emergency operations due to acute thrombotic occlusion of mechanical prosthetic valve.

5) Pannus formation: echocardiographic measurement of unacceptably high gradients on mechanical prosthetic valve due to pannus formation.

6) New valve degeneration: recent pathologic involvement of previously normal and untouched valve; for example, patient reoperated due to aortic stenosis previously performed mitral valve replacement.

7) Bioprosthetic dysfunction.

Distribution of patients into these groups is as follows: reconstructive surgery in first operation (110 patients, 35.5%), PVE (12 patients, 3.8%), PVL (32 patients, 10.3%), acute thrombotic stuck valve (30 patients, 9.7%), pannus formation

Presented in the 16th Annual Meeting Mediterranean Association of Cardiology and Cardiac Surgery, 26-29 September 2004, Bodrum, Turkey.

Received October 25, 2005; received in revised form March 10, 2005; accepted April 10, 2005.

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Table 1. Causes of Mortality and Major Morbidity

	n	%
Mortality		
Low cardiac output	25	8.09
Cerebrovascular accident	8	2.58
Renal	7	2.26
Sepsis	2	.64
Hemorrhage	2	.64
Total	44	14.23
Major Morbidity		
Permanent pacemaker	12	3.88
Permanent cerebrovascular accident	3	.97
Mediastinitis	1	.32
Total	16	5.17

(21 patients, 6.7%), new valve degeneration (12 patients, 3.8%), bioprosthetic dysfunction (92 patients, 29.7%). Concomitant procedures included the tricuspid valve reconstruction in 66 patients (21.3%), replacement of the ascending aorta in 13 patients (4.2%), and CABG in 2 patients (.64%).

Femoral artery and vein were exposed before sternal reentry to avoid delay if emergent cannulation would be required. Sternotomy was made by an oscillating saw. Arterial cannulation site, either asending aorta or femoral artery, was decided depending on the difficulty of dissection over the aorta. Bicaval venous cannulation and venting from the right upper pulmonary vein was used. Antegrade blood cardioplegia, applied from aortic root, was used alone when only mitral valve was involved. In cases in which aortic valve or both aortic and mitral valves were involved and concomitant procedures were planned, continous retrograde blood cardioplegia combined with antegrade blood cardioplegia were used. Mild systemic hypothermia (30°C) was used. In some cases, the mitral valve was exposed through the right atrial transseptal approach.

Statistical Methods

A commercial statistical software package (SPSS for Windows, version 10.0, SPSS Inc, Chicago) was used for data analysis. Results are presented as mean ± standard deviation. Differences between categorical variables were tested using a χ^2 test; differences between continuous variables were tested using the Student's *t*-test. Univariate and multivariate analyses were used to assess risk factors as independent predictors of early mortality. A *P* value less than or equal to .05 was considered statistically significant for all comparisons.

RESULTS

Hospital mortality was 14.23% (44 patients). There were two intraoperative deaths due to uncontrolled bleeding. Most common mode of death was low cardiac output syndrome (25 patients). The other deaths were attributed to cerebrovascular events in 8 patients, renal insuffiency in 7 patients, and sepsis in 2 patients. Major morbid events occurred in 5.1% of patients; there were 12 permanent pacemaker implantations, 3 cerebrovascular events with neurological sequel, and 1 nonfatal mediastinitis (Table 1).

Table 2. Preoperative Patient Characteristics

	N	Death	%	Univariate
Sex				.427
Male	200	28	14	
Female	109	16	14.67	
Age, y				
0-20	17	2	11.76	.760
21-40	119	12	10.08	.375
40-60	147	22	14.9	.545
61>	26	8	30.76	.017
Functional capacity				.374
NYHA Class I-II	279	24	8.6	
NYHA Class III-IV	130	20	15.38	
Rhythm				.216
Atrial fibrillation	151	21	13.9	
Sinus	158	23	14.55	
Prerenal insufficiency				<.001
Yes	18	8	44.44	
No	291	36	12.37	
Pulmonary artery pressure, mm Hg				.518
>50	126	16	12.69	
<50	183	28	15.3	
Preoperative Cerebrovascular accident				<.001
Yes	18	8	44.44	
No	291	36	12.37	
Urgency of operation				<.001
Emergency	45	16	35.55	
Elective	264	28	10.6	

