Triple Valve Surgery: A 25-Year Experience

Üç Kapak Cerrahisi: 25 Yıllık Deneyim

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ABSTRACT

Objective: Surgical treatment of rheumatic valvular disease still constitutes a significant number of cardiac operations in developing countries. Despite improvements in myocardial protection and cardiopulmonary bypass techniques, triple valve operations (aortic, mitral and tricuspid valves) are still challenging because of longer duration of cardiopulmonary bypass and higher degree of myocardial decompensation. This study was instituted in order to assess results of triple valve surgery.

Methods: Between 1977 and 2002, 34 patients underwent triple valve surgery in our clinic by the same surgeon (EB). Eleven patients underwent triple valve replacement (32.4%) and 23 underwent tricuspid valve annuloplasty with aortic and mitral valve replacements (67.6%).

Results: There was no significant difference between the two groups of patients who underwent triple valve replacement and aortic and mitral valve replacement with tricuspid valve annuloplasty. There were 4 hospital deaths (11.8%) occurring within 30 days. The duration of follow-up for 30 survivors ranged from 6 to 202 months (mean 97 months). The actuarial survival rates were 85%, 72%, and 48% at 5, 10, and 15 years respectively. Actuarial freedom from reoperation rates at 5, 10, and 15 years was 86.3%, 71.9%, and 51.2%, respectively. Freedom from cerebral thromboembolism and anticoagulation-related hemorrhage rates, expressed in actuarial terms was 75.9% and 62.9% at 5 and 10 years. Major cerebral complications occurred in 10 of the 30 patients.

Conclusions: We prefer replacing, if repairing is not possible, the tricuspid valve with a bileaflet mechanical prosthesis in a patient with valve replacement of the left heart who will be anticoagulated in order to avoid unfavorable properties of bioprosthesis like degeneration and of old generation mechanical prosthesis like thrombosis and poor hemodynamic function. In recent years, results of triple valve surgery either with tricuspid valve conservation or valve replacement in suitable cases have become encouraging with improvements in surgical techniques and myocardial preservation methods. *(Anadolu Kardiyol Derg 2004; 4: 205-8)*

Key words: Rheumatic valvular disease, triple valve surgery, survival

ÖZET

Amaç: Gelişmekte olan ülkelerde, romatizmal kapak hastalıklarının cerrahi tedavisi hala kardiyak operasyonların önemli bir kısmını teşkil etmektedir. Miyokard korunması ve kardiyopulmoner baypas tekniklerindeki gelişmelere rağmen, üç kapak operasyonları (aort, mitral ve triküspid kapaklar) uzun süren kardiyopulmoner baypas ve ileri derecede miyokardiyal depresyon nedeniyle güçlük arzeden operasyonlar olarak karşımıza çıkmaktadır. Bu çalışma üç kapak cerrahisi sonuçlarını değerlendirmek üzere yapılmıştır.

Yöntem: Kliniğimizde 1977 ile 2002 yılları arasında aynı cerrah (EB) tarafından 34 hastaya üç kapak operasyonu gerçekleştirilmiştir. On bir hastaya üç kapak replasmanı (% 32.4) ve 23 hastaya aort ve mitral kapak replasmanı ile birlikte triküspid kapak annuloplastisi (% 67.6) uygulanmıştır. Cerrahi girişimlerin erken ve geç sonuçları kaydedilmiştir.

Bulgular: Üç kapak replasmanı yapılan ve aort ve mitral kapak replasmanı ile birlikte triküspid kapak annuloplastisi yapılan hastalar arasında önemli bir fark bulunmamaktadır. Otuz gün içerisinde meydana gelen 4 (% 11.8) hastane ölümü gerçekleşmiştir. Sağ kalan 30 hastanın takip süresi 6 ile 202 ay arasındadır (ortalama 97 ay). Beş, on ve onbeş yıllık sağkalım oranları sırasıyla % 85, % 72 ve % 48'dir. Beş, on ve onbeş yıllık reoperasyondan uzakkalım oranları sırasıyla % 86.3, % 71.9 ve % 51.2'dir. Beş ve on yıllık serebral emboli ve antikoagülan bağlantılı kanama komplikasyonlarından uzakkalım sırasıyla % 75.9 ve % 62.9'dur. Otuz hastanın onunda majör serebral komplikasyonlar gelişmiştir.

