大韓胸部外科學會誌 第5卷 第2號
Vol. 5, No. 2, December, 1972

MITRAL VALVE SURGERY

——Lecture by invitation——

Hisao Manabe,* M. D.

With the developments of extracorporeal circulation and prosthetic heart valves, different methods would be applicable to the patients with mitral valve disease, especially mitral stenosis, depending upon the pathologic and hemodynamic conditions of each patients. The methods available are closed, open mitral commissurotomy and mitral valve replacement. The selection of methods should be carried out with intense care in each patient with mitral valve disease in order to obtain the maximum surgical effects and, of course, with the lowest surgical mortality. For this purpose, complete preoperative assessments of hemodynamics and pathologic conditions of the diseased valve are quite important.

In our department of surgery, as the preoperative studies, we perform right and left heart catheterization together with angiocardiographic and ultrasound echocardiographic studies. The results obtained from all of these studies will give important information concerning the patients undergoing mitral valve surgery.

I am going to show several pictures of the left atrium, mitral valve and left ventricle by injecting a contrast material into the left atrium through a catheter via the atrial septum. As shown in fig. 1, narrowing of the mitral valve can be identified. Contrast material is demonstrated passing through the stenotic valve as a jet stream. Thickening of the valvular leaflet can also be seen as a translucent shadow in the end-diastolic phase. In this phase, the mitral valve protrudes into the left ventricle and can be seen best in the right anterior oblique position(Fig. 2). Movement of the leaflet is also quite important: for example, leaflet movement can bn quantitatively shown by measuring the moving distance at the diastolic and systolic periods. The left side of fig. 3. shows diastolic phase and the right shows systolic phase. In the majority of patients with fused commissures, the outlines of the leaflets are smooth and the moving distance is over 18mm. In these instances, closed mitral commissurotomy would be

Fig. 1.

* *Professor of First Department of Surgery Osaka University Hospital*
Read at the meeting of Thoracic and Cardiovascular Surgery in Korea, May, 1972.

Fig. 2.

Fig. 3.

indicated.

On the other hand, in patients with damaged subvalvular apparatus such as shortened chordae tendinae or deformed and hypertrophied papillary muscle, the mitral dome shown by left atrial injection, is flat, as shown fig. 4, and the leaflet moving distance is short, usually less than 12mm. The left picture was taken in diatolic phase and the right in systolic period. In addition, outline irregularity of the posterolateral area close to the mitral valve and/or a filling defect of contrast material due to the deformed and hypertrophied papil-

Fig. 4.

Fig. 5.

lary muscle may be seen by direct left ventricualr injection (Fig. 5). In the instances with such pathologic conditions of the mitral valve complex, open surgery, either commissurotomy or mitral valve replacement would be necessary.

An irregular filling defect in the left atrium suggests a thrombus mass. A filling defect in the left atrium is shown by arrows in fig. 6. When the existence of thrombus mass is suspected by angiocardiography, absolute indication for open surgery would be made regardless of the condition of the valvular apparatus. Special care should be paid to the prevention of cerebral embolism in these patients.

In fig. 7, a calcific left atrial wall is

Fig. 6.

Fig. 7.

demonstrated. It should be stressed that thrombus formation in the left atrium is almost always associated with a calcific atrial wall. These patients should also be treated with open valve surgery.

Finally, calcific mitral valves are sometimes seen on the routine chest X-ray pictures. This is commoner in the aged patients and the closed method would not give a satisfa-

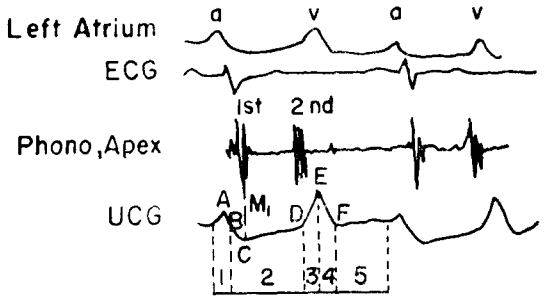

Fig. 8.