According to univariate analysis, age > 60 (*P* = .017), presence of preoperative renal dysfunction (*P* < .001), history of cerebrovascular event (*P* < .001), emergency surgery (*P* < .001) (Table 2); surgery for PVE (*P* = .001) and pannus (*P* = .029) (Table 3); aortic cross-clamp time > 83.69 minutes (*P* = .012) (Table 4); and concomitant replacement of the ascending aorta (*P* < .001) (Table 5) were found to be statistically significant.

Multivariate analysis demonstrated age > 60 (*P* = .006), preoperative history of cerebrovascular accident (*P* = .003), concomitant replacement of the ascending aorta (*P* < .001), and emergency surgery (*P* = .001) as the most important factors affecting mortality (Table 6).

In Table 2, preoperative patient characteristics have been shown. Mortality rates were 15.38 (20/130) in preoperative poor functional status (NYHA Class 3-4) and 15.3% (28/183) in pulmonary hypertension (> 50 mm Hg). But they were statistically insignificant.

In Table 3, underlying etiologies for reoperations have been given. Mortality rates are higher in PVE (50%, 6/12), pannus (23.8%, 5/21), acute thrombotic stuck valve (26.66%, 8/30), but lower in reconstructive surgery in first operation (10.9%, 12/110), bioprosthetic dysfunction (8.69%, 8/92), PVL (12.5%, 4/32), and new valve degeneration (8.53%, 1/12).

Mortality rates in previous cardiac surgery more than once is 12% (4/32). It did not affect mortality. Mortality rates for

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Table 3. Indications for Reoperation (n = 309)*

	N	Death	Univariate
After reconstruction	110	12 (10.9%)	.440
After CMC	43	4	
After OMC	29	3	
Other mitral reconstruction	25	2	
Aortic reconstruction	7	2	
Aortic + mitral reconstruction	5	1	
Bioprosthetic dysfunction	92	8 (8.69%)	.212
Mitral	90	8	
Aortic	2	0	
Acute thrombotic stuck valve (emergency)	30	8 (26.66%)	.431
Mitral	29	8	
Aortic	1	0	
Pannus	21	5 (23.8%)	.029
Mitral	15	3	
Aortic	5	2	
Aortic and mitral	1	0	
Paravalvular leakage	32	4 (12.5%)	.197
Mitral	22	3	
Aortic	10	1	
Prosthetic valve endocarditis	12	6 (50%)	.001
Mitral	5	3	
Aortic	7	3	
New valve degeneration	12	1 (8.53%)	.988
Mitral	7	1	
Aortic	5	0	

*CMC indicates closed mitral comissurotomy; OMC, open mitral comissurotomy.

valve positions have been shown in Table 5. It was 20.83% (5/24) in aortic and mitral valve replacement at the and of the reoperations but it was statistically insignificant.

DISCUSSION

In-hospital mortality was 14.23%. This mortality rate was found to be 35.5% for emergency cases and 10.6% for elective cases. Cohn et al [1993] reported 10%, Brando et al [2002] reported 10.3%, and Jones et al [2001] reported 8.6%

Table 4. Intraoperative Variables

	N	Death	%	Univariate
Aortic cross-clamp time, min				.012
>83	109	25	22.9	
<84	200	19	9.5	
Total perfusion time, min				.242
>125	130	29	22.3	
<125	179	15	8.37	
Previous heart operation				.92
1	277	40	14.44	
>1	32	4	12.5	
Cardioplegia				.686
Retrograde	138	20	14.4	
Antegrade	171	24	14.03	