Sonuç: Sol kalp kapaklarının replasmanı yapılacak ve antikoagüle edilecek hastalarda tercihimiz, onarım olanağı bulunmadığı durumlarda, triküspid kapağın bileaflet bir mekanik protez kapak ile replasmanı olmuştur. Bu sayede biyoprotezlerin dejenerasyon ve eski jenerasyon mekanik kapakların tromboz ve kötü hemodinamik özellikleri gibi istenmeyen etkilerinden uzak kalınmıştır. Son yıllarda, cerrahi tekniklerdeki ve miyokard koruma yöntemlerindeki ilerlemeler doğrultusunda elde edilen triküspid kapak onarımı ya da replasmanı ile üç kapak cerrahisi sonuçları cesaret vericidir. *(Anadolu Kardiyol Derg 2004; 4: 205-8)*

Anahtar kelimeler: Romatizmal kapak hastalığı, üç kapak cerrahisi, sağkalım

Introduction

Today, cardiac valve replacement operations are decreased in number considerably, as a result of appropriate treatment of acute rheumatic fever. However, surgical treatment of rheumatic valvular disease still constitutes a significant number of cardiac operations in developing countries. Despite improvements in myocardial protection and cardiopulmonary bypass techniques, triple valve operations (aortic, mitral, and tricuspid valves) are still challenging because of longer duration of cardiopulmonary

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bypass and higher degree of myocardial decompensation. Results of valve replacement have been well defined by many groups of investigators. Few reports about triple valve procedures, however, define late outcome, because of the relatively small number of patients who have undergone the operation (1-6). Actually there are not so many recent reports discussing triple valve operations in the literature. This report describes the experience of a single surgeon with 34 patients who have undergone triple valve operations with various combinations of prosthetic valves.

Material and Methods

Between 1977 and 2002, 34 patients underwent triple valve surgery in our clinic by the same surgeon (EB). Their ages ranged from 26 to 68 years with a mean of 40 years. Eleven patients (32.4%) underwent triple valve replacement and 23 (67.6%) underwent tricuspid valve annuloplasty with aortic and mitral valve replacements. Seven patients were men (20.6%) and 27 were women (79.4%). Seven patients (20.6%) had undergone previous valve operations; 3 patients had undergone mitral valve replacement, 1 had mitral valve replacement and tricuspid annuloplasty, 1 had aortic valve replacement and mitral valve replacement, 1 had aortic valve replacement and mitral commissurotomy. Preoperative data recorded by echocardiography and cardiac catheterization are listed in the Table 1.

All of the valvular lesions were rheumatic in origin, there was no case of infectious endocarditis. There was no significant coronary artery disease in any patient and no emergent operative procedure as well.

Operative technique was unique except for aortic cannulation. Either femoral arteries had been cannulated before 1982, ascending aorta has been cannulated since then. Moderate systemic hypothermia and antegrade cold crystalloid cardioplegia for myocardial protection were used. Coronary ostea were selectively cannulated and perfused with cardioplegia in 19 patients with severe aortic insufficiency. Aortic and mitral valve replacements were performed with cardioplegic arrest, tricuspid valve procedures were performed on beating heart with cardiopulmonary bypass except for 5 patients. Aortic cross-clamping time was 76±16 minutes and was apparently longer during former 10 years period. De-aeration was achieved by standard means. Prosthetic valvular devices that were substituted in 34 patients are listed in the Table 2. There was no significant difference when preoperative data of patients with tricuspid valve replacement and of patients with tricuspid annuloplasty were compared (Table 3).

Preoperative New York Heart Association functional classification of the 34 patients and postoperative classification of the 30 survivors 6 months after the surgery are shown in the Table 4.

After the operation, all the patients received oral anticoagulation with warfarin and antiaggregant therapy with aspirin and / or dipyridamole. Anticoagulation was controlled by frequent (monthly - bimonthly) prothrombin time assessment.

Follow-up was primarily achieved by annual outpatient clinic visits. Thorough physical examination, chest roentgenogram, electrocardiogram were performed in each visit. Less frequently patients were evaluated with echocardiography and cardiac catheterization.

Cerebral thromboembolism and anticoagulant related major hemorrhage were recorded for evaluation. Prosthetic valve endocarditis, valve thrombosis, and paravalvular leak are defined if they prompted reoperation or caused death.