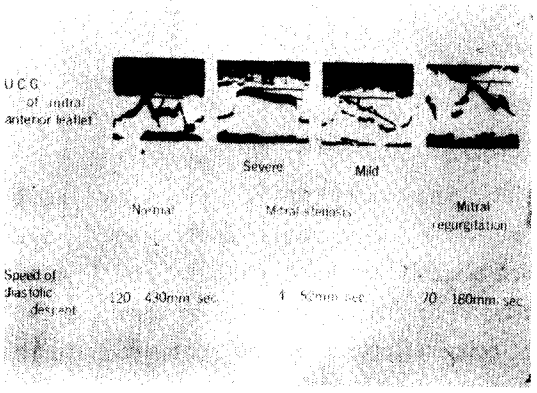

Fig. 9.

ctory result for those patients. Open method must be attempted.

As I have described, angiocardiographic evaluation using left atrial and ventricular injection is essential for an accurate preoperative assessment and for the selection of the most appropriate method for each patient in the different condition.

Next, I would like to talk about ultrasonic echocardiography. We are checking most of the patients by means of echocardiography as a routine examination. This is one of the noninvasive techniques to estimate the movement of the valve leaflets, especially of the anterior leaflet by receiving an echo-reflection of the ultrasonic wave. The schmatic presentation of the normal echogram of the mitral valve is shown in fig. 8. At the C point, the mitral valve closes and at the E

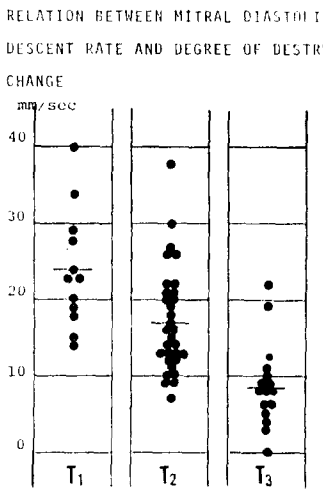

Fig. 10.

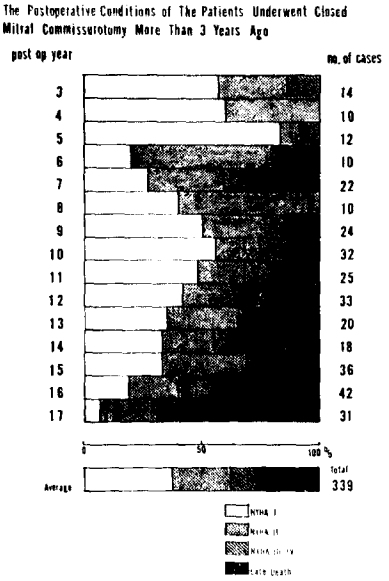

Fig. 11.

point, the valve opens. Following the F point, the valve stays halfly closed, and open slightly at the A point by atrial contraction. In mitral stenosis, as shown in fig. 9, echo-reflection shows a special square wave type. From the tracing of echo-reflection, the mitral diastolic descent rate, that is, the movement of the EF segment per second is measurable. Mitral diastolic descent rate correlated not only with functional condition such as pressure gradient or valve area, but also with the anatomical change of the mitral valve. The anatomical and pathologic changes of the stenotic valve are classified into 3 groups. Type 1 indicates pliable leaflets and no subvalvular fusion. Type 3 represents the most destructive change of the valve, severe subvalvular fusion and marked thickening of the leaflets. Type 2 located in between. In 12 out of 15 patients having a severe subvalvular fusion and classified in type 3, the average diastolic descent was 8.7 mm/sec. In 12 patients with stenosis of type 1 and 31 patients of type 2, it averaged 24 and 17mm/sec. respectively (Fig. 10). On the basis of these findings, open surgery should be considered for the patient whose descent rate is below 10mm/sec.

