

Long-Term Results of Open Mitral Commissurotomy : Effects of Pathologic Features and Surgical Techniques

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Of the 174 patients with mitral stenosis (MS) who underwent open mitral commissurotomy (OMC) at Nagasaki University Hospital between 1971 and 1988, the cases of the 50 pure MS patients who underwent OMC alone as the first operation were retrospectively investigated, and the indications for OMC in these MS patients were evaluated. According to the pathological features of the mitral valve (Types I-III) and operative methods used (r: radical OMC, c: conservative OMC), the patients were classified into 4 groups, groups I, IIr, IIc, and III, and we compared the changes in the mitral valve area before and after the operation and the cardiac functions and clinical status in the late postoperative period in these groups. In all groups, the mitral valve area was significantly increased in the early postoperative period, then gradually decreased, but on average it remained larger in the late postoperative period than before the operation. However, significantly larger mitral valve areas were maintained in the late postoperative period than those before the operation only in groups I and IIr. Group IIr showed the highest % increase of the valve areas in the late postoperative period. Furthermore, group IIr maintained the best NYHA cardiac function classes and the highest percentage of normal sinus rhythm on electrocardiograms in the same period. These results suggested that OMC was effective in the Types I and II MS patients, and the complete removal of subvalvular fusions with debridement of calcified foci was considered to be particularly effective for Type II patients to maintain the favorable operative effects and high quality of life for a long period.

Key Words : Open mitral commissurotomy, Mitral stenosis,
Mitral restenosis, Mitral valve

Introduction

Open mitral commissurotomy (OMC) was widely used as a common surgical procedure for mitral stenosis (MS) until the first half of the 1980s¹⁾. The number of patients newly contracting MS has markedly decreased because the medical treatment of rheumatic fever (which causes MS) has improved. However, patients who have had MS for long periods have severe valvular lesions such as calcification of the leaflet, and the number of fused and deformed

chordae and papillary muscles increases ; OMC is often not appropriate as a treatment for these conditions. However, the marked improvement of valve prostheses and surgical techniques has made mitral valve replacement (MVR) safe, and MVR has become widely used for the treatment MS instead of OMC.

However, it is the duty of cardiac surgeons to continue the follow-up observations and treatment of patients who have undergone OMC. There have been a number of studies of the prognosis of OMC patients over long periods²⁻⁷⁾, but the mechanism of restenosis, which is one of the complications in the late period after OMC, is unknown and its risk factors have not been identified. Only a few detailed studies have shown a relationship between the pathological features of MS and operative methods and the incidence of restenosis⁸⁾. In the present study, we examined changes in the mitral valve area (MVA), cardiac functions and conditions in patients who had undergone OMC, taking into account the mitral pathological features and operative methods used.

Subjects and Methods

Between 1971 and 1988, open heart operations under cardiopulmonary bypass were performed in 1,051 patients at Nagasaki University Hospital. Of these patients, 229 had MS ; OMC was performed in 174 of these patients and MVR was performed in the other 55 patients. Of the patients who underwent OMC, those who simultaneously underwent an operation of other valves for combined valvular diseases or other operations such as coronary artery bypass grafting were excluded, leaving 150 patients who underwent OMC alone. Of the 150 patients, 4 patients died in the perioperative period (mortality rate, 2.7%). By 1995, when we performed this survey, 3 patients had died, and 20 patients had undergone reoperation (MVR in most of these patients). These 23 patients were excluded from the analyses. Of the remaining patients who underwent OMC as the first cardiac operation, we studied 50 who were diagnosed as having pure MS by preoperative cardiac

catheterization, echocardiography, and observation during the operation, and for whom echocardiographic records before and immediately after the operation and in the late postoperative period were available.

According to the pathologic features of the mitral valvular structures observed during the operation, the 50 patients were first classified into 3 types: Type I (pliant, mobile cusps with few subvalvular changes), Type II (thickened cusps with moderate subvalvular changes), and Type III (a rigid funnel-shaped valve due to fused cusps, chordae and papillary muscles). The Type II patients were then subdivided into 2 groups according to the operative methods used; the letter "r" denotes radical OMC (OMC with an extensive division of fused chordae and papillary muscles), and the letter "c" denotes conservative OMC (OMC with minimal or no subvalvular incision). Therefore, the patients were finally classified into 4 groups; I, IIr, IIc, and III. The operative method used for most of the patients in group I was conservative OMC, and all patients in group III were treated by radical OMC.

