Functional Results 5 Years After Successful Percutaneous Mitral Commissurotomy in a Series of 528 Patients and Analysis of Predictive Factors

BERNARD IUNG, MD, BERTRAND CORMIER, MD, PIERRE DUCIMETIERE, PhD,* JEAN-MARC PORTE, MD, OLIVIER NALLET, MD, PIERRE-LOUIS MICHEL, MD, JEAN ACAR, MD, ALEC VAHANIAN, MD

Paris, France

Objectives. This study sought to assess late functional results after successful percutaneous mitral commissurotomy and to determine their predictors.

Background. Few studies have reported late results of percutaneous mitral commissurotomy or have analyzed their late results regardless of immediate results, despite the fact that late deterioration may well be related either to a decrease in valve area or to poor initial results.

Methods. Between 1986 and 1992, 528 patients underwent successful percutaneous mitral commissurotomy (mean [±SD] age 46 ± 18 years; mean follow-up 32 ± 18 months). A successful procedure was defined by a mitral valve area $\geq$1.5 cm^2 and no regurgitation >2/4. Dilation was performed using a single balloon in 13 patients, a double balloon in 349 and the Inoue balloon in 166. Multivariate analysis was performed with a Cox model.

Results. The survival rate for patients in New York Heart Association functional class I or II, with no cardiac-related deaths or need for mitral surgery or repeat dilation, was 76 ± 6% at 5 years. By multivariate analysis, the independent predictors of good functional results were echocardiographic group (p = 0.01), functional class (p = 0.02) and cardiothoracic index (p = 0.005) before the procedure and valve area after the procedure (p = 0.007). The predictive model derived allowed estimation of the probability of good functional results according to the value of these four predictors for any given patient.

Conclusions. Good functional results were observed 5 years after successful percutaneous mitral commissurotomy in a large series of varied patients. The analysis of predictive factors may provide useful indications for follow-up results in patients undergoing this technique.

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Since 1984 (1), numerous reports have demonstrated the safety of percutaneous mitral commissurotomy with regard to the improvement of mitral valve function in patients with mitral stenosis (2–9). However, few series have reported late results, and most included either a majority of old patients or essentially young patients with pliable valves (10–12). Moreover, these series took into account all the procedures, whatever their immediate results. Poor late results may be related to different mechanisms depending on whether they are the consequence of restenosis or poor immediate results.

The purpose of the present study was therefore to assess late results after successful percutaneous mitral commissurotomy in a large single-center series that included a variety of patient subsets. This allows an accurate assessment of late results and the analysis of their predictive factors.

From the Cardiology Department, Tenon Hospital and *INSERM U258, Broussais Hospital, Paris, France.

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Address for correspondence: Dr. Bernard Iung, Cardiologie, Hopital Tenon, 4, rue de la Chine, 75020 Paris, France.

Methods

Patients. From March 1986 to February 1992, 606 consecutively admitted patients residing in France underwent percutaneous mitral commissurotomy in our department, 528 of whom (87%) had good immediate results, which were defined as a final mitral valve area $\geq$1.5 cm^2 as assessed by echocardiography and no mitral regurgitation >2/4 according to the Sellers classification. These 528 patients form the basis of the present study, and their characteristics are detailed in Table 1.

Technique. Dilation was always performed using the anterograde transvenous approach. The mitral valve was dilated with a single balloon in 13 patients (Trefoil 3 × 12 mm, Schneider Europe) and a double balloon in 349, as previously reported (Trefoil 3 × 10 mm or 3 × 12 mm plus a 15- or 19-mm balloon) (3). After October 1990, the Inoue balloon was systematically used in 166 patients, with stepwise inflation under echocardiographic guidance (13) (Table 2).

Measurements. The cardiothoracic index was calculated on a chest radiograph in the posteroanterior projection. After echocardiography and fluoroscopy, mitral valve anatomy was assessed and patients were classified into three groups, as previously described (3,4,13,14): flexible valves and mild sub-

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Table 1. Patient-Related Variables Before Percutaneous Mitral Commissurotomy