Table 1. Mitral Valvular Disease

Operation	No. of Patients
Commissurotomy	569
Closed	548
Open	21
Reconstruction	10
Annuloplasty	4
Commissurotomy & Annuloplasty	5
Repair of chorda & Annuloplasty	1
Valve Replacement	79
Prosthetic Valve	70
Homograft Valve	9
Total	658

I have discussed surgical indications for mitral valve disease and from now, I am going to speak about the results of surgery. Since 1952, we have performed mitral valve surgery on total 658 patients, of these patients, 548 were treated by closed commissurotomy and in 79 patients valve replacement was performed. Twelve patients were treated by open commissurotomy and 10 by annuloplasty (Table 1).

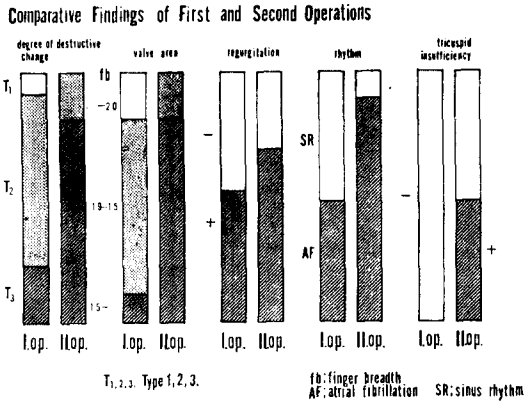

Fig. 12.

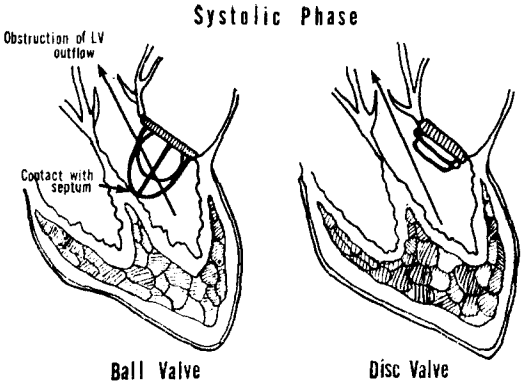

Fig. 13.

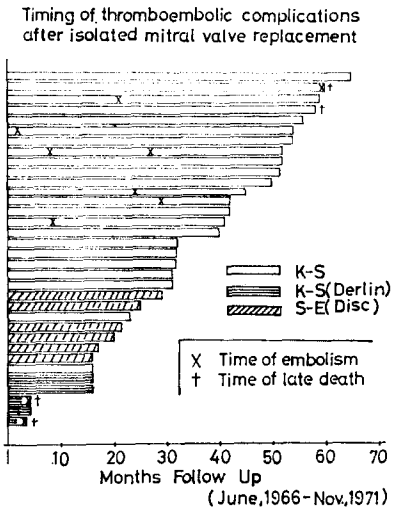

Fig. 14.

The follow-up study of 548 patients who survived over 3 years following closed commissurotomy is demonstrated in fig. 11. Late death occurred in the group of patients who lived more than 5 years after surgery. After 9 years' postoperative period, the incidence of late death increased progressively year by year and the number of patients in NYHA functional class 1 decreased. Approximately 10% of the patients who had closed mitral commissurotomy required reoperation for restenosis or regurgitation. The average time interval between the first and second operations is 8.5 years. The characteristic findings at the time of reoperation were not only restenosis but also increased destructive changes of the valve resulting in an increased regurgitation. Interesting to know, ocurrence of the associated tricuspid insufficiency was also observed in as much as 48% of patients. Fourteen out of 29 patients who underwent reoperation had both mitral restenosis and associated tricuspid insufficiency (Fig. 12).

At the second operation for the patients previously treated by closed commissurotomy, open surgery is indicated for the reasons mentioned above. Even at this moment, we try to reserve their own valve as much as possible, but if surgical benefits can not be expected, valve replacement would be performed. At present, various kind of prosthetic valves are comercially available. In our institute, we prefer the low-profile disc valve such as the Kay-Shiley disc valve, and the Starr-Edwards metal disc valve for the mitral valve replacement for the following reasons. Because of its low profile design, the chance of left ventricular outflow obstruction or contact with the ventricular septum during systole is much less than that with the long-caged ball valve(Fig. 13). This appears of

Fig. 15.