Mann-Whitney test was used to define significant differences among nonparametric variables. Time related events were assessed by Kaplan-Meier test. Calculations were performed by SPSS 10.0 for Windows program.

Table 1. Preoperative echocardiography and catheterization results

Number of patients	34
Atrial fibrillation, n(%)	26 (76.5)
Pulmonary artery pressure, mmHg	35.9 ± 7.5
Ejection fraction, %	49.1 ± 4.7
Left ventricular end diastolic diameter, mm	55.6 ± 4.4
Left ventricular end systolic diameter, mm	38.4 ± 3.9

Table 2. Prosthetic valves replaced in aortic, mitral, and tricuspid position

Prosthetic valves	Aortic	Mitral	Tricuspid
Björk-Shiley	14	13	2
St. Jude	8	8	3
Duramedics	4	4	-
Omniscience	2	1	-
Edwards-Tecna	2	2	-
Beall	1	2	2
Edwards-Mira	1	1	-
Starr-Edwards	-	2	-
Lillehei-Kaster	-	1	1
Carpentier-Edwards	-	-	3

Table 3. Preoperative data according to the type of tricuspid valve surgery

	Tricuspid valvuloplasty	Tricuspid valve replacement
Number of patients	23	11
Age, years	41.6±4.7	37.4±5.3
Atrial fibrillation, n (%)	18 (78.3)	9 (81.8)
PAP (mmHg)	35.4 ± 8.3	36.8 ± 5.8
EF, (%)	49.0 ± 4.9	49.4± 4.4
LVEDD, (mm)	56.1 ± 5.0	54.5 ± 2.4
LVESD, (mm)	39.1 ± 4.1	37.9 ± 2.7

EF: Ejection fraction, LVEDD: Left ventricular end diastolic diameter, LVESD: Left ventricular end systolic diameter, PAP: Pulmonary artery pressure

Table 4. Preoperative and postoperative functional classification of patients

Preoperative NYHA functional class			
	Tricuspid valve annuloplasty	Tricuspid valve replacement	Total
II	8	0	8 (23.5%)
III	13	9	22 (64.7%)
IV	2	2	4 (11.8%)
Preoperative NYHA functional class			
	Tricuspid valve annuloplasty	Tricuspid valve replacement	Total
I	11	2	13 (43.3%)
II	8	5	13 (43.3%)
III	2	2	4 (13.3%)

NYHA: New York Heart Association

Results

There were no significant differences between the two groups of patients who underwent triple valve replacement and aortic and mitral valve replacement with tricuspid valve annuloplasty in age of operation, preoperative functional class, pulmonary artery pressure, or myocardial function.

There were 4 hospital deaths (11.8%) occuring within 30 days after operation. Three of the four hospital deaths occured in the first 10 years period of the series. Two of these patients were in NYHA Class IV and two were in Class III preoperatively. Operative procedures of these 4 patients were the same with the rest. One of the patients with severely depressed myocardial function underwent triple valve replacement and could not be weaned from cardiopulmonary bypass. The other patient with tricuspid annuloplasty was weaned from cardiopulmonary bypass but was lost due to low cardiac output syndrome. One of the two patients in Class III developed multiple organ failure following pulmonary infection and sepsis. The other patient was lost because of low cardiac output syndrome.

The duration of follow-up for 30 survivors ranged from 6 to 202 months (mean 97 months). The actuarial survival rates of the 30 hospital survivors were 85%, 72%, and 48% at 5, 10, and 15 years respectively. In half of the late deaths the cause was cardiac. Four patients died because of congestive heart failure with normally retained prosthetic valves. Fatal cerebral complications developed in 3 patients. In one patient the cause of late death was malignancy. Myocardial function of the patients with late death was not specifically poor at the time of operation. The two patients who died as a result of cerebral thromboemboli had valve replacement with caged-ball prostheses. The causes of the 8 late deaths are listed in the Table 5.