The records of these patients during hospitalization and as outpatients were reviewed and analyzed for the patients' physical conditions, NYHA cardiac functional classes, electrocardiographic and echocardiographic data, and data from cardiac catheterization before and after the operation. The follow-up study of most patients in the late postoperative period who could come to our hospital was performed by questioning, physical examinations, and electrocardiographic and echocardiographic examinations. In some of the patients who could not come to our hospital, after receiving informed consent from the patients, copies of the hospital records obtained from their local doctors were carefully examined for the above-mentioned information. All data are expressed as the mean \pm standard deviation. Statistical analysis was performed with the unpaired Student's *t* test and Chi square test, and values of $P < 0.05$ were regarded as significant.

Results

Preoperative clinical status and follow-up period

Table 1 shows the number of patients, preoperative clinical status, follow-up period, and presence or absence of significant differences among the groups. In the group showing more severe lesions (group I < group II < group III), the age at operation was higher, the MVA was smaller, and the mean PAW pressure was slightly higher. However, there were no significant differences in the incidence of atrial fibrillation observed by electrocardiography and NYHA cardiac functional classes among the groups. The mean follow-up period was 14.4 ± 5.0 years, and the follow-up periods of all patients were longer than 6 years. Since radical OMC has only recently been adopted for the treatment of Type III mitral valvular lesions, the mean follow-up period of group III was significantly shorter than those of groups I and IIc ($P < 0.05$).

Changes in MVA before and after operation

In all groups, the MVA measured by echocardiography was significantly increased in the early postoperative period compared with that before the operation ($P < 0.001$), and was decreased during the follow-up period. The reduction of MVA in the late postoperative period was smallest in group IIr (where it was not significant), while the other 3 groups showed significant decreases in MVA compared to that in the early postoperative period ($P < 0.05$). The MVA in the late postoperative period was still significantly larger than that before the operation in all groups except group III (Table 2). Group III showed the highest increase in MVA during the early postoperative period because of the small MVA before the operation, and in the late postoperative period group IIr showed the highest increase (Fig. 1). There were no differences between the MVA measured by echocardiography before the

Table 1. Preoperative clinical status, cardiac rhythm, catheterization data and postoperative follow-up period.

Group	I	IIr	IIc	III	Total
Number of patients	12	14	18	6	50
Age	$36.3 \pm 11.6^{*1}$	46.3 ± 9.4	42.9 ± 7.4	49.8 ± 8.9	43.1 ± 10.0
male/female	5/7	3/11	6/12	3/3	17/33
NSR	5 (42%)	1 (7%)	7 (39%)	1 (17%)	13 (27%)
AF	7 (58%)	13 (93%)	11 (61%)	5 (83%)	37 (73%)
NYHA Class	2.92 ± 0.67	3.00 ± 0.78	2.72 ± 0.75	3.00 ± 0.89	2.88 ± 0.75
MVA (cm ²)	1.27 ± 0.37	1.11 ± 0.23	1.05 ± 0.29	$0.83 \pm 0.27^{*2}$	1.09 ± 0.31
PAWm (mmHg)	18.0 ± 4.2	20.4 ± 4.7	19.8 ± 4.4	$27.2 \pm 8.0^{*3}$	20.4 ± 5.5
follow up (yrs)	15.5 ± 4.6	11.7 ± 4.7	16.8 ± 4.8	$11.2 \pm 2.8^{*4}$	14.4 ± 5.0

Values = mean \pm standard deviation; NSR, number of patients with normal sinus rhythm; AF, number of patients with atrial fibrillation; NYHA, functional classification according to the criteria of the New York Heart Association; MVA, mitral valve area measured by echocardiography; PAWm, mean pulmonary arterial wedge pressure; *1 $p < 0.05$ vs. group IIr and III, *2 $p < 0.05$ vs. group I, *3 $p < 0.05$ vs. group I, IIr and IIc, *4 $p < 0.05$ vs. group I and IIc (unpaired Student's *t* test).

