Re-evaluation of the Indications for Cardiac Valve Replacement

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We re-evaluated the indications for mitral valve replacement and reconstruction, and attempted to determine the optimal time for aortic valve replacement. (1) The actuarial event-free survival rate in patients undergoing open mitral commissurotomy for mitral stenosis with far-advanced subvalvular deformities was 78 per cent at 11 years after surgery and similar in patients undergoing mitral valve replacement for mitral stenosis. Postoperative clinical improvements compared favorably with those in patients undergoing mitral valve replacement. If quality of postoperative life in patients not requiring anticoagulants is borne in mind, open mitral commissurotomy should be given strong consideration as the procedure of choice for the majority of patients with mitral stenosis. (2) The long-term results of reconstructive procedures for mitral regurgitation largely depend upon the pathological anatomies contributing to the development of mitral regurgitation. The results were less satisfactory in patients with fibrotic changes of valvular and subvalvular tissue than in patients undergoing mitral valve replacement for mitral regurgitation. (3) In aortic valve replacement, the postoperative prognosis was poor in patients with a preoperative left ventricular end-systolic volume index exceeding 200 ml/m² and left ventricular ejection fraction less than 0.35. Operative management of patients with aortic valve disease should be considered, before severe left ventricular systolic dysfunction is evident.

Cardiac valve replacement has played an important therapeutic role in the treatment of patients with valvular heart disease. However, the long-term results of valve replacement are still limited by various complications which involve mechanical function, thromboembolic complications, infection, and hemolysis. Therefore, especially in the surgical management of patients with mitral valve disease, there are justifiably, controversies regarding whether to replace or reconstruct a valve. On the other hand, in patients with aortic valve disease, it is imperative to determine when aortic valve replacement should be considered, because the postoperative prognosis largely depends upon the reversibility of preoperative left ventricular dysfunction.

In this study, we re-evaluated the respective indications for mitral valve replacement and reconstruction, and attempted to determine the optimal time for operative management of patients with aortic valve disease.

MATERIALS AND METHODS
From January 1972 to December 1982, 269

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Key Words:
Mitral valve replacement
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patients underwent mitral valve surgery for pure or predominant mitral stenosis at Osaka University Hospital. In 249 of these patients (92.5%), open mitral commissurotomy (OMC) was performed and in the remaining 20 patients (7.5%) mitral valve replacement (MVR) was required because of a severely scarred cuspal type of stenosis in 10 patients, a heavily calcified valve in seven, and regurgitation produced at the time of OMC in three. The 249 patients undergoing
OMC were divided into three groups, according to a pathological classification for stenosed mitral valves modified from the classification originally reported by Sellors et al.: Type I—mobile cusps without subvalvular changes (30 patients); Type II—thickened cusps with mild to moderate subvalvular changes (152 patients); Type III—rigid cusps with severe subvalvular changes (67 patients). In all the patients with Types II and III, complete relief of subvalvular fusions was achieved by separating the fused and shortened chordae and papillary muscles down to the bases by means of sharp dissection.

Sixty-two patients (51.2%) underwent mitral annuloplasty for mitral regurgitation and 59 patients (48.8%) underwent MVR. Mitral annuloplasty by J.H. Kay’s procedure, plication of leaflets, and repairing torn or elongated chordae. The patients undergoing mitral annuloplasty were divided into four groups, according to pathological factors contributing to the development of mitral regurgitation: 20 patients, torn or elongated chordae; 23 patients, dilated annulus; 18 patients, fibrotic changes of valvular and subvalvular tissues.

From 1970 to 1982, 131 patients underwent aortic valve replacement using the Björk-Shiley tilting disc valve.

