Changes in Surgical Treatment of Mitral Valve Disease in Our Department

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ABSTRACT

The surgical procedures used to treat mitral valve disease have changed in the last 30 years. The aim of this study was to assess trends in surgical procedures for mitral valve disease at the Jikei University Hospital. From 1972 to 2003, 770 patients with mitral valve disease underwent one of following procedures in our department : closed mitral commissurotomy, open mitral commissurotomy, mitral valve replacement and mitral valve plasty. The number of patients with mitral valve disease has decreased since the 1980s, because of a decrease in the incidence of rheumatic valvular disease. The surgical procedures have changed with the causes of mitral valve disease. As a result, the incidence of degenerative and ischemic mitral regurgitation has increased, and mitral valve plasty has been performed more often. (Jikeikai Med J 2004 ; 51 : 97–103)

Key words : mitral valve disease, heart surgery

INTRODUCTION

Among cases of mitral valve disease, the incidence of regressive lesion-induced mitral valve regurgitation (MR) and ischemic MR has recently increased, whereas the incidence of rheumatic valvular disease has decreased. Furthermore, surgery for mitral valve disease has recently been performed less often. Since our department was established in 1972, we have aggressively treated valvular diseases. In the last 30 years, surgical procedures have significantly changed with the nature of valvular disease.

In the present study, we reviewed changes in surgical procedures for mitral valve diseases such as closed mitral commissurotomy (CMC), open mitral commissurotomoy (OMC), and mitral valve replacement (MVR) for mitral valve stenosis (MS), and MVR and mitral valve plasty (MVP) for MR.

PATIENTS AND METHODS

1. Patients

From April 1972 through March 2003, 770 adult patients (303 men and 467 women) underwent surgery for mitral valve disease one or more times in our department. Patients simultaneously operated on for tricuspid valve disease were included but those who were simultaneously operated on for aortic valve disease were excluded.

2. Methods

We studied subjects, pathogenesis, changes in surgical procedures and reoperation, in cases of MS and cases of MR.

RESULTS

1. Patients

Of the 770 patients undergoing surgery for mitral valve disease, 541 had MS and 229 had MR.   Until the mid-1980s the incidence of MS was high and appeared likely to increase further, but the incidence of MS has actually decreased since the mid-1980s. The incidence of rheumatic mitral valve disease has decreased, whereas the incidence of degenerative mitral valve disease has increased.   Accordingly, the rate of MVP for MR has increased (Fig. 1).

The mean age of patients at the time of surgery was 48.3 years.   As the Japanese population has aged, the average age of patients has increased from the 1970s (40.9 years), through the 1980s (48.2 years) and 1990s (53.5 years), to the 2000s (57.6 years ; Fig. 2).
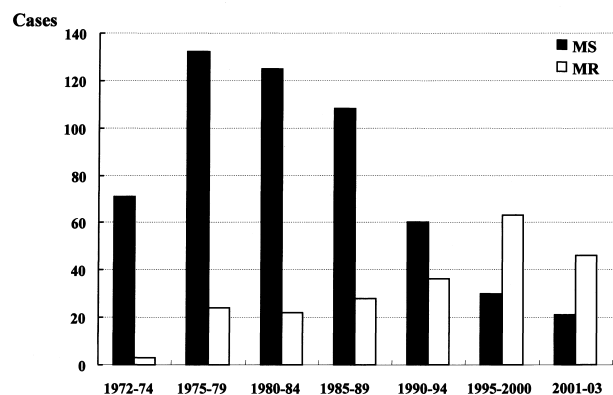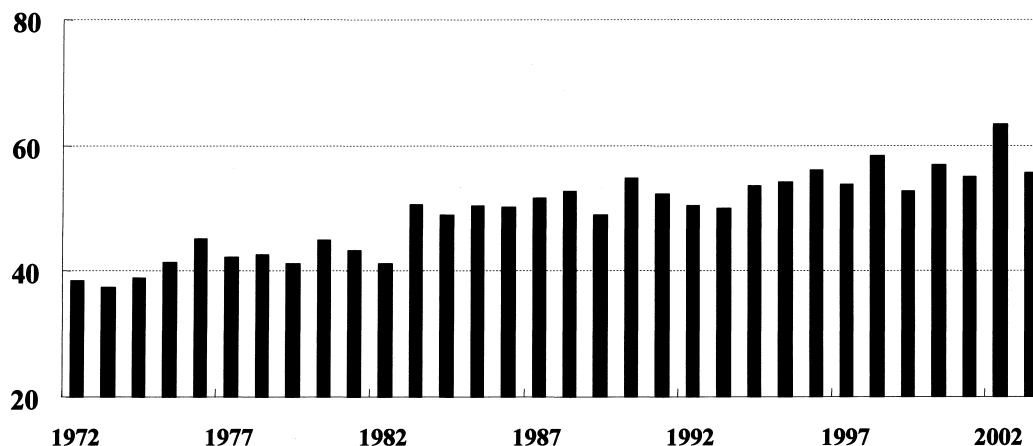
2. Changes in surgical procedures