Age (yr)*	46.6 ± 13.4
<50	326
50–70	176
≥70	26
Male/female	86/442
NYHA functional class	
I	2
II	140
III	367
IV	19
Cardiac rhythm	
Sinus	318
AF	210
Previous surgical commissurotomy	
Yes	86
No	442
Mitral regurgitation (Sellers classification)	
0	348
1	168
2	5
Echocardiographic group	
1	87
2	311
3	130
Cardiothoracic index*	0.51 ± 0.06
≤0.5	307
0.5–0.6	174
≥0.6	37
Mean pulmonary artery pressure (mm Hg)*	31.8 ± 10.1
<30	263
≥30	265
Mean left atrial pressure (mm Hg)*	21.8 ± 6.3
<15	83
15–20	128
≥20	317
Cardiac index (liters/min per m²)*	2.92 ± 0.65
<2.5	135
2.5–3	149
≥3	244
Left atrial diameter (TM echo) (mm)*	49.4 ± 7.2
<50	307
50–60	163
≥60	58
Mitral valve area (planimetry) (cm²)*	1.08 ± 0.22
≤0.75	50
0.75–1	119
1–1.25	223
≥1.25	127
Mean transmitral gradient (Doppler) (mm Hg)*	9.9 ± 4.3
<15	461
≥15	67

*Subgroup cutoff points are defined for univariate and multivariate analysis. Data presented are mean value ± SD or number of patients. AF = atrial fibrillation; NYHA = New York Heart Association; TM echo = time-motion echocardiography.

valvular disease (length of chordae ≥10 mm) (*group 1*); flexible valves and extensive subvalvular disease (length of chordae <10 mm) (*group 2*); and calcified valves (*group 3*). Patients

Table 2. Procedure-Related Variables

Double balloon	349
Single balloon	13
Inoue balloon	166
Effective balloon-dilating area (cm²)*	5.6 ± 0.7
≤5.5	220
>5.5	308

*Subgroup cutoff points are defined for univariate and multivariate analysis. Data presented are mean value ± SD or number of patients.

with extensive subvalvular disease associated with calcified valves were classified as group 3. In a subset of 40 patients in our series, the mean (±SD) Wilkins score was 8.0 ± 0.8 (range 7 to 9) for echocardiographic group 1; 9.9 ± 1.3 (range 8 to 12) for group 2; and 12.5 ± 1.3 (range 10 to 15) for group 3.

Echocardiographic examination was performed on the day before and 24 to 48 h after percutaneous mitral commissurotomy. The reference measurement used to calculate mitral valve area was planimetry by two-dimensional echocardiography. In 25 patients, planimetry was not possible, and an estimation from the transmitral pressure half-time index with the Doppler technique was used for statistical analysis. In the whole series, the correlation between the assessment of valve area by planimetry and by the pressure half-time index was r = 0.76 before the procedure and r = 0.81 after the procedure.

Before and immediately after the procedure, right and left heart catheterization was performed, cardiac output was determined by the thermodilution method, and degree of mitral regurgitation was assessed according to the Sellers classification on left ventriculography in a 30° right anterior oblique view.

Effective balloon-dilating area was calculated according to usual geometric and trigonometric formulas (15).

Echocardiographic and hemodynamic data before and after the procedure are presented in Tables 1 and 3. All data were entered prospectively in a computerized data base beginning in 1986.

Follow-up. Follow-up was performed at 1-year intervals. Data were collected either during patient visits to the department or by a standardized questionnaire sent to the patient's cardiologist or, in case of no answer, to the patient's local physician.

Follow-up was concluded in February 1993 (the minimal duration was thus equal to the 1-year follow-up interval). Follow-up was completed for 511 patients (97%), with a mean follow-up period of 32 ± 18 months (up to 84) in all 528.

Clinical events were defined as death, mitral surgery or repeat dilation and New York Heart Association functional class, which were combined as the following end points: 1) global survival; 2) survival with deaths of cardiac origin only (noncardiac deaths were censored); 3) survival with no cardiac-related death and no need for mitral surgery or repeat dilation; 4) survival with good functional results (functional class I or II) and no cardiac-related death or need for mitral surgery or repeat dilation.

Table 3. Patient-Related Variables After Percutaneous Mitral Commissurotomy

Mean pulmonary artery pressure (mm Hg)*	23.2 ± 8.2
≤20	202
>20	284
Mean left atrial pressure (mm Hg)*	13.1 ± 5.1
≤12	269
>12	259
Cardiac index (liters/min/m²)*	3.18 ± 0.72
<3	211
3–3.5	160
≥3.5	157
Mitral regurgitation (Sellers classification)	
0	202
1	242
2	67
Mitral valve area (planimetry) (cm²)*	1.98 ± 0.30
≤1.75	119
1.75–2	153
≥2	256
Mean transmitral gradient (Doppler) (mm Hg)	4.4 ± 1.8
≤2.5	80
2.5–5	233
≥5	187

*Subgroup cutoff points are defined for univariate and multivariate analysis. Data presented are mean value ± SD or number of patients.

