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Late Results of Open Mitral Commissurotomy —Factors Influencing Long-term Functional Rehabilitation—

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Summary

Multiple variables influencing long-term functional rehabilitation after open mitral commissurotomy were examined in 60 patients who survived for at least one year after surgery and were followed for one to 17 years. The preoperative duration of symptoms, presence of atrial fibrillation or coexisting valvular disease and cardiac size shows a significant positive correlation with the results of open mitral commissurotomy. The pathology of the mitral valve is an additional, and more important, contributor to the prognosis. The results of valvotomy in cases with subvalvular lesions were poor. The division of fused chordae or papillary muscles yield benefits, but late deterioration occurred in some cases.

In order to improve functional result, early operation, prior to the development of atrial fibrillation or secondary tricuspid regurgitation, is recommended. Valve replacement in cases with significant damage to the mitral valve apparatus should be considered more actively than before, the risks of this procedure have decreased in recent years.

Introduction

The results of surgical treatment of heart disease become apparent only with long-term observation of patients. Open mitral commissurotomy (OMC), which is the treatment of choice for mitral stenosis, has certainly saved or prolonged the lives of many disabled patients. However, it is not adequately clear whether another goal of surgery has been achieved; i.e., enabling a patient with significant mitral stenosis to lead an active and useful life with no symptoms.

Key words: Open mitral commissurotomy, Subvalvular mitral stenosis, Valvotomy vs valve replacement, Radiocardiography.

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Table I. Cases of mitral commissurotomy between 1962 and 1978. Three late deaths were due to cerebral hemorrhage (one), reoperation because of restenosis (one) and unknown cause (one).

Procedure	No. of cases	Early death	Late death	Lost to follow-up	Survivor followed
OMC	64	3	2	7	52
OMC+TAP	10	1	0	1	8
OMC+AC	3	0	1	2	0
Total	77	4 (5%)	3 (4%)	10	60

OMC: Open mitral commissurotomy, TAP: Tricuspid annuloplasty, AC: Aortic commissurotomy

This report focuses on patients who have survived for at least one year after OMC and tries to define the factors which prevent complete recovery (New York Heart Association, NYHA, Class I) following OMC.

Materials and method

Of the 77 patients who underwent OMC for mitral stenosis between 1962 and 1978, 60 survivors have been followed in clinic visits or by a mail survey for one to 17 years (mean 7.3 years). Fifty-two had OMC alone and eight had additional tricuspid annuloplasty (Table I). Patients treated with valve replacement at the time of OMC were excluded in this study. The ages of the patients varied from 22 to 52 years with a mean age of 36.6 years. There were 14 males and 46 females. The preoperative NYHA classification was 23 (38%) in Class II and 37 (62%) in Class III. Mitral valvotomy was performed without anoxic arrest in the earlier cases, but in recent years simple anoxic arrest (22 cases) or cardioplegic arrest (6 cases) has been used.

The pre- and postoperative hemodynamic status was followed by radiocardiography (RCG) which was analyzed by an analog simulation method.[8] Among the many variables obtained,

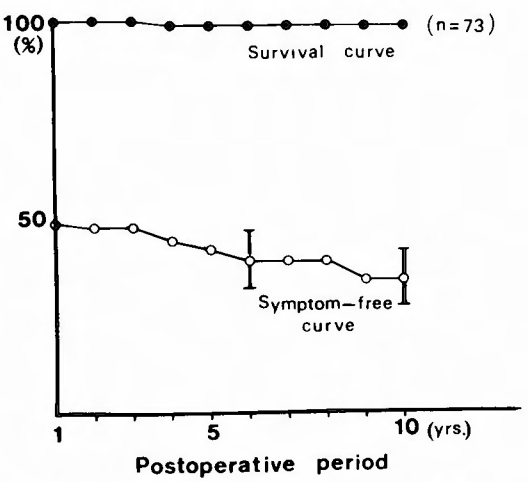

Fig. 1. Cummulative survival and symptom-free curves. Operative deaths were excluded in this figure.

Table II. Probable causes of late deterioration.

