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Original Article / Özgün Makale

Repeat valve surgery: An analysis of 182 patients

Yinelenen kapak cerrahisi: 182 hastanın analizi

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Background: In this study, we aimed to investigate the preoperative and operative risk factors in patients undergoing valve replacement for the second time, including the types of valves and surgical methods used.

Methods: Between January 1994 and December 2009, a total of 2089 valve replacements were performed in our clinic, and 182 (112 females, 70 males) of these operations (8.7%) were repeat valve surgeries.

Results: The mean age for repeat surgery was 49.2±27.4 years while the mean time elapsed between the first and second surgeries was 11.8±5.7 years. The follow-up period after repeat surgery was 2.6±1.3 years. Bioprosthesis valves were removed from a total of 142 patients (78%), and mechanical valves were removed from 40 patients (22%). In total, 221 valves were replaced. The total number of valves implanted was 219, and valve repair alone was performed on three patients. Of the valves implanted in repeat surgery, 197 (90%) were mechanical valves. The preoperative echocardiography findings revealed that the major problem (84%) observed was valve dysfunction, followed by infection. Fifteen patients (8.2%) who underwent repeat surgery died during the operation or within the first month afterwards.

Conclusion: Repeat heart valve surgery may be performed using the standard surgical procedures with acceptable mortality. Factors increasing the probability of repeat surgery include emergency interventions and infections; however, pulmonary hypertension is not a factor that increases the probability of repeat valve replacement surgery.

Key words: Aortic valve; mitral valve; repeat heart valve surgery.

Amaç: Bu çalışmada, ikinci kez yinelenen kapak değişimi olgularında ameliyat öncesi ve ameliyat sırası risk faktörleri, kullanılan kapak türleri ve ameliyat yöntemleri araştırıldı.

Çalışma planı: Kliniğimizde Ocak 1994 - Aralık 2009 tarihleri arasında toplam 2089 kapak replasmanı gerçekleştirildi ve bu ameliyatların 182'sini (112 kadın, 70 erkek) yinelenen kapak ameliyatları oluşturdu.

Bulgular: Yinelenen ameliyat için ortalama yaş 49.2±27.4 yıl, ilk ameliyat ile ikincisi arasındaki ortalama süre ise 11.8±5.7 yıl olarak hesaplandı. Tekrar ameliyat sonrası takip süresi 2.6±1.3 yıl idi. Toplam 142 (%78) hastadan biyoprotez kapak, 40 (%22) hastadan ise mekanik kapak söküldü. Toplam değiştirilen kapak sayısı 221 idi. Toplam takılan kapak sayısı 219 idi, sadece kapak onarımı ise üç hastada uygulandı. Tekrar ameliyatta takılan kapakların 197'si (%90) mekanik kapak idi. Hastaların ameliyat öncesi ekokardiyografik bulguları, esas sorunun kapak disfonksiyonu (%84) olduğunu gösterdi, bunu enfeksiyon takip ediyordu. Yinelenen ameliyat uygulanan 15 olgu (%8.2) ameliyat sırasında veya ameliyattan sonraki ilk bir ay içinde kaybedildi.

Sonuç: Yinelenen kalp kapak ameliyatları, standart ameliyat işlemleri kullanılarak, kabul edilebilir mortalite ile uygulanabilir. Bu ameliyatlarda riski artıran nedenler, acil girişimler ve enfeksiyona bağlı nedenlerdir, bununla birlikte pulmoner hipertansiyon, yinelenen kapak değişimi cerrahisi olasılığını artıran bir neden değildir.

Anahtar sözcükler: Aort kapak; mitral kapak; yinelenen kalp kapak ameliyatları.

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Along with the increase in the number of patients who undergo heart valve surgery, the number of patients requiring a second surgery has also increased. Repeat valve surgery has a higher mortality rate than the initial valve surgery due to the long duration of cross-clamping, bleeding risk, and concomitant pulmonary hypertension. In the 1980s, the mortality rate was 9.4% for elective conditions and 42% for emergency conditions.[1,2] Recently, the mortality and morbidity rates of patients receiving a second valve replacement surgery have significantly decreased due to technological developments and increased experience. Reducing the surgical risk for patients undergoing a second surgery is possible with careful myocardial protection and minimal surgical dissection in conjunction with blood loss and limiting the usage of blood.