Statistical analysis. Cumulative survival curves were determined by an actuarial method with 6-month intervals. Continuous variables are expressed as mean value ± SD and were divided into subgroups with clinically reasonable cutoff points. Analysis of the predictive factors of late results concerned the composite end point of good functional results, defined as survival with good functional results (functional class I or II), no cardiac-related death or need for mitral surgery or repeat dilation.

Univariate analysis was performed using a log-rank test on the 14 preprocedure-related variables in Table 1, the 2 procedure-related variables in Table 2 and the 6 postprocedure-related variables listed in Table 3. Variables with $p < 0.25$ were entered in a Cox proportional hazards model with a backward selection procedure using a significance level of $p = 0.25$. Two-way interactions were studied between these selected variables, using a stratified log-rank test. The final Cox model was elaborated by a backward selection of these variables and the interaction terms, with a significance level of $p = 0.05$.

The assumption of proportional hazards was verified by a graphic method.

A predictive model of continuing good functional results at 3 years was established using the final Cox model, in which the baseline survival function So(t) was estimated from the study cohort. To ensure its accuracy, the estimation of So(t) was limited to 3 years because 201 patients had a follow-up period ≥3 years, although a few patients had a longer follow-up period.

Analysis was performed with SAS statistical software (SAS Institute Inc., release 6.07). Estimation of the Cox model and the survival function was done using the PHREG procedure.

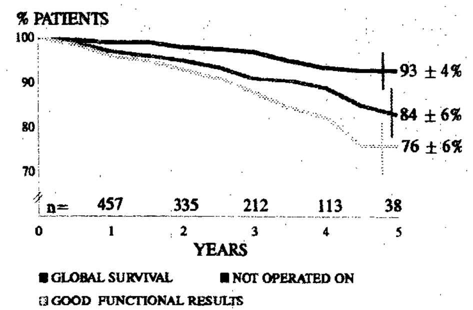

Figure 1. Actuarial results after percutaneous mitral commissurotomy. Actuarial survival rates are represented with 95% confidence intervals (**vertical lines**). **Numbers** at the bottom of the graph indicate the number of surviving patients in functional class I or II with no need for operation or repeat dilation at each year of follow-up ("good functional results").

Results

Global results. Five-year actuarial rates for global survival; survival with no cardiac-related death; survival with no cardiac-related death and no need for surgery or repeat dilation; and the composite end point of good functional results were, respectively, 93 ± 4%, 97 ± 3%, 84 ± 6% and 76 ± 6% (Fig. 1).

Nineteen patients died during follow-up, 8 of cardiac-related causes (congestive heart failure in 5, postoperative death after mitral surgery in 2, myocardial infarction in 1) and 11 of noncardiac-related causes (neoplasia in 6, respiratory insufficiency in 4, suicide in 1). A repeat mitral valve procedure was required in 40 patients: repeat dilation in 5, open heart commissurotomy in 5, mitral valve replacement in 30 (the latter was associated with aortic valve replacement in 4, coronary bypass graft surgery in 1). Surgical findings during the 35 operations were restenosis in 29 patients and moderate stenosis associated with mitral regurgitation in 6.

At the final follow-up examination (mean 34 ± 18 months after procedure), 471 patients were alive and were free of mitral surgery or repeat dilation. Twenty-two patients were in functional class III or IV and did not undergo reoperation. Three patients experienced a transient ischemic attack without sequelae, and one patient in functional class III had a cerebrovascular event with moderate functional sequelae.

Predictive factors of late functional results. By univariate analysis, 15 variables were significant at the $p = 0.25$ level (Table 4, Fig. 2 and 3). Neither of the two procedure-related variables was shown to be significant by univariate analysis. The first Cox proportional hazards model identified six predictors: echocardiographic group, functional class and cardiothoracic index before the procedure and mean pulmonary artery pressure, mitral valve area and mitral gradient after the procedure.