Cause of deterioration	No. of cases
Restenosis	7
Arrhythmia	2
Unknown	2

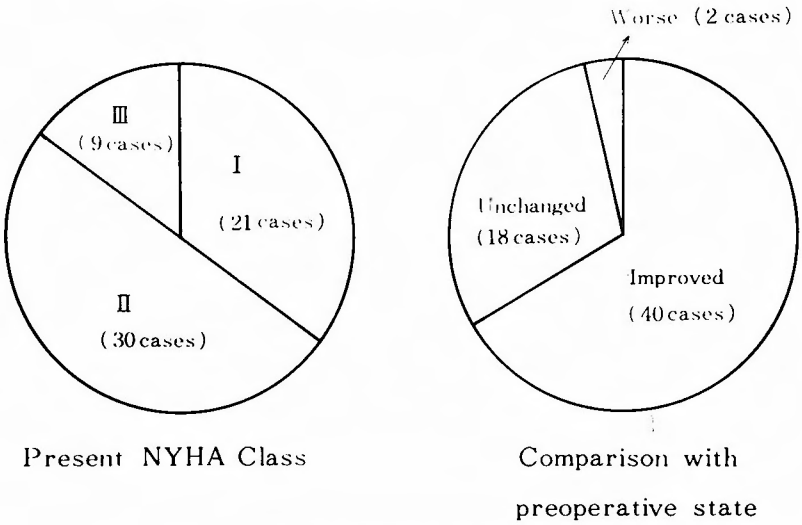

Fig. 2. Present functional Class and comparison with preoperative state.

Table III-a and b. Comparison of preoperative variables basesd on postoperative conditions. Significantly ($p<0.05$*, $p<0.01$)** different from values of NYHA Class I group.

a)

Present NYHA Class	No. of cases	Age (years)	Preop. NYHA Class	History of			Duration of symptom (years)	Preop. AF	Preop. CTR	Associated valvular disease
				CMC	Embolism	CHF				
I	21	35 ±9	2.5 ±0.5	0	6 (29%)	3 (14%)	6.3 ±4.2	6 (29%)	0.54 ±0.08	5 (24%)
II	30	38 ±8	2.6 ±0.5	1 (3%)	6 (20%)	6 (20%)	8.6 ±7.3	20** (67%)	0.58 ±0.08	18* (60%)
III	9	36 ±11	2.8 ±0.4	3 (30%)	1 (11%)	5 (24%)	11.6** ±4.2	6* (67%)	0.63* ±0.09	3 (33%)

CMC: Closed mitral commissurotomy, CHF: Congestive heart failure, CTR: Cardiothoracic ratio, AF: Atrial fibrillation,

b)

Present NYHA Class	Cardiac index (l/min/M²)	Pulmonary wedge pressure (mmHg)	Pulmonary artery (syst.) pressure (mmHg)	LVEDP (mmHg)	Mitral valve area (cm²)
I	2.8±0.7	18±5	50±24	7±2	1.2±0.5
II	2.7±0.6	18±5	43±16	9±4	1.2±0.3
III	2.5±0.7	18±4	54±23	7±3	1.1±0.6

mean±SD

LVEDP: Left ventricular end-diastolic pressure

cardiac index, right and left heart volumes (RHV and LHV), mean pulmonary circulation time (PCT) and RHV/LHV ratio, which are especially influenced by mitral stenosis[10], were examined in this study.

Results

Cummulative survival and symptom-free (NYHA Class I) curves are shown in figure 1. Although the long-term survival rate is satisfactory, the symptom-free rate is less than 50% even in the early postoperative period and is approximately 30% at 10 years. Symptomatic deterioration after a period of improvement was noted in 11 patients 4 to 16 years after surgery (Table II). Two of them required mitral valve replacement 11 years after OMC because of restenosis. At repeat operation, severe calcification of the leaflets, not present at the time of the first procedure, was seen in both cases. Nevertheless, approximately 70% of survivors still improved by at least one functional class, although half of them remained in Class II (figure 2).