Fig. 16.

particular importance in the small left ventricular cavity in mitral stenosis.

The most difficult and unsolved problem in valve replacement is thrombo-embolic complication. We always place the patients with prosthetic valve replacement on anticoagulant therapy, however, 9 out of 34 long survivours (26.5%) were complicated by thromboembolism, of which 4 patients died of cerebral embolism (Fig. 14). A silastic disc poppet was examined at necropsy in a patient who died of cerebral embolism after surgery. Slight material erosion of the disc poppet was

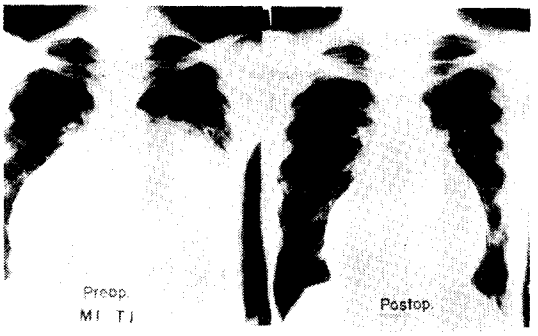

Fig. 17.

found but it looked more or less normal. We have not experienced any patients complicated by disc variance after mitral valve replacement. The prosthetic valves currently available are materially stable.

Next, I am going to discuss the treatment for mitral insufficiency. There is no way to treat mitral insufficiency by the closed method. Although the open method using cardiopulmonary bypass is performed, here again, repair of the valve must be considered first. Posteromedial and sometimes anterolateral annuloplasty can be applied with best results to mitral regurgitation due to dilated annulus.

Fig. 15 shows a grade 4 over 4 mitral regurgitation demonstrated by left ventriculography in a 31 year-old woman. Annuloplasty of the mitral valve was performed employing the technique shown by Kay.* The pre-and postoperative chest X-ray of this patient are compared in fig. 16, demonstrating a significant reduction in heart size.

The same type of technique is also applicable to tricuspid insufficiency rather commonly associated with mitral valve disease. There is a discrepancy in opinion as to the treatment for this type of tricuspid insufficiency. Some recommend aggressive surgical

* Kay JH et.: The surgical treatment of mitral insufficiency associated with torn chordae tendinae Ann. Thorac. Surg. 1:269, 1965.

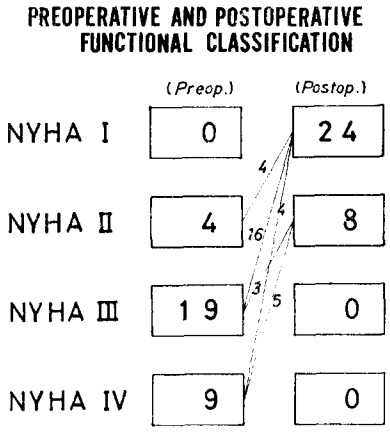

Fig. 18.

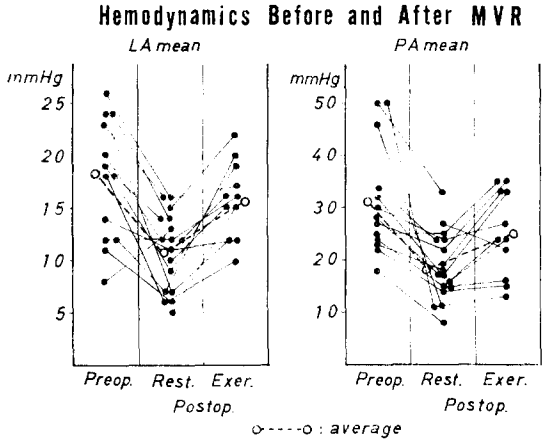

Fig. 19.