The final Cox model included three preprocedure variables and one variable related to the quality of the result of percutaneous mitral commissurotomy. This model did not

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Table 4. Predictive Factors of Good Late Functional Results by Univariate Analysis

Variable	p Value
Before procedure	
Age	0.0001
Gender	0.67
Functional class	0.013
Rhythm	0.0002
Previous commissurotomy	0.80
Mitral regurgitation (Sellers classification)	0.001
Echocardiographic group	0.0002
Cardiothoracic index	0.001
Mean pulmonary artery pressure	0.97
Mean left atrial pressure	0.96
Cardiac index	0.075
Left atrial diameter (time-motion echocardiography)	0.002
Mitral valve area (planimetry)	0.25
Mean transmitral gradient (Doppler)	0.24
Procedure	
Type of balloon	0.54
Effective balloon dilating area	0.84
After procedure	
Mitral regurgitation (Sellers classification)	0.001
Mean pulmonary artery pressure	0.002
Mean left atrial pressure	0.009
Cardiac index	0.62
Mitral valve area (planimetry)	0.0012
Mean transmitral gradient (Doppler)	0.01

include interaction terms. The independent predictors of continuing good functional results were lower echocardiographic group (p = 0.01), lower functional class before the procedure (p = 0.02), lower cardiothoracic index before the procedure (p = 0.005) and greater valve area after the procedure (p = 0.007). The strength of these predictors is indicated by the adjusted relative risks derived from the final Cox model in Table 5.

Predictive model of late functional results. The predictive model derived from the final Cox model, which included four covariates, allowed estimation of the probability of good functional results according to echocardiographic group, functional class and cardiothoracic index before the procedure and valve area after the procedure. Predicted rates of good functional results at 3 years are shown in Figure 4 and are as follows: 98% for patients in echocardiographic group 1 and functional class I or II, with a cardiothoracic index <0.5, before dilation and a valve area ≥2 cm^2 after dilation; 84% for patients in echocardiographic group 2 and functional class III or IV, with a cardiothoracic index between 0.5 and 0.6, before dilation and a valve area between 1.75 and 2 cm^2 after dilation; 62% for patients in echocardiographic group 3 and functional class III or IV, with a cardiothoracic index between 0.5 and 0.6, before dilation and a valve area between 1.50 and 1.75 cm^2 after dilation; and 44% for patients in echocardiographic group 3 and functional class III or IV, with a cardiothoracic index >0.6, before dilation and a valve area between 1.50 and 1.75 cm^2 after dilation.

Discussion

In the present study, good functional results without a need for repeat dilation or mitral surgery were obtained in 76% of patients 5 years after successful percutaneous mitral commissurotomy. Predictive factors for continuing good functional results were echocardiographic group, functional class and cardiothoracic index before and valve area after the procedure.

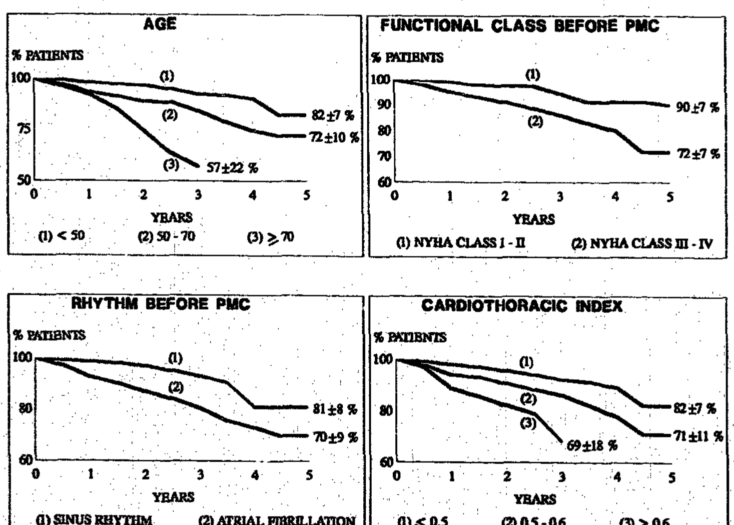


Figure 2. Univariate analysis. Good functional results for clinically relevant predictive factors of late functional results after percutaneous mitral commissurotomy (**curves** were not plotted when the number of patients was <10 for the given period). NYHA = New York Heart Association; PMC = percutaneous mitral commissurotomy.