Actuarial freedom from reoperation rates at 5, 10, and 15 years were 86.3%, 71.9%, and 51.2%, respectively. Reoperation was necessary in 9 (30%) of the 30 patients. Three of the 9 patients with triple valve replacement and 6 of the 21 patients with tricuspid annuloplasty underwent reoperation with a mean interval of 8.5 years. Two patients with triple valve replacement underwent triple re-replacement; one because of valve thrombosis, the other because of intractable hemolysis. One patient with triple valve replacement underwent re-replacement because of xenograft degeneration. Six patients (28.6%) with tricuspid annuloplasty underwent tricuspid valve replacement, 4 with xenografts, 2 with mechanical prosthetic valves. Two patients with xenografts required a third operation for re-replacement of tricuspid prostheses with mechanical valves.

Freedom from cerebral thromboembolism and anticoagulation-related hemorrhage, expressed in actuarial terms, was 75.9% and 62.9% at 5 and 10 years respectively. Major cerebral complications occurred in 10 of 30 patients. The prosthetic valves replaced in 8 of these patients were caged-ball or tilting disc type.

Table 5. Causes of late deaths

Cause	Number of Patients
Congestive heart failure	4
Cerebral thromboembolus	2
Anticoagulation related hemorrhage	1
Noncardiac	1
Total	8

Discussion

Triple valve operation, especially triple valve replacement is not a frequently performed operation, therefore it is difficult, as many other authors also emphasize, to gather sufficient data for meaningful statistical analysis. Different patient characteristics and various kinds of substituted valves make a heterogeneous group. The patient population in this study who has undergone triple valve operation by a single surgeon was 34. Eleven patients had tricuspid valve replacement, whereas 23 had conservative procedure.

The overall early mortality rate within 30 days was 11.8% in this study, which is not higher than the results reported in the literature (1,4,5,7). Preoperative functional class and the urgency of the operation seem to be the most influencing factors on early and late outcomes of the surgical intervention. Patients in functional class IV, those with pulmonary hypertension, and ones who are operated under emergent circumstances have apparently poor prognosis (9). There was no emergent operation in our series, however as a determinant factor of mortality, all patients with early hospital deaths had poor myocardial status. Early and late outcome of triple valve operations have been improved by advances in myocardial protection and cardiopulmonary bypass and surgical techniques. Better results can be obtained with early operative intervention in valvular heart disease before irreversible myocardial deterioration takes place. Major cause of early hospital mortality was myocardial failure. Poor quality of the myocardium was also the most important factor for long term prognosis (2,4). Type of the tricuspid surgery has no influence on late outcome. Half of the patients were lost with myocardial insufficiency.

Major cerebral complications occurred in 10 of 30 patients during the follow-up. The quality of anticoagulation treatment is the most important factor influencing postoperative thromboembolic events (10). Thromboembolic complications seem to happen more frequently in the former 10 years period. The reason for this is the use of old generation caged-ball and tilting disc mechanical heart valves which have higher thromboembolic events than currently used low-profile bileaflet mechanical heart valves. In developing countries, patient cooperation and socioeconomic status appear to be major problems and under some circumstances a drawback in anticoagulation may be reason for thromboembolic events. As a reference hospital, our clinic serves patients coming from remote parts of the country. In such cases, there had been times when an optimum anticoagulation could not be achieved and ended up with thromboembolic events.

One of the most crucial problems to be solved in evaluation of a patient with multiple valvular disease, is the attitude towards the tricuspid valve. During last 2 decades, conservative reparative procedures for functional tricuspid valve insufficiency has been a more popular intervention. In most cases of valvular heart disease, tricuspid insufficiency might have been functional and a manifestation of poor right ventricular function and pulmonary hypertension (2,11). Results with conservative surgery seem to be superior to valve replacement with lower early and late mortality. In our series, patients having tricuspid stenosis together with regurgitation and ones having tricuspid regurgitation with lower pulmonary artery pressure were selected as candidates for tricuspid valve replacement. Patients who

had had De Vega tricuspid annuloplasty previously and still had significant tricuspid regurgitation had undergone valve replacement.

Another problem is the type of the prosthetic valve, which will be replaced in tricuspid position. It is well known from numerous studies that bioprostheses in any position will undergo degeneration if the patient lives long enough (12,13). Yet, reported results with former mechanical prosthetic valves in the tricuspid position were not encouraging (14,15).