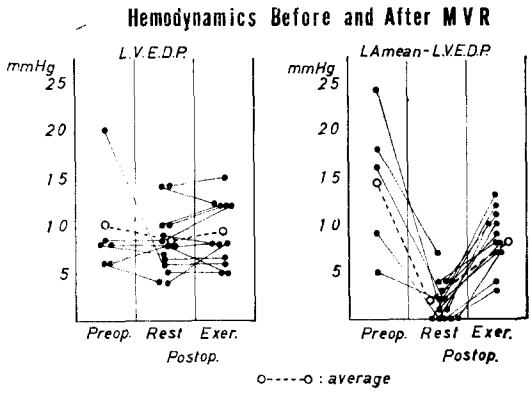

Fig. 20.

intervention to the regurgitant tricuspid valve even by employing valve replacement. Others have the opinion that this type of tricuspid insufficiency is functional and after correction of the mitral valve, regurgitation becomes insignificant, therefore, no surgical intervention is necessary for the tricuspid valve. In our institute, however, we are performing tricuspid annuloplasty whenever significant tricuspid insufficiency is combined with mitral stenosis, and we believe this is quite important to enchance the surgical effects and to reduce the surgical mortality because tricuspid insufficiency is a great disadvantage, particularly in the critical postoperative period.

Fig. 17 is the pre-and postoperative chest X-ray of a patient who underwent both mitral and tricuspid annuloplasty for combined valvular insufficiency. This 26 year-old man had a marked improvement in clinical symptoms from NYHA grade 4 to grade I. His heart size has also markedly decreased.

Although annuloplastic or valvuloplastic surgery can restore the good functioning valve in some patients, severely damaged valves are no longer correctable by the plastic technique and requires replacment.

In the series of 32 patients with complete follow-up studies for 2 years and 10 months on average after mitral valve replacement, 24 patients improved to NYHA grade 1 and the remaining 8 to grade 2 from preoperative grade 3 or 4. There was no patient who remained worse than grade 3 in the long-term survivors (Fig. 18). Thirteen patients were studied before and after prosthetic mitral valve replacement employing right and left heart catheterization and exercise tests. As shown in fig. 19, the left atrial mean pressure at rest decreased in all patients following surgery from 17.6 to 10.9 milimeter of mercury. In 6 patients, the left atrial mean pressure was still elevated higher than 12mm Hg. after

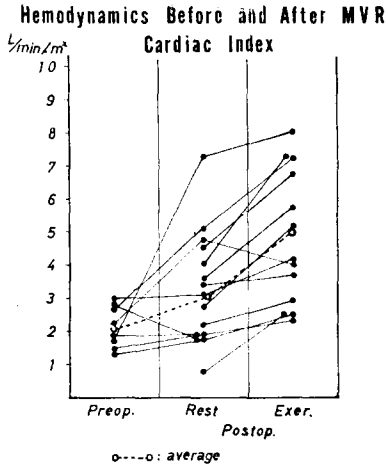

Fig. 21.

surgery. The mean pulmonary artery pressure also decreased and averaged 17.7mm Hg. postoperatively. The pressure gradient across the prosthetic valve, that is, left atrio-ventricular pressure gradient was less than 5mm of mercury, at rest in all patients but one (Fig. 20). Cardiac output also increased significantly following surgery.

With exercise of 25 to 50 watts for several minutes using a bicycle ergometer, a significant increase in cardiac output was observed, although there were simultaneous increases in the pulmonary artery, left atrial mean pressure and the mitral gradient (Fig. 21). From these comparative hemodynamic studies, mitral valve replacement with a well-established indication can benefit the patients incapacitated from mitral valve disease, although the problem of thromboembolic complications remains unsolved at present.

I have talked about mitral valve surgery from my experience of 20 years at our hospital and I believe that mitral valve surgery performed with well-established indications can salvage a large amount of sick patients, and further developments in cardiac surgery will give an answer to the question unsolved at the present time.

I would like to close my speech hoping that this may contribute even a little to your association for cardiac surgery. Thank you.