Preoperative conditions were correlated with the postoperative functional status (Table III-a & b). Longer duration of symptoms, atrial fibrillation and cardiac enlargement were significant adverse factors denoting a poor prognosis. The cardiac index also appeared to affect the results, but not statistically significantly.

The operative findings were considered to correlate closely with the prognosis of OMC Calcification of the cusps, if not severe, did not appear to influence the results (Table IV-a). The production of slight mitral regurgitation by radical commissurotomy did not significantly affect the results, although the postoperative period was relatively short (less than two years)

Table IV-a, b and c. Operative findings and their effect on the results.

a) Calcification

Grade	No. of cases	Present NYHA Class		
		I	II	III
No	52	19 (37%)	26	7
Slight	5	2 (40%)	3	0
Moderate to Severe	3	0	1	2

b) Mitral regurgitation (MR)

Postop. MR	No. of cases	Present NYHA Class		
		I	II	III
+	12	5 (42%)	5	2
−	48	16 (33%)	25	7

c) Left atrium thrombus

Thrombus	Rhythm	No. of cases	Preop. embolism	Postop. embolism	Present NYHA Class		
					I	II	III
+	SR	0	0	0	2 (25%)	5	1
	AF	8	2	0			
−	SR	27	3	1	19 (37%)	25	8
	AF	25	8	1			

SR: Sinus rhythm, AF: Atrial fibrillation

Table V. Comparison of variables among four groups classified according to grade of subvalvular damage. Two cases only with severe calcification were excluded in this table.

Grade of subvalvular lesion	Procedure for subvalvular lesion	Group	No. of cases	Present NYHA Class I	II	III	Postop. period (years)	AF	Associated valvular lesion	No. of deteriorated cases
No or mild	None	A	14	14	0	0	6.8 ±4.7	4 (29%)	2 (14%)	0
		B	20	0	17	3	7.8 ±4.8	15** (75%)	11* (55%)	3 (15%)
Moderate to severe	Separation of chordae or papillary m.	C	16	7※ (44%)	8	1	5.2※ ±2.8	10 (63%)	7 (44%)	4 (25%)
	None	D	8	0	4	4	9.4 ±3.7	8 (100%)	3 (38%)	4 (50%)

*$p<0.02$, **$p<0.01$, when compared with group A.
※$p<0.05$, when compared with group D.

in all five patients with mitral regurgitation who remained in NYHA Class I (Table IV-b). A left atrial thrombus in eight patients with atrial fibrillation had no significant relation to the functional results or to pre- or postoperative embolism (Table IV-c).

Subvalvular lesions were arbitrarily divided into "no or mild" and "moderate to severe" grades. The former was easily treated with simple valvotomy, but in some the result was excellent (NYHA Class I—Group A) and in others less satisfactory (more than Class II—Group B). In the latter, stenosis was not easy to relieve. Some were treated by separation of fused chordae or incision of papillary muscles (Group C) and others were not (Group D). These four groups were compared (Table V). Group C, with division of chordae or papillary muscle, showed a better functional recovery to NYHA Class I in seven of 16 patients (44%) than did group D ($p<0.05$), although the follow-up period of the former (5.2 ± 2.8 years) was significantly shorter than that of the latter (9.4 ± 3.7 years) ($p<0.05$). In patients without significant subvalvular stenosis, the presence of atrial fibrillation and coexisting valvular lesions appeared to be significant factors influencing the results ($p<0.02$ and $p<0.01$, respectively). The hemodynamic state of each group followed by RCG (figure 3) revealed that the cardiac index in group A improved soon after surgery and remained normal thereafter. On the other hand, in groups B and C there was some improvement in the early postoperative period, then deterioration occurred more than five years after commissurotomy. Group D failed to show any improvement with surgery. Although improvement of heart volumes was less satisfactory even in group A, the values in groups A and B appeared to be better than in groups C and D. The changes of PCT, affected not only by pulmonary blood volume but also by the cardiac index, were reciprocal to those of the cardiac index.