RESULTS
(1) Mitral valve replacement, open mitral commissurotomy, and mitral annuloplasty

Actuarial survival rates (excluding operative deaths) in the 146 patients undergoing MVR (Kay-Shiley, 57; Starr-Edwards disc, 49; xenograft, 15; Björk-Shiley, 15; miscellaneous, 10) were 73 per cent at 10 years and 58 per cent at 17 years after surgery. Actuarial free rates from late mortality, reoperation, and thromboembolism were 66 per cent at 10 years and 48 per cent at 17 years after surgery (Fig. 1).

In the 249 patients undergoing OMC, there were four operative deaths (1.3%), 11 late deaths (3.0%), and nine reoperations (3.0%). The actuarial free rate from mortality and reoperation in the total 249 patients was 85 per cent at 11 years after surgery. In patients with Type I, the actu-
Fig.4 Actuarial free rate from mortality and reoperation in patients undergoing mitral annuloplasty and mitral valve replacement for mitral regurgitation.

Fig.5 Actuarial survival rate and actuarial free rate from late mortality and reoperation in patients undergoing aortic valve replacement.

Actuarial event-free survival rate was 100 per cent and in patients with Type II, 87 per cent. In patients with Type III, the actuarial event-free survival rate was 78 per cent and similar to that of patients undergoing MVR for mitral stenosis (Fig. 2).

None of the patients who underwent OMC encountered thromboembolic complications, without anticoagulant therapy. Postoperative cardiac index and effective mitral valve areas, calculated by Gorlin's Formula,
in patients undergoing OMC were compared with those in patients undergoing OMC were compared with those in patients undergoing MVR for mitral stenosis (Fig. 3). Cardiac index in patients with Type III was not significantly different from that in patients undergoing MVR. However, effective mitral valve areas in patients with Type III were 1.5 cm$^2$ at rest and 1.6 cm$^2$ during exercise. In comparison, effective mitral valve areas in patients undergoing MVR were 2.6 cm$^2$ at rest and 2.3 cm$^2$ during exercise. There are statistically significant differences between these values ($p < 0.001$ at rest and $p < 0.01$ during exercise).

As to postoperative clinical improvements in patients with Type III, 67 per cent were in NYHA Class I and 30 per cent in Class II. In patients undergoing MVR, 73 per cent were in Class I and 23 per cent in Class II.

In the 62 patients undergoing mitral annuloplasty (MAP), there was no operative death, no late death, and six reoperations. The actuarial free rates from reoperation in patients with torn or elongated chordae and in patients with dilated annulus were 93 per cent and 83 per cent, respectively. In patients with mitral regurgitation associated with fibrotic changes of valvular and subvalvular tissues, the actuarial free rate from reoperation was 67 per cent at 12 years after surgery. This rate was lower than the actuarial event-free survival rate in the patients undergoing MVR (Fig. 4).

(2) Aortic valve replacement

The actuarial survival rate (excluding operative death) was 84 per cent at 13 years after surgery, and the actuarial free rate from late mortality and thromboembolism was 75 per cent (Fig. 5). There were 10 late deaths in this series. Six of these 10 patients died of congestive heart failure or sudden death; Five of these six patients underwent aortic valve replacement for aortic regurgitation and the remaining one, for aortic stenosis.

In the five patients who died late of congestive heart failure, preoperative left ventricular ejection fraction (LVEF) and left ventricular end-systolic volume index (LVESVI) were $0.27 \pm 0.04$ and $286 \pm 48 \text{ ml/m}^2$, respectively. In constrast,
preoperative LVEF and LVESVI in the surviving patients were $0.47 \pm 0.11$ and $114 \pm 56 \text{ ml/m}^2$, respectively. There were significant differences between the late death group and the survivors group. One patient who died late after aortic valve replacement for aortic stenosis had values of $0.22$ (LVEF) and $219 \text{ ml/m}^2$ (LVESVI) preoperatively. On the seven patients who had values lower than $0.35$ (LVEF) and higher than $200 \text{ ml/m}^2$ (LVESVI) preoperatively, five patients ($71.4\%$) died late of congestive heart failure or sudden death (Fig. 6).