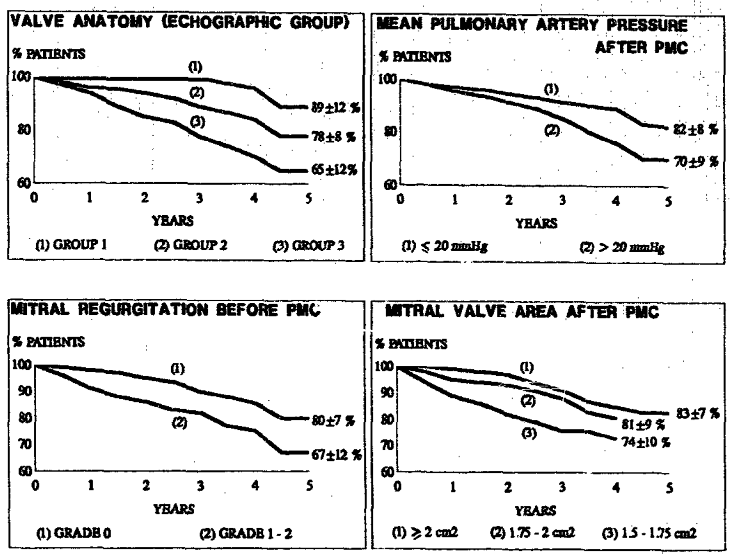


Figure 3. Univariate analysis. Good functional results for echocardiographically and hemodynamically relevant predictive factors of late functional results after percutaneous mitral commissurotomy (curves were not plotted when the number of patients was <10 for the given period). PMC = percutaneous mitral commissurotomy.

Design of the study. Late symptomatic deterioration after percutaneous mitral commissurotomy, as after surgical commissurotomy, may be related to the continuation of poor immediate results or to late deterioration after a successful procedure (16). Poor late results after poor immediate results result from insufficient valve opening or severe mitral regurgitation. In these cases, surgery is often required, but its timing depends on confusing factors, such as extracardiac comorbidities and the habits of the medical and surgical teams concerned. In contrast, late deterioration after a successful procedure is generally related to a progressive decrease in valve area (6,12,17–20). For all these reasons we chose to analyze the predictors of late results in a homogeneous cohort of patients, all of whom had good immediate results from percutaneous mitral commissurotomy. Only one other comparable study has reported late results after successful surgical commissurotomy (21), but it included few patients and therefore no predictor of late deterioration could be identified.

Our definition of good immediate results associated mitral valve area ≥1.5 cm^2 and no regurgitation >2/4. Such results generally provide normal hemodynamic variables, and the same criteria are used in most studies, alone or in combination (17,22).

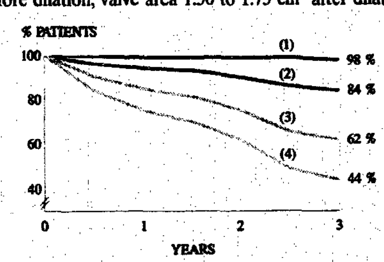
With regard to our end points of late results, we did not

Table 5. *Relative Risks Derived From Cox Proportional Hazards Multivariate Model*

Variable	Relative Risk (95% CI)	p Value
Echocardiographic group		0.01
1	1	
2	1.8 (1.1–2.7)	
3	3.1 (1.3–7.5)	
NYHA functional class		0.02
I/II	1	
III/IV	3.0 (1.2–7.6)	
Cardiothoracic index		0.005
≤0.5	1	
0.5–0.6	1.7 (1.2–2.5)	
≥0.6	2.9 (1.4–6.2)	
Mitral valve area after PMC (cm^2)		0.007
≤1.75	2.4 (1.3–4.5)	
1.75–2.00	1.5 (1.1–2.1)	
≥2.00	1	

CI = confidence interval; NYHA = New York Heart Association; PMC = percutaneous mitral commissurotomy.

Figure 4. Predicted rates of good functional results at 3 years as a function of echocardiographic group, functional class and cardiothoracic index before and mitral valve area after percutaneous mitral commissurotomy: **(1)** = echocardiographic group 1, functional class I or II and cardiothoracic index <0.5 before dilation, valve area ≥2.00 cm^2 after dilation; **(2)** = echocardiographic group 2, functional class III or IV and cardiothoracic index 0.5 to 0.6 before dilation, valve area 1.75 to 2.00 cm^2 after dilation; **(3)** = echocardiographic group 3, functional class III or IV and cardiothoracic index 0.5 to 0.6 before dilation, valve area 1.50 to 1.75 cm^2 after dilation. **(4)** = echocardiographic group 3, functional class III or IV and cardiothoracic index >0.6 before dilation, valve area 1.50 to 1.75 cm^2 after dilation.