Discussion

Although most patients with mitral stenosis obtained symptomatic relief after OMC, some patients did not improve or experienced recurrence of cardiac symptoms. Of the preoperative factors, longer duration of symptoms, atrial fibrillation, cardiac enlargement and coexisting

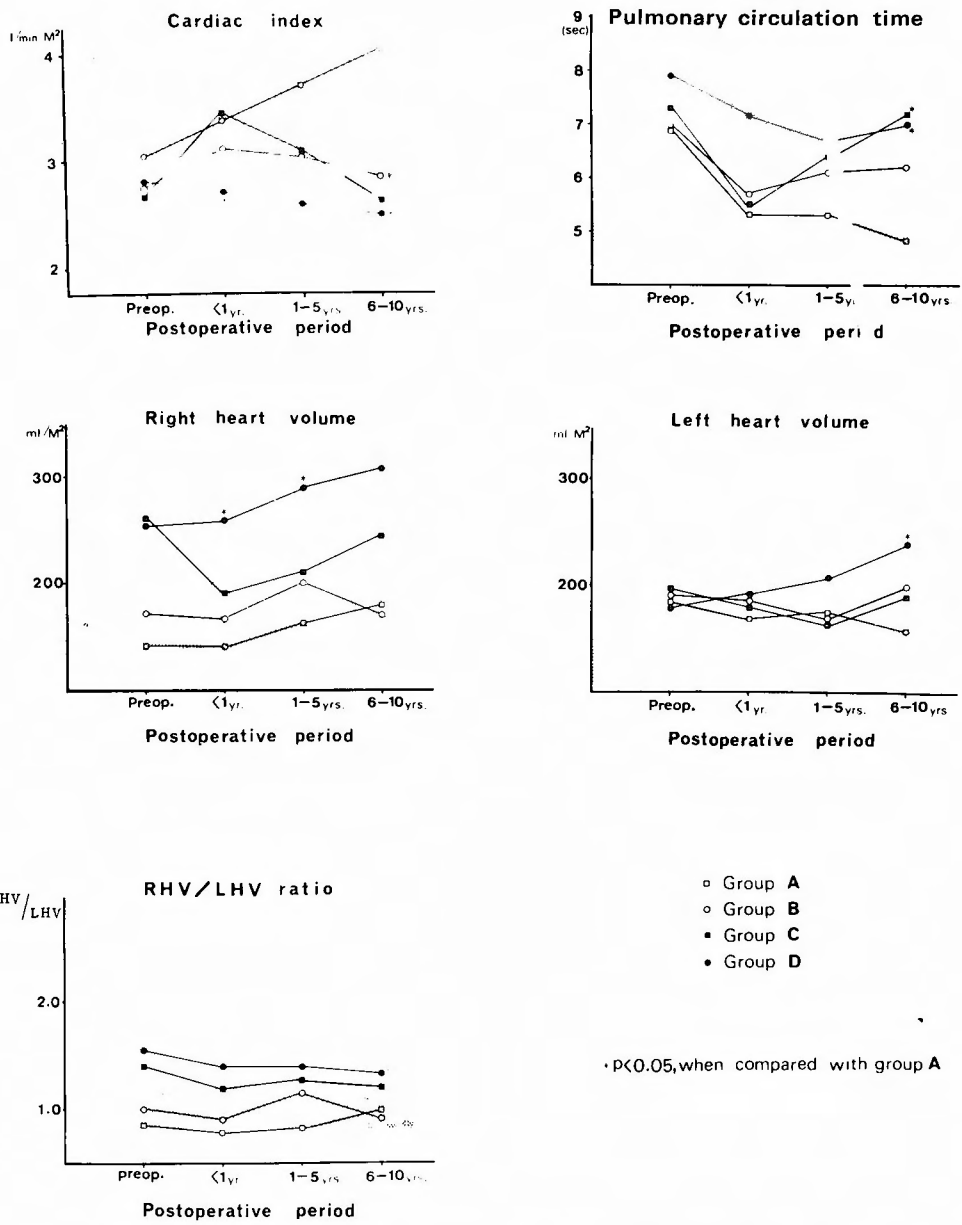

Fig. 3. Data obtained by radiocardiogram. Normal values are shown by black shadows.

valvular lesions affected the results adversely. We had previously reported that most of these factors were also significant in the prognosis of valve replacement[7]. Pathology of the mitral apparatus and myocardial dysfunction were considered to be other, and probably more important, factors influencing functional rehabilitation.