1) MS

In the 1970s and 1980s the main surgical procedure for MS was either CMC, with a conservative operation for mitral valve disease, or OMC. CMC was performed for the last time in 1976. OMC was done for only 13 cases of isolated mitral valve disease in the 1990s. OMC is now sometimes done when aortic valve replacement is complicated by minor MS.

CMC

The mean age of 41 patients (13 men and 28 women) operated on before 1976 was 34.3 years (age range, 19 to 51 years) at the time of surgery.   Almost all patients had rheumatic febrile MS. Without the use of an artificial heart-lung machine, thoracotomy through the fourth intercostal space was done transatrially in 23 cases and transventricularly in 6 cases (no data are available for other early cases).   Digital dissection and Sakakibara's cutter were used for transatrial procedures, whereas Tubbs' cardiovalvulotome was used in a transventricular procedure to blindly perform commissurotomy[1].

OMC

In the 1980s, the mitral valve was usually reached with an atrial transspetal approach via median sternotomy with the use of an artificial heart-lung

Fig. 1.   Number of cases of mitral valve disease

Fig. 2.   Patients' mean age at surgery

machine and extracorporeal circulation, whereas the mitral valve was usually reached by way of the right-side left atrium after 1990[2].　The commissure and the subvalvular tissue were then resected with an open procedure, and the unknitting was done.　Before 1994, OMC was performed for 296 patients (78 men and 218 women) with an average age at surgery of 46.3 years (age range, 24 to 72 years).　Of these patients, 15 (5.1%) underwent a second operation because of restenosis after OMC or CMC.

MVR

The mitral valve was reached by way of the right- side left atrium via a median sternotomy with a heart-lung machine and extracorporeal circulation. However, when tricuspid valve surgery was also performed, the mitral valve was reached with an atrial transspetal approach.　The most commonly used type of mechanical valve was the Carbomedics valve (84 cases), followed by the Björk-Shiley valve (41 cases), the Duromedics valve (23 cases), the St. Jude Medical valve (12 cases), the SAM (Sakakibara-Arai-Mera) valve (7 cases), and the SorinBicarbon valve (3 cases).　Tissue valves were introduced in 1975, when the Hancock valves were used.　Subsequently, the Inosecu-Shiley (3 cases) and the Carpentier-Edwards valve (9 cases) were used (Fig. 3). Tissue valves are the primary choice for patients 70

years or older.

2)　MR

MVP has been aggressively performed with the total circumferential purse-string technique and chordoplasty[3], particularly for patients with rheumatic fever complicated by MS.　This procedure was developed by Arai of our department.　In the 1980s, artificial valve replacement was done for 86% of cases of MR.　In the 1990s, the incidence of MR caused by degenerative lesions increased and MVP conforming to the "French correction" introduced by Carpentier[4] became the procedure of first choice.　Thus, the incidence of MVP has continued to increase such that MVP now accounts 90% of MR cases.

MVR

This procedure is the same as MVR for MS. The method of valve insertion has changed slightly, however.　Previously both the anterior and posterior leaflets were excised, but more recently the posterior leaflet is left intact.　In the case of ischemic regurgitation, both leaflets are left to preserve left ventricular function.　The Carbomedics valve was the most commonly used mechanical valve for MS (28 cases), followed by the Duromedics valve (23 cases), the Bjork-Shiley (11 cases), the SAM valve (5 cases), and the St. Jude Medical valve (2 cases).　Tissue valves used were the Inoescu-Shiley valve (14 cases) and the Carpentier-Edwards valve (2 cases ; Fig. 3).