Postoperative hemodynamic studies were carried out on eight patients undergoing aortic valve replacement for aortic regurgitation. Preoperative LVEF was $0.46 \pm 0.06$; it improved to $0.67 \pm 0.06$ postoperatively ($p < 0.01$). LVESVI decreased to $36 \pm 12 \text{ ml/m}^2$ postoperatively from a preoperative value of $126 \pm 12 \text{ ml/m}^2$ ($p < 0.001$) (Fig. 7).

**COMMENT**

(1) Mitral valve replacement versus valve reconstruction

Open mitral commissurotomy for mitral stenosis is a well-established procedure and a common misurotomy technique which includes separation of subvalvular fusions has been widely employed. However, in mitral stenosis with far-advanced subvalvular deformities, whether to replace or reconstruct a valve remains controversial. Despite the many refinements achieved in valve prosthesis, replacement still carries the risks of thromboembolic, mechanical, and infectious complications. The long-term outlook with mitral valve replacement is far from ideal. Our policy in order has been to salvage a stenosed mitral valve to delay the need for the prosthesis. An analysis of the long-term results of open mitral commissurotomy demonstrated that the more severe were the pathological deformities of the mitral valve, the less satisfactory were the long-term results. The effective mitral valve areas in patients with far-advanced subvalvular deformities (Type III) were significantly smaller than in patients undergoing mitral valve replacement. However, the actuarial event-free survival rate in these patients with Type III was 78 per cent at 11 years after surgery and similar to that in patients undergoing mitral valve replacement. Postoperative clinical improvements compared favorably with those in patients who underwent mitral valve replacement. In fact, it is difficult to compare the long-term outlooks

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with open mitral commissurotomy and mitral valve replacement because of the differences in patient selection. However, if quality of life postoperatively in patients not requiring anticoagulants is borne in mind, open mitral commissurotomy should be given strong consideration as the procedure of choice for the majority of patients with mitral stenosis.

Reconstructive surgery for mitral regurgitation also remains controversial. The long-term results of mitral annuloplasty largely depend upon the pathological anatomicies contributing to the development of mitral regurgitation. Good to excellent results in mitral annuloplasty were obtained in patients with torn or elongated chordae and dilated annulus. However, in patients with fibrotic changes in valvular and subvalvular tissues, the results were less satisfactory. The actuarial event-free rate was low in these patients. Therefore, mitral valve replacement is preferred in patients with mitral regurgitation associated with fibrotic changes in valvular and subvalvular tissues.

(2) Optimal time of aortic valve replacement

The question remains as to the long-term outlook for patients undergoing aortic valve replacement. Because the prognosis mainly depends upon postoperative reversibility of depressed left ventricular function, it is imperative to determine the optimal time for intervening with aortic valve replacement. Aortic valve replacement should be performed before preoperative left ventricular dysfunction becomes irreversible. As noted by Bonow R. O. et al., a most important predictor is left ventricular systolic function. Bonow emphasized that, because the time course between left ventricular dysfunction and symptoms is relatively short, it appears reasonable to operate in all asymptomatic patients with left ventricular systolic dysfunction. Henry WL et al.5 by using M-mode echocardiography, reported that when the left ventricular end-systolic dimension was 55 mm or greater and left ventricular fractional shortening was less than 25 per cent, aortic valve replacement carried a higher risk of perioperative and postoperative death through congestive heart failure. Our analysis by contrast left ventriculography demonstrated that the patients dying late after aortic valve replacement had values of 286 ml/m² (LVESVI) and 0.27 (LVEF) on average preoperatively. There were significant differences between the late death group and the survivors group. The postoperative prognosis was poor, especially in patients with LVESVI exceeding 200 ml/m² and LVEF less than 0.35 preoperatively. As today aortic valve replacement itself carries a low risk with suitable myocardial protection during the operation, operative management of patients with aortic valve disease should be considered in patients with LVESVI lower than 200 ml/m² and LVEF higher than 0.35.

REFERENCES