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Seven Years' Experience with Cardiac Valve Surgery in Consecutive Patients over Sixty Years of Age

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Abstract: From May 1984 through March 1991, 19 consecutive patients 60 years of age and older (mean age 65.9; range 60–78 years) underwent valvular surgery. These comprised 6 isolated aortic valve replacements (Group 1), 9 isolated mitral valve replacements and one mitral commissurotomy (Group 2), and 3 patients with combined aortic and mitral procedures (Group 3) which included replacement of at least the aortic valve. Carpentier-Edwards bioprosteses were used in most cases. Three patients had undergone previous cardiac operations. Five patients underwent semi-emergency procedures for acute valve perforation due to infectious endocarditis and prosthetic valve failures. Operative mortality was 11% (2/19 patients). Late death occured in two patients, but the cause of death was not related to prosthetic valves in either. At follow-up, the 15 surviving patients were in New York Heart Association functional class I or II.

Key words: Cardiac valve surgery, Patients over 60 years of age

INTRODUCTION

Before the 1970s, some center considered advanced age a contraindication to valve surgery. Over the last two decades, however, morbidity and mortality in surgery for valvular heart disease has decreased. This improvement is due to better myocardial preservation, continued refinement of surgical techniques, and improved valve prostheses. However, the risk of operative mortality for valvular surgery still remains between 5% and 12%.[1)]

Previous studies have indicated advanced age to be independent predictor of operative mortality.[2)] As the population ages, increasing numbers of elderly patients will be considered for cardiac surgery. Recent studies have reported excellent results in septo- and octogenarians.[4–12)] It is important that the risks, benefits, and costs of this trend should be better understood by Japanese physicians and the society at large.

We retrospectively analyzed the results of valvular surgery and identified factors contributing to current operative mortality after valvular surgery in our 19 consecutive patients over 60 years of age.

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MATERIALS AND METHODS

During the seven-year period from May, 1984, through March, 1991, 42 consecutive patients underwent cardiac valve surgery under conventional cardiopulmonary bypass at Yamanashi Medical College Hospital. Of the 42 patients shown in Table 1, this study prospectively evaluated the 19 (45%) over 60 years of age. Data abstracted from a retrospective review of patient records included clinical

Table 1. Valvular surgery in 42 consecutive patients in each decade of life. (May, 1984 March, 1991. Yamanashi Medical College Hospital)

Age group (years)	Aortic valve Surgery	Mitral valve Surgery	A+M valve Surgery	Total
0– 9	1	1		2
10–19	1			1
20–29		1		1
30–39	2	1	1	4
40–49	3	4		7
50–59	3	3	2	8
60–69	4	7	3	14
70–79	2	3		5
Total	16	20	6	42

and echo/angiocardiographic variables (age, sex, diagnosis on admittance, cardiac risk factors, procedure performed, and postoperative complications). Cardiac function was evaluated with echocardiography and cardiac catheterization including coronary angiography. Catheterization was not performed in patients with mitral stenosis accompanied by large left atrial thrombi, nor in those with thrombosed mitral prosthetic valves.

Operative techniques consisted of standard median sternotomy, routine aortic and right atrial cannulation, and nonpulsatile systemic moderate hypothermic cardiopulmonary bypass. Multidose, cold potassium cardioplegia was employed during the aortic crossclamp period. Oxygenated blood cardioplegia has been used since 1984. Topical hypothermia was used to augument cardiac cooling. Since 1988 we have also routinely used an elective prophylactic intra-aortic balloon pump (IABP) in older patients to prevent cardiac dysfunction before cardiopulmonary bypass.

Bioprostheses were frequently used in older patients.[3)]

Interrupted, pledgetted, horizontal, and mattress sutures were employed. Portions of the mitral valve and chordal attachments were preserved whenever possible. Tricuspid annuloplasties were performed according to the technique of DeVega.

Results

Table 2 to 5 summarize preoperative clinical characteristics. Patients comprised 10 men and 9 women, with ages ranging between 60 and 80 years (mean, 65.9 years). They were classified into three groups according to surgical procedure. Mean ages were 68.3 (60–78) years for the 6 patients undergoing aortic valve surgery (Group 1); 65.6 (60–72) years for the 10 patients with mitral valve surgery (Group 2); and 62.3 (60–65) years for 3 patients with aortic and mitral valve surgery (Group 3).

Causes of aortic valve disease were rheumatic in 5 patients, congenital in 2, resulting from infectious endocarditis in one, and from prosthetic valve failure (Ionescu-Shiley valve) in another. Causes of mitral valve disease were rheumatic in 9 patients, due to chorda rupture of papillary muscles in 2, infectious endocarditis in one, and a thrombosed prothetic valve (Bjork-Shiley valve) in another.