Table 5. Valve Positions (n = 309)*

	Number	Death	%	Univariate
MVR	235	30	12.76	.903
AVR	32	6	18.75	.92
AVR + MVR	24	5	20.83	.912
MVR + TVR	2	1	50	.076
PVL-repair	16	2	12.5	.637
Additional Procedure				
Ascending aorta replacement	13	7	53.84	<.001
Tricuspid reconstruction	66	10	15.15	.086

*MVR indicates mitral valve replacement; AVR, aortic valve replacement; TVR, tricuspid valve replacement; PVL, paravalvular leak.

mortality rate. In our study, high number of emergency cases led to a higher rate of mortality. In multivariate analysis, the possible factors that affect the mortality rate are as follows: age over 60, previous CVA, ascending aortic replacement, and emergency cases.

In our study, we found that sex did not affect early mortality rate. There are many reports that confirmed sex does not affect the mortality rate [Cohn 1993, Jones 2001, Brando 2002]. However, the other studies pointed out that mortality rate in reoperations was found significantly higher in women patients [Lytle 1986] or male patients due to bioprothesis dysfunction [Akins 1988]. In our study, the mortality rate is significantly higher in patients aged over 60. In the literature, it is reported that age was an effective factor on the mortality rate [Pihler 1995].

The advanced level of the functional capacity did not affect the mortality rate in our study. However, it was reported that the operative mortality was higher in patients with NYHA class III-IV [Cohn 1983, Huseybe 1983]. In the literature, it is found that emergency operation also affects mortality rate [Pansini 1990]. In our study, we had 130 patients in NYHA Class III-IV, but the number of emergency cases was 45. The mortality rate was found significantly higher in emergency cases according to multivariate analysis.

The mortality rate was 20.8% in patients with double valve replacements but this result was not significant in multivariate analysis. The mortality rate was 53.07% (7/13) and associated ascending aorta replacement was found to be significant in multivariate analysis. Pihler et al [1995] reported that ascending aortic replacement with a composite graft was a factor influencing the mortality rate. Pansini et al [1990] also stated that previous thromboembolism was an important factor on mortality rate. In Turkey, rheumatic valve disease is

Table 6. Predictors of Hospital Mortality in Multivariate Analysis

Risk Factors	Odds	CI (95%)	*P*
Age > 60 y	7.3	1.7-30.1	.006
Emergency cases	8.1	2.4-27.7	.001
Preoperative cerebral accident	11.8	2.4-58.7	.003
Ascending aorta replacement	27.4	6-127	<.001

still widespread and these patients are operated on in younger ages. The mean age of this study was 42 years and routine coronary angiography was performed to all patients over 40 years old. In our study, only 2 patients underwent coronary artery bypass as an additional procedure.

Thrombotic valve obstructions is generally due to uncorrect usage of anticoagulation drugs; however, it may develop because of pannus formation [Rizeoli 1999]. We reviewed the patients having mechanical valve thrombosis in 2 groups as shown in Table 3; acute thrombotic stuck valve, and pannus formation. All patients in the acute thrombotic stuck valve group were operated urgently whereas all operations in pannus group were performed electively. The mortality rate in stuck valve group was 26.6%, in pannus group was 23.8%. Dürrleman et al [2004] reported 30-days mortality rate of 25% in 39 patients with prosthetic valve thrombosis. They also stated that thrombolitic treatment had to be only a bridge to operation and operation had to be performed soon after diagnosis is established. It is reported that gradually growing of a pannus tissue may result in an obstruction in a prosthetic valve even 10-15 years later [Horstkotte 1995]. We have also observed thrombosis in some of our patients having pannus. Clinically, patients with acute thrombosis are operated urgently whereas patients with pannus, who have not had any previous thrombolitic treatment, are operated electively.

It is reported that endocarditis is the highest risk factor for patients who need valvular reoperations [Antunes 1992]. In our study, the highest rate was found in patients with PVE when the mortality rate was classified using univariate analysis (P = .002); however, this rate was not significant in multivariate analysis.