Table 2. Pre- and postoperative mitral valve area (cm²): Difference between echocardiographic and intraoperative measurement.

Group	I	II r	II c	III
Echocardiographic Measurement				
(a) preoperative	1.27±0.37	1.11±0.23	1.05±0.29	0.83±0.27
(b) early postop.	2.41±0.26* ¹	2.45±0.20* ¹	2.15±0.25* ¹	2.05±0.22* ¹
(c) late postop.	1.63±0.22* ³	2.04±0.28* ²	0.56±0.26* ³	1.37±0.21
Intraoperative Measurement				
(d) pre OMC	1.32±0.40	1.13±0.26	0.14±0.33	0.93±0.25
(e) post OMC	2.95±0.10* ⁴	2.85±0.20* ⁴	2.80±0.27* ⁴	2.68±2.05* ⁴
E/O ratio				
(f) preop.(a/d)	0.96±0.06	0.99±0.07	1.03±0.10	0.89±0.11
(g) early postop. (b/e)	0.82±0.09* ⁵	0.86±0.08* ⁵	0.77±0.07* ⁵	0.77±0.12

Values = mean±standard deviation ;

E/O ratio, the ratio of mitral valve area between echocardiographic and intraoperative measurements.

*¹ and *² p<0.01 vs. value a ; *³ p<0.05 vs. value a ; *⁴ p<0.01 vs. value d ; *⁵ p<0.05 vs. value f.

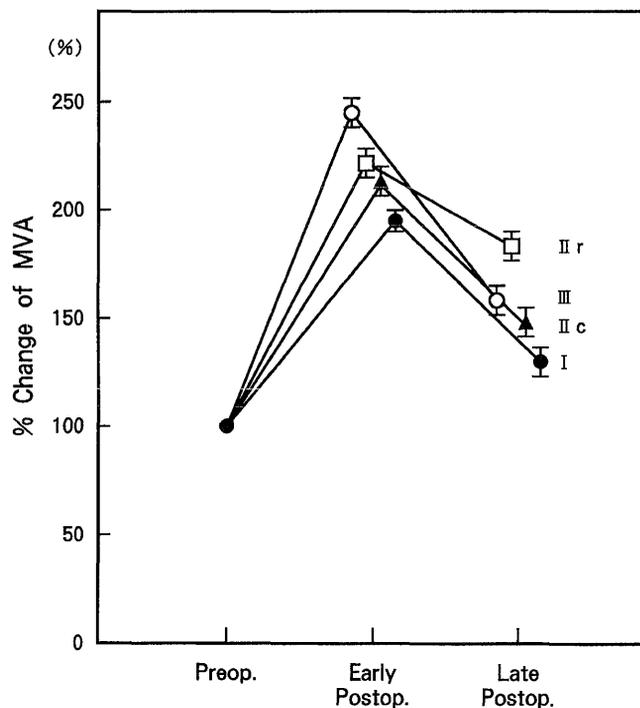


Fig. 1. Percent change of mitral valve area following open mitral commissurotomy.

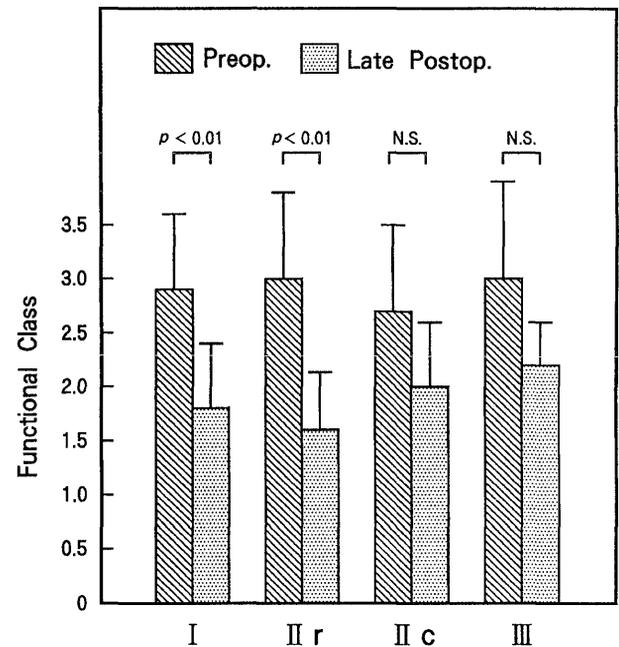


Fig. 2. Comparison of NYHA class between preoperative and late postoperative period