In general, patients undergoing mitral valve surgery (Groups 2 and 3) tended to suffer more cerebral infarctions, due to left atrial thrombi complicating atrial fibrillation mainly. The overall incidence of strokes was high at 8 of 19 patients (42%).

Table 2. Preoperative clinical characteristics of 19 consecutive patients over 60 years of age undergoing valvular surgery

Risk factors	Aortic valve Surgery	Mitral valve Surgery	Double valve Surgery
No of patients	6	10	3
Age (years)	68.3±6.8	65.6±4.0	62.3±2.1
Sex (M/F)	5/1	2/8	3/0
NYHA (grade)	3.3	3.0	2.0
Atrial fibrillation	1	9	3
Stroke		6	2
LA thrombi		5	
Endocarditis	1	3	
Ischemic heart	1	1	
Reoperation	1	2	
Semiemergency op	2	3	
Cancer postop	1	1	1

Table 3. Distribution of valvular lesions in 19 patients over 60 years of age

Lesion	Aortic valve	Mitral valve	Aortic and mitral valve
Regurgitation	3	3	0
Stenosis	2	5	3
Mixed	1	2	0

Semi-emergency operations were indicated in 5 patients, resulting from aortic bioprosthetic failure with severe hemolysis, thrombosed mitral prosthetic valve, severe aortic stenosis with an aortic valve pressure gradient of 110 mmHg, acute mitral incompetence due to infectious endocarditis, and mitral stenoinsufficiency with large atrial thrombi, respectively. Significant coronary artery disease, an indication for coronary bypass operation, was not present in this series. All patients had cardiomegaly. Significant left ventricular dysfunction (defined as LVEF<40%) was seen in 3 patients. Three additional patients had ejection fractions between 0.4 and 0.5. The remaining 13 patients had good cardiac function. Mean cardiac index in each of the three groups was 2.6±0.5 l/min/M^2 in group 1, 2.5±0.8 in group 2, and 2.7±0.5 in group 3.

Laboratory hepatic, renal and pulmonary function data are shown in Table 5. Hepatic function was within normal limits in group 1 and 2, but was slightly elevated in group 3. In renal function, decreased creatinine clearance ratios (<60%) were observed in 2 patients with aortic valve disease and in 6 patients with mitral valve disease. Elevated creatinine levels (>3.0 mg/d*l*) were not seen.

Table 6 shows operative procedure and patients dying in the early and late postoperative periods.

The most common procedures were isolated aortic valve replacement in 6 patients and isolated mitral valve replacement in 7. There were 2 perioperative (early) deaths (11%) and 2 late deaths. The oldest surviving patient was at operation a 75-year-old man who underwent aortic valve replacement for acute aortic valve perforation due to infectious endocarditis complicated by a congenital quadricuspid

Table 4. Preoperative hemodynamic variables in three groups over 60 years of age

Hemodynamic Variables	Aortic valve Surgery	Mitral valve Surgery	Double valve Surgery
CTR (%)	56± 6	62± 7	55±18
LVDd (mm)	53±13	51± 7	45±12
LVDs (mm)	33±13	33±10	32±11
LVEF (%)	67±13	65±16	70±18
LVEDVI (m*l*/M^2)	80±29	94±25	75±27
LVESVI (m*l*/M^2)	35±14	47±24	28±16
LVEF (%)	56± 8	50±20	65± 8
PAWP (mmHg)	10± 5	17± 8	11± 3
PASP (mmHg)	32± 7	43±11	26± 3
PADP (mmHg)	11± 5	19± 8	10± 5
LVEDP (mmHg)	28±10	8± 6	10± 0
CI (l/min/M^2)	2.6±0.5	2.5±0.8	2.7±0.5

Abbreviations: CI: cardiac index; CTR: cardiothoracic ratio; EF: ejection fraction; LVDd: left ventricular diastolic dimension; LVDs: left ventricular systolic dimension; LVEDP: left ventricular end-diastolic pressure; LVEDVI: left ventricular end-diastolic volume index; LVESVI: left ventricular end-systolic volume index; PAWP: pulmonary artery wedge pressure; PASP: pulmonary artery systolic pressure; PADP: pulmonary artery diastolic pressure;