In conclusion, although valvular reoperations can be performed with acceptable mortality and morbidity rates in elective cases, it has still high rates in emergent cases. We have also confirmed that mortality rate has risen in concomitant ascending aorta replacement. When we evaluated the subgroups of patients, mortality rates have been found to be lower in patients with bioprosthetic dysfunction, reconstructive surgery in first operation, and new valve degeneration but higher in PVL, PVE, acute thrombotic stuck valve, and pannus formation.

REFERENCES

Akins CW, Buckley MJ, Daggett WM, et al. 1998. Risk of reoperative valve replacement for failed mitral and aortic bioprosthesis. AnnThorac Surg 65:1545-52.

Antunes MJ. 1992. Reoperations on cardiac valves. J Heart Valve Dis 1:15-28.

Brando CMA, Pomerantzeft PMA, Souza LR, et al. 2002. Multivariate analysis of risk factors for hospital mortality in valvular reoperations for prosthetic valve dysfunction. Eur J Cardiothorac Surg 22:922-6.

Cohn LH, Aranki SF, Rizzo RJ, et al. 1993. Decrease in operative risk of reoperative valve surgery. Ann Thorac Surg 56:15-21.

Dürrleman N, Pelerin M, Bouchard D, et al. 2004. Prosthetic valve thrombosis: Twenty year experience at the Montreal Heart Institute. J Thorac Cardiovasc Surg 127:1388-92.

Horstkotte D, Burckhardt D. 1992. Prosthetic valve thrombosis. J Heart Valve Dis 4:141-53.

Huseybe DG, Pluth JR, Piehler JM, et al. 1983. Reoperation on prosthetic heart valves: an analysis of risk factors in 552 patients. J Thorac Cardiovasc Surg 86:543-52.

Jones JM, O'Kane H, Gladstone DJ, et al. 2001. Repeat heart valve surgery: Risk factors for operative mortality. J Thorac Cardiovasc Surg 122:913-8.

Lytle BW, Cosgrove DM, Taylor PC, et al. 1986. Reoperations for valve surgery:perioperative mortality and determinants of risk for 1000 patients, 1958-1984. Ann Thorac Surg 42:632-43.

Pansini S, Ottino G, Forsennati PG, et al. 1990. Reoperations on heart valve prosthesis: an analysis of operative risks and late results. Ann Thorac Surg 50:590-6.

Pihler JM, Blackstone EH, Bailey KR, et al. 1995. Reoperation on prosthetic heart valves. J Thorac Cardiovasc Surg 109:30-48.

Rizeoli G, Guglielmi G, Toscano G, et al. 1999. Reoperations for acute prosthetic thrombosis and pannus: an assessment of rates, relationship and risk. Eur J Cardiothorac Surg 16:74-80.

REVIEW AND COMMENTARY

Reviewer MB134 writes:

a) Why was 83.4 minutes chosen as the cutoff for significance in the cross clamp time?

b) Was any of the emergency patients with valve thrombosis treated prior to surgery with thrombolytic therapy?

Author's Response by Dr. Mehmet Toker:

a) Mean aortic cross clamp time of all 309 patients in the study was 83.4 minutes. Patients were divided into two subgroups according to that figure and compared statistically in multivariate analysis for mortality.

b) In our center, the cardiologists have also been using thrombolytic therapy for the patients with thrombotic mechanical valve dysfunction [Özkan 2000].

There were two patients on whom MVR was performed who primarily received thrombolytic therapy before the valvular reoperation. First patient came to our hospital with pulmonary edema with stuck valve after one year thrombolytic therapy. Redo MVR was performed in that patient. Second patient was also reoperated in a more stable condition after six months thrombolytic therapy. Interestingly, pannus formation was detected in both atrial and ventricular side of the mechanical valve intraoperatively. Either during the treatment of thrombolytic therapies, or in redo valvular reoperations; insufficient INR levels were present in both patients.

Reference

Özkan M, Kaymaz C, Kýrma C, et al. 2000. Intravenous thrombolytic treatment of mechanical prosthetic valve thrombosis: A study using serial transesophageal echocardiography. J Am Coll Cardiol 35:1881-9.

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