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restrict the analysis either to mortality alone, because its incidence was very low, or to the need for repeat dilation or mitral surgery, because some patients with late deterioration of valve function do not undergo reoperation because of refusal or surgical contraindications. Our composite end point of good functional results did, however, take into account all the clinical consequences of deterioration of valve function. Such an end point is justified in a pragmatic approach in which the aim of percutaneous mitral commissurotomy is to obtain continuing good functional status, as attested by a cardiologist or a physician, whereby the risk of any subjective bias is markedly reduced.

Late results of percutaneous mitral commissurotomy. The present study shows evidence of good late results after successful percutaneous mitral commissurotomy, with 76% of patients having good functional results at 5 years. The analysis of these results according to the data in the published reports must take into account the regular inclusion of patients with poor immediate results of percutaneous mitral commissurotomy in the other series (7,10–12,22). Moreover, late results must be analyzed according to the characteristics of the patients involved. Late results are less satisfactory in a North American population, where patients are older and frequently have severe valve deformities. In the series of Cohen et al. (10), the mean age of the 146 patients was 59 ± 15 years, and event-free survival was 51% at 5 years. In another North American population, the early restenosis rate was 21% at 6 months (23). Results are naturally better when patients are younger and have a more suitable valve anatomy. The European series of Pan et al. (11) included 350 patients with an average age of 46 years and reported an 85% rate of event-free survival without restenosis at 5 years. In a study from India that included 600 patients with a mean age of 27 ± 8 years, the incidence of restenosis was only 1.7% during a mean follow-up period of 37 months (12). In a series from Saudi Arabia of 41 patients (mean age 26 years), no restenosis occurred at 1 year follow-up (24).

Late results of surgical commissurotomy. These differences in patient characteristics also limit any comparison of late results of percutaneous mitral commissurotomy with those of surgical commissurotomy. Most large series concerning closed mitral commissurotomy have included young patients and reported reoperation-free survival rates of between 72% and 94% at 6 years (25–27). With regard to open mitral commissurotomy, reoperation-free survival ranged from 85% to 95% at 5 years (28–30). In a comparative study (22), the incidence of mitral surgery or repeat dilation was higher after percutaneous mitral commissurotomy than after open mitral commissurotomy (34% vs. 13% at 3 years), but that study was not randomized. It is clear that any comparison of the results of percutaneous mitral commissurotomy with those of surgical commissurotomy requires prospective randomized studies. The few randomized studies published so far do not demonstrate any superiority of closed (31,32) or of open mitral commissurotomy (33) over percutaneous mitral commissurotomy. However, these studies involve few patients, have a limited duration of follow-up and, above all, include young patients (mean age range 27 to 31 years) with valve anatomy suitable for percutaneous mitral commissurotomy, so that their conclusions cannot be universally applied.

Predictive factors of late results of percutaneous mitral commissurotomy. The relation between valve anatomy and deterioration of late results is well established (6,7,10,11). Series with repeated evaluations of valve area by echocardiography or hemodynamic variables after percutaneous mitral commissurotomy have included few patients (37 to 57), with a mean follow-up of 7 to 24 months (17–20,34) and may reflect a selection bias (19). All these studies reported a relation between the extent of valve deformity and the occurrence of restenosis. The predictive value of valve anatomy was also demonstrated during long-term follow-up after surgical commissurotomy (25,27,35).

The predictive value of functional class has been described after percutaneous mitral commissurotomy (10,36) and after surgical commissurotomy (25,35,37).

Cardiothoracic index was a predictor of late results in two series of surgical commissurotomy (27,30). Cardiomegaly is an overall phenomenon that may be the consequence of several mechanisms that have been identified as predictors of poor late results after surgical commissurotomy (30,35) or after percutaneous mitral commissurotomy (10,11): dilation of the left atrium, impairment of left ventricular function and increases in left ventricular end-diastolic pressure. Cardiothoracic index is an easily available measure that takes into account associated cardiac diseases and the consequences of mitral stenosis. Conversely, left ventricular end-diastolic pressure or ventricular diameter is more specifically related to heart failure but is generally linked to associated diseases more than to the direct consequences of mitral stenosis.