MVP

In 1991, the number of patients undergoing MVP began to exceed the number of patients undergoing MVR, but the increase in MR cases with degenerative lesions was conspicuous (Table 1).　There were many cases of posterior leaflet prolapse.　The most frequent area of prolapse was P3 and the least frequent was P1, according to Carpentier's classification (Fig. 4).　The surgical procedures included quadrangular resection of the prolapsed area, annuloplasty of the
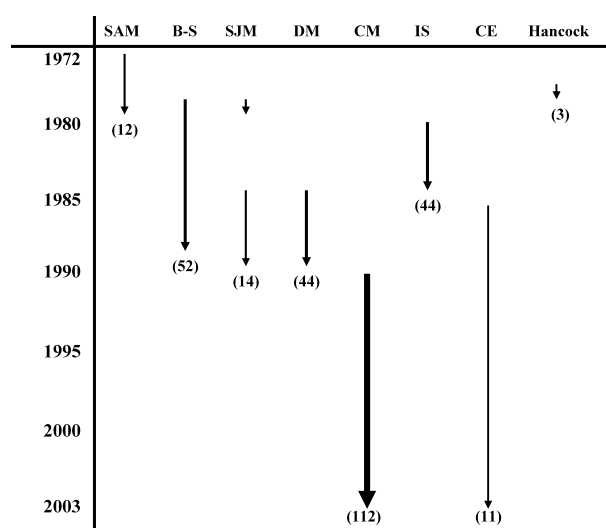
B-S: Björk-Shiley,　SJM: St. Jude Medical,　DM: DuroMedics,　CM: Carbo Medics
IS: Ionescue-Shiley ,　CE: Carpentier-Edwards

Fig. 3.　Types of prostheses used in MVR

Table 1.　Etiology of MR

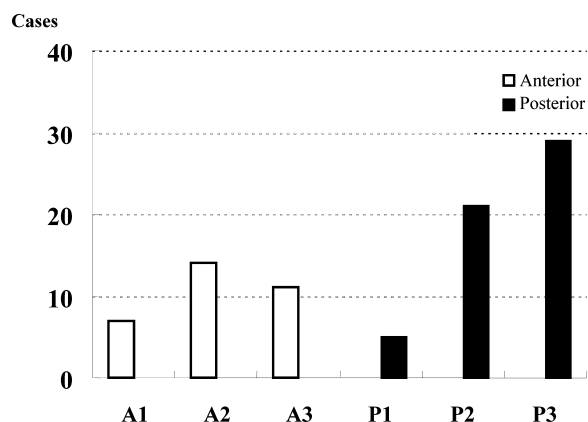|	
Degenerative valvular disease	117 (84.8%)
Infectious endocarditis	10 (7.2%)
Ischemic valvular disease	8 (5.8%)
Rheumatic valvular disease	2 (1.4%)
Traumatic valvular disease	1 (0.7%)

Cases

Fig. 4. Location of prolapsing lesions

Table 2. Surgical procedures of MVP

Procedures	No. (%)
Posterior leaflet resection	59 (43.0)
Anterior leaflet resection	32 (23.0)
Anterior and posterior leaflet resection	18 (13.0)
Chordae shortening (WSCP)	29 (21.0)
Chordae transfer	4 (3.0)
Chordae replacement with PTFE	6 (4.3)
Cleft closure	4 (3.0)
Imbrication suture	2 (1.5)
Valve debridement	2 (1.5)
Compression suture	6 (4.3)

WSCP: wrapping and shortening chordoplasty
PTFE: polytetrafluoroethylene

annular portion for cases of posterior leaflet prolapse[5] or anterior leaflet prolapse, triangular resection of the prolapsed area, and the Kay-Reed method[6,7] for the commissure with reconstruction with artificial chorda (Table 2). We aggressively performed triangular resection, which is rarely performed elsewhere, and Kurosawa of our department developed chordae wrapping and shortening chordoplasty.

3. Reoperation

Of 204 cases of MS for which MVR was performed, 87 (43%) were reoperated cases. The most common reason for reoperation was restenosis after OMC or CMC, followed by primary failure of a tissue valve, leakage around a mechanical valve and malfunction of a mechanical valve due to thrombosis, and

Table 3. Causes of reoperation

Restenosis after OMC or CMC	47 (54.7%)
PTF	26 (30.2%)
Mechanical valve malfunction	8 (9.3%)
Restenosis after MVP	4 (4.7%)
AVSD	1 (4.7%)

PTF: primary tissue failure
AVSD: atrioventricular septal defect

Table 4. Reoperation after MVP

Patient	Age	Sex	Interval	Initial procedure
1	29	F	16 months	Triangular resection (A2) Ring annuloplasty, Kay commissuroplasty
2	25	F	2 weeks	Quadrangular resection (P1) Artificial chorda Ring annuloplasty
3	19	F	8 months	Triangular resection (A2) Ring annuloplasty
4	59	M	4 months	Quadrangular resection (P2) Ring annuloplasty

stenosis after MVP (Table 3).