operation and that directly measured before the OMC in all groups, and the MVA measured by echocardiography in the early postoperative period was smaller than that directly measured after the OMC in all of the groups. This difference was larger in the more severe lesions, and smaller in group IIr (in the which radical removal of subvalvular stenosis lesions was performed) than in group IIc. The difference was in the order of group III > group IIc > group IIr > group I (Table 2).

Clinical status in the preoperative and late postoperative periods

Figure 2 shows the NYHA classes in the preoperative and late postoperative periods. In all groups, the NYHA class was better in the late postoperative period than in the preoperative period, but significant improvement was maintained up to the late postoperative period in groups I and IIr alone. To examine the relationship between MVA

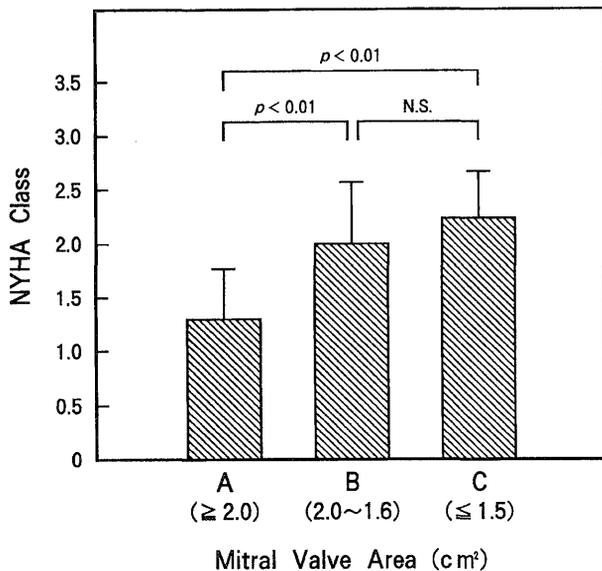


Fig. 3. NYHA functional class in the late postoperative period: Relation to decrease of MVA

measured by echocardiography in the late post-operative period and the clinical status, the patients were classified into 3 groups according to the MVA size; group A: 2.0 cm² or larger (20 patients), group B: 1.6-2.0 cm² (20 patients), and group C: 1.5 cm² or smaller (10 patients). The NYHA class was significantly better in group A than in the other 2 groups (Fig. 3).

The percentage of patients with normal sinus rhythm (NSR) as determined by electrocardiography increased from 7% before the operation to 21% in the late postoperative period in group IIr, while the remaining 3 groups showed a decrease. The mean percentage of the 4 groups decreased from 28% before the operation to 18% in the late postoperative period, but the differences before and after the operation were not significant in any of the groups (Fig. 4).

Discussion

As the criteria of MS lesion levels, the 3-type classification reported by Sellors et al⁹. in 1953 has been most widely used. Initially, this classification was based on findings by palpation of cusps from the left atrium during closed mitral commissurotomy. However, since detailed observation of the valve including the subvalvular regions has become possible with the introduction of OMC, the more accurate classification based on the pathologic features of the entire valve including the subvalvular regions is now generally used^{9,10}.