The last independent predictor of late results in our study was mitral valve area after the procedure. This factor was also predictive of late results in the series of Cohen et al. (10), which included all procedures, regardless of the immediate results. In our study, valve area was assessed by planimetry with two-dimensional echocardiography, which has the advantage of being a direct measurement, as valve area as assessed by hemodynamic variables with the Gorlin formula may be misleading immediately after dilation (38,39). Doppler calculation using the pressure half-time index may likewise lead to inaccurate estimation of valve area, especially when performed immediately after the procedure (40). Planimetry may be considered as the reference measurement of mitral valve area (41). The main disadvantage of planimetry is its nonfeasibility in patients with low echogenicity or with a very irregular mitral orifice (including heavily calcified valves). When valve area could not be assessed by planimetry, we used a calculation with pressure half-time index performed 1 or 2 days after the procedure, when this measurement has recovered its validity (42). This substitution avoided a potential selection bias by excluding patients with calcified valves from the multivariate model, because such patients are more likely to have poor late results.

Several patient-related characteristics had no predictive value of late functional results in our multivariate analysis, in particular, mitral regurgitation, rhythm, age, previous surgical commissurotomy and valve area before the procedure, although they have been identified as predictors in other studies of late results after percutaneous mitral commissurotomy or surgical commissurotomy (7,25,27,30,43). These apparent discrepancies may be attributable to confounding phenomena. In our study, most of these factors were highly significant predictors in univariate analysis, which did not, however, reflect their individual effects but their relationship with the independent predictors later identified in the multivariate Cox model. Further, age, previous surgical commissurotomy and valve area before the procedure are also independent predictors of immediate results (2,3,7) and may influence late results after either percutaneous mitral commissurotomy or surgical commissurotomy (11,27,35) in which poor immediate results have been taken into account, unlike our present series.

Most of the procedures were performed in our series with a double balloon or the Inoue balloon, which are the most commonly used techniques. There are few comparative studies of results with the double balloon and the Inoue balloon techniques, but immediate results do not seem to differ (44–46). In our study, the technique used did not influence late results after successful percutaneous mitral commissurotomy.

Application of predictive model. The present single-center series of patients with a wide range of clinical characteristics allowed the elaboration of a predictive model of late functional results after successful percutaneous mitral commissurotomy. Excellent predicted late results in patients who are good candidates for percutaneous mitral commissurotomy (echocardiographic group 1) are consistent with the results reported in other studies (12,33). In patients with less appropriate anatomy because of extensive subvalvular disease (echocardiographic group 2) and cardiomegaly, the prediction of a high proportion of good functional results 3 years after a successful procedure argues in favor of performing percutaneous mitral commissurotomy in these patients, who present frequently in developed countries. Finally, in very unfavorable cases with valve calcification (echocardiographic group 3), advanced heart disease and only intermediate results (valve area between 1.5 and 1.75 cm^2 after the procedure), percutaneous mitral commissurotomy may nonetheless be indicated when the surgical alternative is of high risk.

Limitations of the study. A limitation of the present study is the absence of standardized echocardiographic follow-up to allow the analysis of the anatomic mechanisms involved in secondary deterioration after successful percutaneous mitral commissurotomy and the establishment of a rate for restenosis. This was not possible here because of the number and geographic diversity of the patients studied.

It must also be noted that echocardiographic assessment of mitral valve anatomy uses a previously described qualitative classification (3,4,13,14) with an overall assessment of valve anatomy in our series as in others (6). The Wilkins' scoring system is widely used (10,11,17,47), but it is not possible to evaluate the respective values of these methods, because there are no comparative evaluations (2).

The model that we derived here may not be applied alone to select patients because it does not predict immediate results and because it includes a variable linked to an immediate result of the procedure. An improvement in patient selection would require the identification of the predictive factors of immediate results from another model.

Conclusions. The good functional results observed 5 years after successful percutaneous mitral commissurotomy in a group of patients with varied clinical characteristics and valve anatomy further confirm the wide applicability of this technique. In conjunction with the analysis of the predictors of immediate results, the findings of the present study may contribute to better patient selection. The predictive model derived should provide better guidelines for patient follow-up and enable a better prognosis to be made after successful percutaneous mitral commissurotomy for the individual patient.

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