Our department has often used the Ionescu-Shiley tissue valve; an early study by Kozukue et al.[8] showed favorable postoperative hemodynamics. However, as shown by a study by Sakamoto et al.[9], early tears often develop at the site of leaflet detachment and lead to dysfunction 2 or 3 years after surgery; the valve must then be replaced. Four mechanical valves were also replaced and one of them was conducted 22 years after replacement of the Kay-Shiley valve because of repeated thrombosis[10].

Of 141 patients undergoing MVP for MR, 9 underwent reoperation. Of these 9 patients, 4 cases underwent MVP for MR because of degenerative lesions after 1991 (Table 4). Some patients underwent reoperation for MR after surgery to treat an atrioventricular septal defect. Artificial valves were replaced in all these patients.

Dɪsᴄᴜssɪᴏɴ

Surgical procedures for treating mitral valve disease, specifically, MS, were first suggested by

Brunton[11] in 1902 and applied clinically by Cutler et al.[12] in 1923. In the early twentieth century, attempts were made to treat mitral valve disease endoscopically. The first attempt to surgically treat mitral valve disease in Japan was the digital commissurotomy performed by Professor Sen Sakakibara of Tokyo Women's Medical University in 1952. Subsequently, our department was established by Professor Arai, who was an associate of Professor Sakakibara. Our department performed CMC for 44 patients, including those referred to us from the First Department of Surgery. These patients' mean age of 34 years reflects the many cases of MS due to rheumatic fever. With the spread of OMC performed with an artificial heart-lung machine since 1957[13], our department performed CMC for the last time in 1976. In the 1980s, OMC was done for 65% of cases of MS. In patients with mitral valve disease with MS or in patients being treated for the first time, a conservative operation was thought more favorable for left ventricle function; therefore, OMC was considered the procedure of first choice[14,15].

In our department the severity of MS is classified, on the basis of the nature of the valve during the operation, as Type I to Type III, according to the scheme of Miyazawa et al.[16]. Cases of Type I and Type II MS were to be treated with OMC to improve left ventricular function, and cases of Type III MS, according to Sellors' classification[17] by Hashimoto et al.[15], were to be treated with MVR. The severity of subvalvular stenosis and the degree of shortening of tendinous cords on preoperative ultrasonography of MS were classified as Types I to IV. Type I cases were those in which the tendinous cords were slightly shortened and almost identical with the normal subvalvular apparatus. Type II cases were those with an intermediate degree of hypertrophy and a more or less normal distance between the mitral leaflet and the papillary muscles. Type III cases of those in which the hypertrophy, shortening, and fusion of the tendinous cords were significant and a tendinous cord-like tissue remained but did not reach the fused, thickened subvalvular apparatus. Type IV cases were those in which the mitral leaflet and the subvalve form a lump that appears as fused mass of thickened tissue. OMC was performed for Types I to III, and MVR was found suitable for Type IV cases, which are the most severe[16]. The classification of Miyazawa et al. was simple but useful for surgical decision-making. Moreover, this concept was confirmed by Hashimoto et al. who analyzed postoperative left ventricular wall motion[15].

Although our basic policy has not changed, assessment and diagnosis with cardiac ultrasonography have advanced and have provided important indicators for surgical procedures such as the mitral valve area (≤ 1.5 cm²). We also determine the surgical indication by referring to the Guidelines for Surgical and Interventional Treatment of Valvular Heart Disease (JCS 2002)[18]. For OMC, Types I and II in Sellors' classification[17] were seldom observed, and the indication was limited to minor MS in the replacement of the aortic valve. Instead of becoming obsolete, however, OMC is considered the standard treatment for rheumatic valvular disease[19].

With the incidence of rheumatic valvular disease decreasing, fewer valve replacements are being performed. Most such procedures are done to treat restenosis after OMC or CMC and prosthetic malfunction. As an initial procedure, valve replacement is often performed owing to infectious endocarditis.