Table 5. Preoperative laboratory hepatic, renal, and pulmonary function

TP (g/d*l*)	7.0±0.7	7.2±0.3	6.7±0.1
Tot. Bili. (mg/d*l*)	1.2±1.1	0.6±0.1	0.6±0.1
LDH (U/*l*)	404±102	410± 89	374± 34
GOT (U/*l*)	25± 16	22± 6	41± 19
GPT (U/*l*)	14± 4	21±12	39± 18
Tot. Chol (mg/d*l*)	169± 14	208± 27	151± 33
HB (g/d*l*)	12.6±2.1	13.0±2.3	12.4±2.9
BUN (mg/d*l*)	38± 35	23± 5	18± 2
Crtn (mg/d*l*)	1.0±0.6	0.8±0.3	0.9±0.2
Ccr (%)	79± 49	60± 25	101± 31
% VC	88± 15	76± 11	89± 3
$FEV_{1.0}{}^{\%}$	68± 9	76± 12	70± 7

Abbreviations: BUN: blood urea nitrogen; Ccr: creatinine clearance; Crtn: creatinine; FEV: forced expiratory volume; GOT: glutamic oxaloacetic transaminase; GPT: glutamic pyruvic transaminase; HB: hemoglobin; LDH: lactic dehydrogenase; Tot Chol: total cholesterol; Tot Bili: total bilirubin; TP: total protein; VC: vital capacity.

Table 6. Surgical procedures and results in 19 patients

Procedure	No. of patients	Early death	Late death
AVR	6	1	
MVR	7		
MVR+TAP	2	1	1
OMC	1		
AVR+OMC	2		1
AVR+MVR+TAP	1		
	19	2	2

Abbreviations: AVR: aortic valve replacement; MVR: mitral valve replacement; OMC: open mitral commissurotomy; TAP: tricuspid annuloplasty.

Table 7. Prosthetic valve types and implant positions

Prosthetic Valve	Aortic position	Mitral position	Total
Mechanical			
Duromedicus		2	2
St. Jude Medical	3	2	5
Medtronic-Hall	3	1	4
Biological			
Carpentier-Edwards	3	5	8

Table 8. Peri- and postoperative variables in three groups over 60 years of age

	Group 1	Group 2	Group 3
	Aortic valve Surgery	Mitral valve Surgery	Double valve Surgery
No of patients	6	10	3
Elective IABP use	3	6	1
Urgent IABP use		1	
CPB time (min)	157±65	134±55	152±47
Cross-clamp time (min)	131±59	106±44	106±37
Respirator use (h)	26±9	30±11	15±1
Postoperative hospitalization (day)	55±29	66±20	44±5

aortic valve.

Concerning the selection of prostheses, the Carpentier-Edwards bioprosthesis was used in 8 elderly patients (42%) for any valve position.

Table 8 shows perioperative and postoperative variables in each group.

Elective prophylactic use of IABP was employed in 10 patients (53%); a 72-year-old woman was the only patient requiring urgent use of this support, occurring immediately after cardiopulmonary bypass for left ventricular rupture after mitral valve replacement. Mean aortic cross-clamping time and mean bypass time were 131±59 and 157±65 minutes in group 1, 106±44 and 134±55 minutes in group 2, and 106±37 and 152±47 minutes in group 3, respectively. Spontaneous defibrillation without DC shock was achieved in all cases, but prolonged bypass was unavoidable in 2 patients, resulting ultimately in early death. Postoperative respirator use was 26±9 hours in group 1, 30±11 in group 2, and 15±1 in group 3. Postoperative hospitalization was 55±29 days in group 1, 66±20 in group 2, and 44±5 in group 3. Postoperative respirator use and hospitalization were also prolonged in patients with reduced systemic activities due to preoperative cerebral accidents.

Two perioperative deaths (11%) were recorded, one an acute aortic regurgitation resulting from Ionescu-Shiley bioprosthetic failure and subsequent acute renal failure due to severe hemolysis, and in a 72-year-old woman with severe mitral stenoinsufficiency and tricuspid regurgitation with large left atrial thrombi. The first underwent aortic valve re-replacement with a Carpentier-Edwards bioprosthesis, but required prolonged perfusion (bypass time; 293 min) and inadequate cardiac protection (cross-clamp time; 260 min) for uncontrolled aortic bleeding. Low cardiac output immediately developed and the patient died on the second postoperative day. The second patient underwent mitral valve replacement with a Carpentier-Edwards bioprosthesis and tricuspid annuloplasy with initial hemodynamic improvement, but subsequently required re-exploration for uncontrolled left ventricular repture. She could not be resuscitated.