In this article, we present the characteristics, indications for surgery, surgeries performed, and early follow-up results of patients who underwent repeat valve surgery at our clinic over the last 15 years.

PATIENTS AND METHODS

Between January 1994 and December 2009, a total of 7560 open-heart surgeries were performed at our clinic. Of these surgeries, 2089 (27.6%) were valve replacement surgeries, and 8.7% of the valve replacements were repeat valve surgeries (Table 1).

Of the repeat valve surgery patients, 112 (62%) were female, and 70 (38%) were male. The mean age was 49.2±27.4 years old, and the duration between the first and second surgeries was 2.6±1.3 years (Table 2).

In order to determine the indications for surgery, valve dysfunctions were evaluated under five different criteria:[2]

1. Prosthetic valve dysfunction: Valve dysfunction resulting from tissue ingrowth, mechanical dysfunction, and calcification or leaflet tears for bioprostheses

2. Periprosthetic leak: Periprosthetic leak and a normally functioning prosthesis

3. Valve thrombosis: Thrombosis of the mechanical valve to the extent that the thrombosis interferes with the valve opening

4. Prosthetic valve endocarditis: Patients with infection or inflammation documented on the valve specimen or patients who underwent surgery while receiving prolonged antibiotic treatment for clinical endocarditis or vegetation on their echocardiogram

5. Valve obstructions: A mean mitral valve gradient higher than 10 mmHg and a mean aortic valve gradient higher than 50 mmHg.

Surgical procedure

A median sternotomy was performed on all repeat heart valve surgery patients and on those presenting with a space among the heart and sternum [radiolucent air space as shown during preoperative assessment by computed tomography (CT) or a left lateral chest X-ray]. In cases with inadequate space or in those with firm adhesions among the heart and sternum, a sternotomy was performed following femoral cannulation. Prior to this procedure, the airway was disconnected, and the mean pressure was kept below 60-65 mmHg.

A repeat median sternotomy was performed on all patients after cutaneous and subcutaneous incisions were made, and the sternal wires were removed. Standard aortocaval or bicaval cannulations were performed on all other patients except for six who underwent femoral cannulation. While antegrade cardioplegia from the aortic root was initially applied to all patients, direct intermittent cardioplegia was administered after an aortotomy in patients undergoing aortic valve replacement (AVR) or AVR + mitral valve replacement (MVR). The old valve was cut from the suture lines and excised, and the valve replacement was performed using a figure-8 suture or U-suture with Teflon pledges.

Statistical methods

For analysis of the demographic, preoperative, operative, and postoperative data and comparison of the median ± t standard deviation results of the different groups, categorical data chi-square tests were performed

Table 1. Number of valve replacements by year

Year	Valve replacement	Repeat valve replacement	Repeat valve valve replacement
	n	n	%
2009	139	25	18
2008	136	16	11.7
2007	139	33	23.7
2006	125	17	13.6
2005	159	12	7.5
2004	123	12	9.7
2003	99	10	10.1
2002	147	7	4.7
2001	108	7	6.4
2000	155	11	7
1999	173	10	5.7
1998	156	4	2.5
1997	103	1	0.9
1996	115	10	8.6
1995	111	6	5.4
1994	101	1	0.9
Total	2089	182	8.7

using the Statistical Package for the Social Sciences (SPSS Inc., Chicago, Illinois, USA) 17.0 statistics software. Mortality-linked independent variables were also analyzed with multivariate regression analysis. *P* values of less than 0.05 were considered significant.

RESULTS

Bioprosthesis valves were removed from 142 patients (78%), and mechanical valves were removed from 40 patients (22%) over the 15-year course of our study. A total of 221 of these kinds of valves were replaced, with 170 of these being bioprosthesis valves and 51 being mechanical valves. Aortic valves were excised from 13 patients, aortic and mitral valves were removed from 30 patients, and mitral valves were removed from 130 patients. A total of 219 aortic valves were replaced, and valve repair alone was performed in three patients. Repeat valve replacement was performed in 16 cases with aortic positioning, 37 cases with aortic and mitral positioning (tricuspid positioning in one case), and 128 cases with mitral positioning. One hundred and ninety-seven (90%) of the valves inserted during the second surgery were mechanical valves (Table 2).