The advantages of OMC as a surgical procedure for MS are; (1) less invasion and lower risks than MVR, (2)

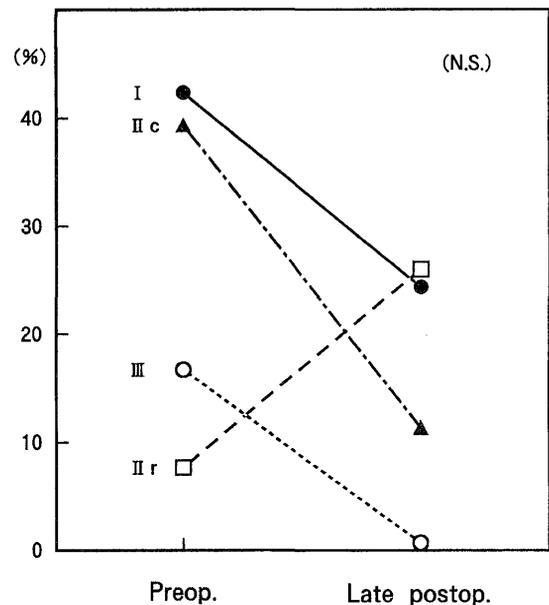


Fig. 4. Percentage of normal sinus rhythm in pre- and postoperative periods. Narimatsu

cardiac functions are well maintained by the conservation of the patient's own valve structure, and (3) postoperative high quality of life (QOL) can be expected because less medication including anticoagulant drugs is usually necessary. However, the results obtained with MVR are remarkably improved to the same level as those with OMC, and the low risk of OMC as a major reason for selecting this procedure is becoming less important. If the relief of stenosis obtained by OMC is insufficient, cardiac symptoms remain and reoperation is required when restenosis progresses in the late postoperative period¹¹. In selecting an operative method, therefore, the long-term QOL of the patients should be considered more important than the operative mortality rate alone. It is thus useful to examine whether MS lesions can be completely relieved by OMC and whether the operative effects are maintained for extended periods.

Formerly, OMC was performed only for MS patients who had no significant regurgitation, mild degree of rigidity or calcification of the leaflet, and had only a mild degree of subvalvular lesions (Types I and II). Since the complete relief of stenotic lesions by extensive division of fused chordae and papillary muscles has become attainable, the MVA of most Type III patients can be increased to more than 3 cm². Therefore, it has been proposed that Type III patients should also be treated by OMC¹²⁻¹⁴. However, Oyama¹⁰ compared the MVA directly measured during the operation with the functional MVA determined by cardiac catheterization in 19 patients with MS who underwent radical OMC of subvalvular stenosis lesions, and showed that the MVA directly measured after extension by OMC was about 4 cm² in all patients, but the

functional MVA measured after the operation was significantly smaller than the MVA directly measured during the operation in these patients. Furthermore, in the group showing more severe lesions, the difference between the directly measured MVA and the functional MVA was higher. Kozawa et al¹⁵⁾ also compared the MVA measured directly during the operation with the functional MVA measured by cardiac catheterization and two-dimensional echocardiography, and showed that the functional MVA measured before the operation corresponded to the MVA measured directly during the operation before extension by OMC, but the functional MVA measured after the operation was smaller than the MVA measured directly during the operation after extension by OMC. These results agreed with those of our survey. In some of the patients who underwent reoperation with the diagnosis of restenosis by echocardiography and cardiac catheterization, we often found that the directly measured MVA at the time of reoperation was significantly larger than the preoperative functional MVA. These observations suggested that in patients with high rigidity and calcification of the mitral valve, even if stenotic lesions in the leaflet and subvalvular regions are sufficiently removed by extensive OMC, the mitral valve does not fully open under the condition of spontaneous beating after the operation. The restriction of the valve movement results in a decrease in the postoperative functional MVA and sustained cardiac symptoms, and causes restenosis in the late postoperative period.

In this survey, group IIr maintained the best conditions in the late postoperative period. This group showed a significantly larger MVA even in the late postoperative period compared with that before the operation, the highest % change of MVA in the 4 groups, an increase in the percentage of patients with NSR after OMC (which was not observed in the remaining groups), and significant improvement of the NYHA class. These results suggested that OMC is effective for the treatment of Types I and II MS, and the aggressive removal of subvalvular lesions was considered to be particularly effective for Type II patients to maintain good cardiac functions and high QOL for long periods. In the Type III patients with high rigidity of the mitral valve, the increase in the functional MVA and

improvement of clinical symptoms are limited even if stenotic lesions are completely removed. Therefore, MVR should be applied to all Type III patients.

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