Progression of mitral stenosis and timing of surgery: Diseases with left ventricular overload, such as aortic valve disease or mitral regurgitation, are likely to lead to severe, perhaps irre-

versible, left ventricular dysfunction at any time. Therefore, early operation is advisable[2]. It is thought, however, that myocardial damage in mitral stenosis is essentially determined by severity of the initial rheumatic inflammation, and FOWLER et al.[3] state that there is no resaon to recommend surgery until the patient is progressively limited, because earlier operation yields no benefits in the preservation or restoration of myocardial function[6]. On the other hand, pathologic changes of the mitral apparatus, the degree of which could also be related to the severity of the initial inflammatory process, may show a later progression, especially affecting the anatomy of the cusps, as seen in our reoperated cases. This late progression is considered to be a nonspecific process resulting from trauma to the valves caused by turbulent blood flow, analogous to the mechanism of calcific aortic stenosis developing upon a bicuspid valve[13]. From this point of view, SPENCER[14], BONCHEK[1] and their associates argue for early operation. Furthermore, they have pointed out that delaying operation may lead to serious secondary complications, such as atrial fibrillation (55% in our series) and thromboembolism (22% in our series). The duration of symptoms, in our study, was significantly longer in the patients with poor results (NYHA Class III) than in those with excellent results (Class I) ($p<0.01$). This finding might be due in part to the development of atrial fibrillation because of significant differences of duration of symptoms between those with atrial fibrillation (9.9 ± 6.2 years) and those without it (6.3 ± 5.6 years) ($p<0.05$). However, the severity of subvalvular changes was not affected by the timing of surgery, since no significant difference of preoperative duration of symptoms was noted between those with no or mild subvalvular changes (groups A and B, 7.9 ± 5.5 years) and those with moderate to severe damage (groups C and D, 8.6 ± 6.7 years)($p>0.6$).

Valvular anatomy and residual stenosis or restenosis: Deformity of the mitral valve is closely related to residual stenosis or restenosis of the mitral valve[5,12]. HIGGS et al.[4] stated that residual stenosis was a commoner cause of residual or recurrent symptoms than was restenosis. If fibrocalcific changes of the leaflets are severe, stenosis may persist due to the inability of the leaflets to be moved by the available filling pressure even after the commissures are cut all the way to the annulus[13]. For mild calcification, however, commissurotomy is still recommended, even in a second trial[9]. On the other hand, involvement of the chordae or papillary muscles may cause a "funnel-type" deformity of the mitral valve which makes relief of the obstruction impossible[13]. Hemodynamic data by RCG revealed incomplete relief of stenosis in group D. Separation of fused chordae or papillary muscles, which was first performed in our cases in 1969, resulted in symptomatic as well as hemodynamic improvement. However, in four of 16 cases (25%) deterioration occurred after five-year period of improvement. The reported incidence of restenosis after valvotomy varies greatly in the literature, but appears to be significantly lower with the open method than with the closed method[11]. Restenosis was confirmed in seven patients of our series by RCG or echocardiography who also showed symptomatic deterioration 4 to 16 years after OMC. Five of them had significant subvalvular lesions also.

Commissurotomy versus valve replacement: Cases of "commissure type" mitral stenosis with little involvement of cusps and chordae are good candidates for valvotomy and are the only ones in which good long-term results can be expected. On the other hand, heavy calcification of the