When the preoperative echocardiographic findings of the patients were evaluated, valve dysfunction was the dominant problem and occurred in 33% of the cases. Degeneration, stenosis, thrombosis, pannus, stuck valve, leakage, and rupture as subgroups of dysfunction were observed as echocardiographic-specific dominant lesions in 51% of cases. Another valve replacement indication was infection along with the resulting lesions (16%) (Table 3).

Fifteen patients (8.2%) died during surgery or within the first month after surgery. While bioprosthesis valves were replaced in 12 of these patients, three patients died due to various other causes revealed during or after their mechanical valve replacement. Mechanical valves had been inserted into 12 of these patients, and bioprosthesis valve replacement had been performed in three of them.

Among patients with previous valve replacements, mortality was higher when the indication was endocarditis or a thrombosed valve compared with a periprosthetic leak or prosthetic valve dysfunction. Valve thrombosis occurred only in mechanical valves. Mortality occurred in 12 of 128 patients in the mitral position, and the mortality rate for combined aortic and mitral valve replacement at reoperation was 8% (3/37).

While myocardial failure was defined as the cause of death in seven patients (47.6%), bleeding, endocarditis, bronchopneumonia, multiple organ failure, and cerebrovascular events were the causes of death in the others.

Pulmonary hypertension was 56 mmHg (range 25-125 mmHg) in the surviving patient group and

Table 2. Demographic characteristic of the cases. Replaced and inserted valve inventory

	Mechanic		Bioprosthesis		
	n	%	n	%	%
Number of patients with secondary valve replacement	40	22	142	78	
Total removed valves (n=221)	51		170		
Total inserted valves (n=219)	197		22		
Changed valve type and position (n=patient)					
Aortic valve replacement (n=13)	3		10		7.1
Aortic valve replacement + MVR (n=39)	11		28		21.4
Mitral valve replacement (n=130)	26		104		71.5
Repeat inserted valve type and position (n=patient)					
Aortic valve replacement (n=16)	15		1		8.8
Aortic valve replacement + MVR (n=37) (+1 TVR)	32		5		20.8
Mitral valve replacement (n=128)	117		11		64.8
Repair (n=3)					1.6
Mean age (year) 49.2±27.4 (14-76)					
First operation time (mean) 11.8±5.7 (1 month-33 years)					
Mean pulmonary artery pressure					
(All patients) 56 mmHg (25-125 mmHg)					
Mean pulmonary artery pressure					
(Deceased patients) 70 mmHg (50-95 mmHg)					

MVR: Mitral valve replacement; TVR: Tricuspid valve replacement.

Table 3. Echocardiographic findings

	n	%
Dysfunction		
Dysfunction	60	33
Degeneration	27	14.8
Stenosis	26	14.2
Thrombosis	17	9.3
Pannus	4	2.2
Stuck valve	6	3.3
Leakage	10	5.5
Rupture	3	1.5
Infection		
Vegetation, leakage, stuck valve, rupture included	29	16

70 mmHg (range, 50-95 mmHg) in the deceased patient group, and there was no statistically significant difference in pulmonary pressure between these two groups ($p>0.05$).

Primary femoral cannulation was performed in four cases (2.2%). During sternotomy, two cases (1.1%) had major bleeding over the right ventricle. The source of bleeding was repaired following femoral cannulation. Nine cases (4.9%) had minor right atrial bleeding which was easily repaired.

In multiple variable analysis, emergency surgery, infective endocarditis, stuck valve, and infection were related to early period mortality ($p<0.05$), whereas gender, age, valve type used in the first operation, multiple valve surgery, and increased pulmonary artery pressure were unrelated.