An open procedure to treat MR was first performed by Lellihei et al. with an artificial heart-lung machine in 1957[20]. Burr et al.[21] reported in 1976 that 36 of 67 cases of mitral valve disease were rheumatic and 5 were degenerative. These data suggest a source of problems, as commissurotomy and then annuloplasty were performed even for cases in which MS was more severe than MR (MSr) or cases in which MR was more severe than MS (MsR). Since 1975, our department (Arai[3]) has aggressively conducted valvuloplasty in which tendoplasty is combined with the total circumferential purse-string technique. Of 303 mitral valve surgeries performed from 1972 through 1981 and reported by Kume et al.[22], 24 cases (8.5%) were MVPs. The concept of annuloplasty has recently been superceded by insertion of annular rings. In the series reported by Burr et al.[21], OMC was also done for about half of cases. However, this does not suggest that OMC was done only for MS. MVP,
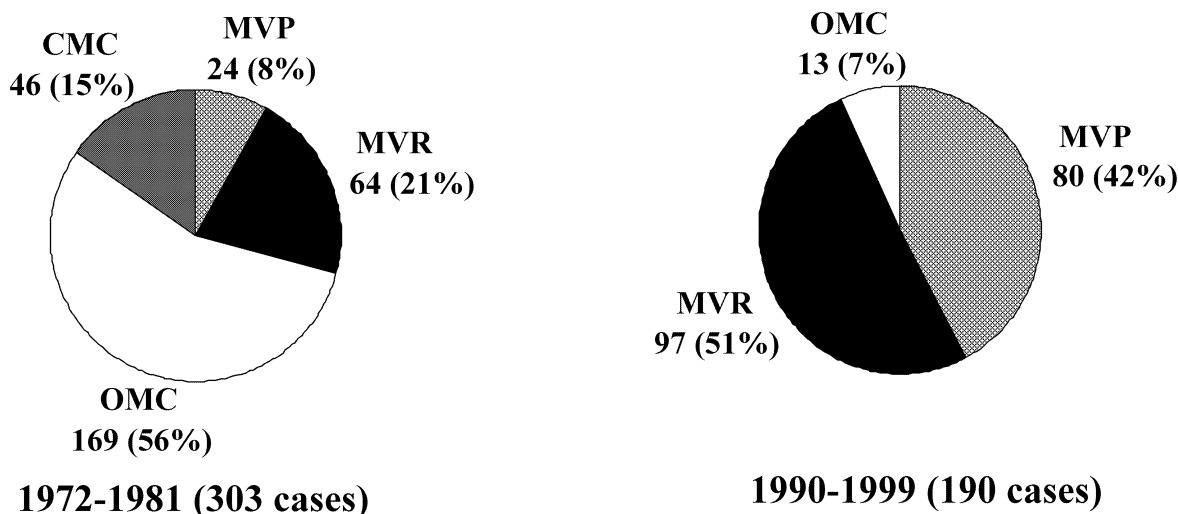
Fig. 5. Change in surgical procedures for mitral valve diseases

which was performed less often in the 1980s but more often in the 1990s, was done in 80 (40%) of 190 cases for which mitral valve surgery was performed (Fig. 5). Of 141 cases treated with MVP from 1991 through 2003, degenerative lesions were present in 85%. Rheumatic valvular disease was only the fourth most common cause of MR in our series (1.4% of cases, Table 1) following degenerative valvular disease, infectious endocarditis, and ischemic valvular disease. Our surgical results for MVP were satisfactory[23].

Among surgeries for mitral valve disease, the percentage of rheumatic valvular disease is expected to decrease further whereas the percentage of degenerative and ischemic mitral valve regurgitation are expected to increase. Half of patients with MS undergo reoperation, but because cardiac failure and cachexia develop in some patients who refuse reoperation, careful follow-up is important so that the need for reoperation is not overlooked.

There are some patients referred from departments of internal medicine in an early, asymptomatic MR because a cardiac murmur or arrhythmia has been detected. In cases of asymptomatic MR, a left ventricular ejection fraction of less than 60% and a left ventricular end systolic diameter of more than 45 mm are considered indications of surgery according to the Guidelines for Surgical and Interventional Treatment of Valvular Heart Disease (JCS 2002)[18]. Theoretically, MVP is easier at an early stage with-

out excessive deformation of the leaflet. Also, the postoperative prognosis is considered more favorable because cardiac function has not decreased greatly. Further study of the timing of surgery is needed as the number of relevant cases increases.

In ischemic MR, much controversy surrounds surgical procedures and the surgical results of severe cases cannot be considered satisfactory. Our department performs off-pump coronary bypass surgery followed by MVP with an artificial heart-lung machine when cardiac ultrasonography has revealed more than the intermediate degree of regurgitation so that the duration of artificial heart-lung machine use and ischemic may be shortened as much as possible.

Conclusions

Among surgeries for mitral valve disease, MVP is the most frequently performed procedure, although CMC was once the most common procedure. As the age of patients undergoing surgery increases, the number of cases of rheumatic valvular disease decreases, and the number of cases of degenerative and ischemic MR increases, there is the need to provide more appropriate treatment by following up pathogenic changes.

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