The 2 late deaths included a 65-year-old woman with mitral stenoinsufficiency and tricuspid regurgitation with large left atrial thrombi who underwent mitral valve replacement with a Carpentier-Edwards bioprosthesis and tricuspid annuloplasty. Postoperative hemodynamics were uneventful, but moderate hemoglobinuria appeared. Paravalvular leakage was suspected and acute renal failure developed. She died 3 months postoperatively due to multiple organ failure.

The fourth deceased patient was a 60-year-old man with aortic stenoinsufficiency and mitral stenosis complicated by Wallenberg syndrome. He underwent aortic valve replacement with a Medtronic-Hall mechanical prosthesis and concomitant mitral commissurotomy. Long-term postoperative anticoagulant therapy with warfarin and bucolom was monitored. However, chronic cerebral infarction developed and he died five years postoperatively due to acute pneumonia.

The remaining 15 survivors are healthy and all report a high quality of life.

Discussion

Modern estimates of operative mortality for valvular heart surgery remain between 5% and 12%.[1] The risk of operative mortality for valvular replacement in the elderly ranges 3%[15] and 37%.[16] In their Veterans Administration Cooperative Study, however, Sethi et al.[1] describe the negative influence of advanced age in mitral but not aortic valve replacement. Previous studies from the University of Toronto group indicated that advanced age was an independent predictor of operative mortality in valvular surgery.[2] They also stated in a recent report[11] that significant predictors of operative mortality were urgent surgery, mitral or double-valve disease,

and nongrafted coronary artery disease, female gender, and depressed left ventricular function, and that each independently elevated the risk of mortality in valvular surgery in the aged poulation.

In their paper, urgent surgery was associated with a mortality of 21.9%, compared with 7.8% for elective surgery. Aortic valve replacement was associated with a 6.1% mortality risk, compared with 15.1% for mitral valve surgery and 18.9% for double-valve surgery. Coronary artery disease increased the risk of valvular surgery (6.6% v. 12.9%). Female patients were 2.73 times less likely to survive than male patients (female, 14.4%; male 5.6%). Any degree of left ventricular impairment resulted in increased mortality compared with normal left ventricular function. Predicted mortality range from 0.9±1.6% for patients in the lowest-risk category to 76±16% for those in the highest-risk category. Morbidity was significantly increased in the older population, and each complication was associated with increased mortality. Death occured in 50% of patients developing perioperative myocardial infarction, in 23% with low cardiac output syndrome, in 55% with a sternal infection, and in 28% with re-exploration. The incidence of operative mortality in the Toronto group was 28.9%.

Although urgent surgery was not identified as a predictor of operative mortality in the Veterans Administration Cooperative Study[1], many authors have reported it an important risk factor in any valve replacement. Early referral before the onset of severe symptomatology may improve results for urgent surgery in elderly patients, especially in those with severe aortic stenosis, or with aortic/mitral valvular lesions due to infectious endocarditis. Earlier studies reported operative survival to be adversely influenced by chronic aortic or mitral regurgitation. Because of improved methods of noninvasive cardiac functional assessment, patients with volume-overloaded ventricles are now being referred for surgery before they develop irreversible dysfunction.

We consider that IABP support procedure should be applied as earlier as possible, before operation or prior to the induction of aortic cross-clamp in order to preserve cardiac function and organ perfusion during induction of anesthesia, before and during cardiopulmonary bypass. Next, improved techniques in myocardial protection may reduce the incidence of postoperative ventricular dysfunction in any degree of preoperative ventricular impairment. Although due to incomplete distribution, we take a cautious view of warm antegrade cardioplegic induction for acute ischemic syndrome, this procedure may be appropriate for the hypertrophied ventricle, particularly if the coronary arteries are not obstructed. In mitral valve replacement, we prefer leaflet and chordal preservation whenever possible to maintain leaflet-annular continuity and to enhance postoperative ventricular function. Adoption of these techniques may reduce the disadvantages of mitral repair, particularly in mitral valve regurgitation.

Generally, the aged patient is characterized as having more advanced symptomatology, decreased left ventricular function, and associated coronary artery disease than the younger patient. Urgent surgery is required more frequently than in younger patients. Patients or their physicians may delay referral for surgery until marked clinical deterioration forces attention. In additions, the relatively reduced activity of the elderly may delay the onset of symptoms for comparable hemodynamic lesions.

In aged patients, modification of life style may be preferable to major surgery; reasons include the attendant risk of mortality, painful recovery, or permanent disability.

Our experience raises important considerations in operative indications for valvular disease in elderly patients with reduced function resulting from cerebral infarction. Intensive care and general hospitalization were longer. We believe, however, that they are able

to have a rehabilitation planning with more satety and to gain a more quality of life.

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