DISCUSSION

Mortality during or after repeat valve replacement surgery is greater than that for the initial surgery.[1] The number of patients who undergo surgery a second time is increasing due to valve diseases. Pulmonary hypertension, impaired ventricular performance, advanced age, and bacterial endocarditis further increase the probability that repeat surgery will be required. Difficulty in exploration, the risk of bleeding, and incomplete myocardial protection are additional risk factors for patients requiring a second surgery.[2-4] In our study, while the incidence of repeat surgery among all valve replacement patients was 1% after one year, it increased up to 23% after that. We did not define pulmonary hypertension as an important risk factor for mortality. Although exploration difficulty and incomplete myocardial protection seem risky, we suggest repeating the sternotomy and standard cannulation even though difficulties in exploration and incomplete myocardial protection appear to increase the risk. Additionally, antegrade cardioplegia and/or coronary ostium perfusion are sufficient for all patients.

Endocarditis is associated with the highest risk in all of the surgical series. The mortality rate has been reported to be 34% in emergency situations and 15% during elective surgery. The mortality rate for prosthesis endocarditis following prosthesis valve implantation is about 73% during the early period and 40% during the late period, and early surgery performed before the cardiac skeleton is damaged increases the surgical success of valves infected with staphylococcus endocarditis.[5,6] Our clinical strategy on repeat valve surgery due to infection is to typically begin antibiotic therapy. Surgery is then performed when the infection is suppressed as long as there is no clinical worsening or echocardiographically dangerous vegetation.

In our clinic, the majority of repeat valve replacements consists of young patients with bioprosthesis valves. The preference of this patient group for bioprosthesis valves can be attributed to their socioeconomic status, difficulties with coumadin treatment, and reproductive age. The mean deformation duration for bioprosthesis valves was approximately 11 years, which is in compliance with the durations anticipated for this type of valve. The increase in metal valve insertion can be explained by the more advanced age (mean, 49 years) of these patients.

Mortality is high in patients requiring repeat prosthetic valve surgery. However, the rate decreases if the reason for the surgery is leakage. It has been previously shown that there is no difference in mortality rates between mitral and aortic valve leakage treatments.[6-8]

The dominant echocardiographic finding for valve replacement was dysfunction, and the second most common risk factor was infection with related complications. It is noteworthy that general dysfunction is mentioned for bioprosthesis valves, whereas more specific lesions have been reported for mechanical valves. Repair was primarily performed after leakage diagnosis without infection (three cases).

In studies which have examined the surgical risk factors for reoperation, valve pathology was not found to be significant. In addition, depending on the type of first surgical intervention, there could be an increased risk in the reoperation. In a multivariate analysis, advanced age, previous aortic or tricuspid valve operations, and

preoperative shock were found to increase mortality in valve surgery. When considering surgical procedures, the repair of periprosthetic valve leaks carries the highest risk, while conservative mitral valve surgery carries the lowest.[2,9-12]

Meanwhile, in our study the presence of emergency surgery, infective endocarditis, stuck valve, and infection were associated with early period mortality. On the other hand, gender, age, valve type used in the first operation, multiple valve surgery, and increased pulmonary artery pressure were unrelated.

As studies have shown, a median sternotomy and aortic bicaval cannulation are frequently used in reoperations, with femoral cannulation being an alternative location. These patients are preoperatively assessed with CT. Our findings regarding the median sternotomy and aortic bicaval cannulation were in agreement with previous studies.[11-13] We also determined that left lateral chest X-rays provided sufficient preoperative assessment during a 15-year period when CT was not widely used.

Acute obstruction of a metallic valve is a life-threatening complication. Mortality rates from 8-42% have been reported in series with emergency interventions. The extremely severe clinical conditions of the patient and reoperation are the major factors which increase the risk of mortality.[14-18] However, while a difference between mechanical and bioprosthesis valve replacement was not defined in our series, we observed that patients with mechanical valves generally underwent the reoperation earlier than patients with bioprosthesis valves.

The major cause of death following repeat valve replacement is myocardial failure. Death due to uncontrolled bleeding usually occurs because of left ventricle rupture after mitral valve replacement.[2,14-17] In our series, the most common cause of death was also myocardial failure, and in two cases, it was due to left ventricle rupture and related uncontrolled bleeding.

In conclusion, repeat valve replacement can be performed with an acceptable mortality rate. They provide sufficient comfort both for the surgeon and the patient when carefully done via a standard median sternotomy and conventional cannulation control.

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