On the other hand, satisfactory results of replacement of tricuspid valve with St. Jude Medical valve are reported (16). St. Jude Medical prostheses were our choice in tricuspid position since they have been first introduced because of their low profile and ventral flow properties. We prefer replacing if not repairing the tricuspid valve with a bileaflet mechanical prosthesis in a patient with valve replacement of the left heart who will be anticoagulated in order to avoid unfavorable properties of bioprosthesis like degeneration and other complications of mechanical prosthesis like thrombosis and poor hemodynamic function. Although the number of prosthetic heart valves replaced in tricuspid position is too small to make a meaningful comparison, one can comment relying on the experience with different kinds of mechanical heart valves replaced widely in mitral and aortic positions.

Operative strategy for multiple valvular heart disease is still a challenging problem for cardiac surgeons with higher mortality and morbidity rates than other cardiac operations. In recent years, results of triple valve surgery either with tricuspid valve conservation or valve replacement in suitable cases have become encouraging with improvements in surgical techniques and myocardial preservation methods.

References

1. Brown PS, Roberts CS, McIntosh CL, Swain JA, Clark RE. Late results after triple-valve replacement with various substitute valves. Ann Thorac Surg 1993;55:502-8.
2. Michel PL, Houdart E, Ghanem G, Badaoui G, Hage A, Acar J. Combined aortic, mitral and tricuspid surgery: results in 78 patients. Eur Heart J 1987; 8: 457-63.
3. Gersh BJ, Schaff HV, Vatterott PJ, et al. Results of triple valve replacement in 91 patients: perioperative mortality and long-term follow-up. Circulation 1985; 72: 130-7.
4. Kara M, Langlet F, Blin D, et al. Triple valve procedures: an analysis of early and late results. Thorac Cardiovasc Surgeon 1986; 34: 17-21.
5. Mattila S, Harjula A, Kupari M, Kyllonen KEJ. Combined multiple-valve procedures: factors influencing the early and late results. Scand J Thor Cardiovasc Surg 1985;19:33-7.
6. Sullivan MF, Roberts WC. Clinical and morphologic observations after simultaneous replacement of the tricuspid, mitral and aortic valves. Am J Cardiol 1986; 58: 781-9.
7. Livi U, Biritiolotti U, Rizzoli G, Valfre C, Mazzuco A, Galluci V. Surgical treatment of patients with triple heart valve disease. Results and analysis of factors affecting the surgical outcome. Thorac Cardiovasc Surgeon 1982; 30: 288-91.
8. Macmanus Q, Grunkemyier G, Starr A. Late results of triple valve replacement: A 14 year review. Ann Thorac Surg 1978; 25: 402-6.
9. Stephenson LW, Kouchoukos NT, Kirklin JN. Triple valve replacement. An analysis of 8 year experience. Ann Thorac Surg 1977; 23: 327-32.
10. Acar J, Enriquez-Sarano M, Farah E, Kassab R, Tubiana P, Roger V. Recurrent systemic embolic events with valve prosthesis. Eur Heart J 1984; 5 (Suppl D): 33-8.
11. King RM, Schaff HV, Danielson GK, et al. Surgery for tricuspid regurgitation late after mitral valve replacement. Circulation 1984; 70 (Suppl 1): I-193.
12. Cohen SR, Silver MA, McIntosh CL, Roberts WC. Comparison of late (62 to 140 months) degenerative changes in simultaneously implanted and explanted porcine (Hancock) bioprostheses in the tricuspid and mitral valve positions in six patients. Am J Cardiol 1984; 53: 1599-602.
13. Guerra F, Bortolotti U, Thiene G, et al. Long-term performance of the Hancock porcine bioprosthesis in the tricuspid position. A review of forty-five patients with fourteen-year follow-up. J Thorac Cardiovasc Surg 1990; 99: 838-45.
14. Bache RJ, From AH, Castaneda AR, Jorgensen CR, Wang Y. Late thrombotic obstruction of Starr-Edwards tricuspid valve prosthesis. Chest 1972; 61: 613-6.
15. Björk VO, Henze A, Péterffy A. Can a mechanical heart valve be used in the tricuspid position? Experience with Björk-Shiley tilting disc valve in 70 patients. Eur Heart J 1980;1:55-61.
16. Minami K, Horstkotte D, Schulte HD, Bircks W. Thrombosis of two St. Jude Medical prostheses in one patient after triple valve replacement. Case report and review of the literature. Eur J Cardiothorac Surg 1988;2:48-52.