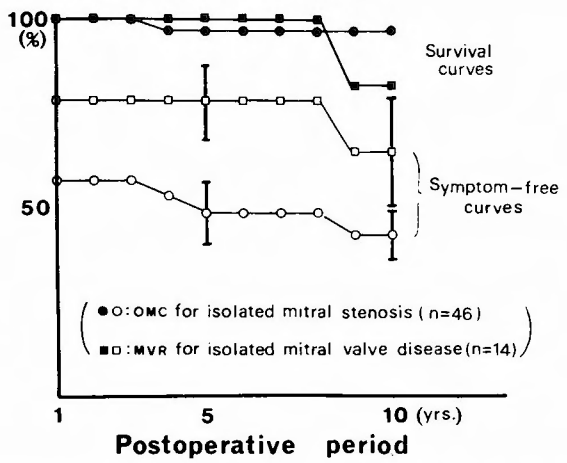

Fig. 4 Comparison of survival and symptom-free curves between cases with open mitral commissurotomy for isolated mitral stenosis and those with mitral valve replacement for isolated mitral valvular disease. Operative deaths are excluded in this figure.

leaflets is a definite indication for valve replacement. Between these two extremes, the choice of operation, valvotomy or valve replacement, varies not only with the experience and attitude of the surgeon, but also with the type of valve pathology seen[14]. It seems likely that involvement of the cusps and chordae in the stenotic process would permit the attainment of only temporary relief of mitral valve obstruction[13], even if fused chordae or papillary muscles are split in an effort to avoid valve replacement, as shown in this study. Thus, valvotomy in such cases is merely palliative when we aim to achieve complete recovery to NYHA Class I with surgery. In our experience, the symptom-free rate after mitral valve replacement for isolated mitral valve disease (mostly mitral stenoinsufficiency) was significantly higher than after OMC for isolated mitral stenosis (figure 4). Since the latter included cases with good valvular anatomy as well as with subvalvular lesions, the difference would be more significant if only patients with subvalvular lesions were compared with those treated by mitral valve replacement. Postoperative embolism was found in one patient in the valve replacement group (0.013/patient-year) and in two patients in the OMC group (0.007/patient-year) in this series ($p>0.4$). The operative mortality rate for valve replacement (22%) is higher than that for OMC (6%). With the fall in mortality in recent cases due to continuing improvement of surgical techniques, myocardial protection during surgery and artificial valves, the value of valve replacement is increasing in our clinic.

In order to improve functional rehabilitation, early operation, prior to the development of secondary complications due to long-standing mitral obstruction, would seem to be indicated, especially for patients who are unable to function in NYHA Class I but have good valvular anatomy. The choice of operative methods, valvotomy or valve replacement, for patients with significant subvalvular lesions, which can be precisely evaluated by echocardiography preoperatively, depends on the individual's life-style and wishes[15]. Valvotomy for such patients

is perhaps safer, but less curative than valve replacement. It is usually stated that a candidate for valve replacement should be in functional Class III or IV. However, valve replacement in the advanced stage of the disease may not truly rehabilitate the patient because of the development of persistent atrial fibrillation or secondary tricuspid insufficiency.

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和文抄録

直視下僧帽弁交連切開術後の遠隔成績
——とくに術後機能回復に影響する因子について——

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僧帽弁狭窄症（MS）に対する直視下僧帽弁交連切開術（OMC）は，定型的手術としと確立されている．その遠隔成績の報告も数多く大体満足すべきものである．しかし手術目的をMSの根治（無症状な状態で完全に社会復帰させる）とする立場からみると，現在のOMCの結果はなお姑息的な感が強い．我々はOMC後の完全回復（NYHAI度）を妨げる因子の解明を目的として，術後1年以上生存した60人のOMC患者（平均追跡期間7.3年）を対象として，アンケート調査および外来診察とくにradiocardiographyなどを利用して分析を行った．その結果，(1)症状発現より手術までの病悩期間，(2)心房細動，(3)合併弁膜症，(4)心拡大などが有意に術後機能回復に影響を与えた．従って，心房細動の固定化する前，あるいは二次的三尖弁逆流の発生以前に早期に手術を行う心要がある．更に僧帽弁病変の程度も結果を大きく左右すると思われ，とくに弁下狭窄を有する症例に対する弁切開の結果は不良である．これら症例に対する癒合腱索，乳頭筋切開術は明らかな効果を有するものの，5年以後に悪化傾向がみられる．最近の僧帽弁置換術の成績の向上を考慮すれば，かかる症例に対して，以前よりもっと積極的に弁置換を考慮すべきではないか．