Predictive Factors for Persistence of Atrial Fibrillation After Mitral Valve Operation

Renato A. K. Kalil, MD, PhD, Claudia B. Maratia, MD, Alessandro D'Ávila, MD, and Fernando B. Ludwig, MD

Instituto de Cardiologia do Rio Grande do Sul, Fundação Universitária de Cardiologia, Porto Alegre, Brazil

Background. **The majority of patients operated on for mitral valve disease with chronic atrial fibrillation (AF) do not recover sinus rhythm with conventional postoperative treatment. The maze procedure may be used in these circumstances. To define the precise indications for the maze procedure, it would be necessary to identify those patients based on preoperative factors.**

Methods. **A retrospective study was undertaken on 100 consecutive patients operated on for mitral valve disease in chronic AF. The return to sinus rhythm was analyzed with relation to age, gender, AF duration, left atrial size, left ventricular ejection fraction, lesion type, valve procedure, associated procedures, and reoperation.**

Results. **At late follow-up (more than 1 year) 26 (26%) patients presented sinus rhythm and 74 (74%) remained in AF. Statistical single parametric analysis demonstrated that mitral stenosis was a risk factor for maintaining AF, whereas regurgitation was more associated to sinus rhythm recovery. There was no relation with the other parameters with return to sinus rhythm. It should be noted, however, that 96% of this series had AF for more than 6 months preoperatively.**

Conclusions. **The majority of patients with mitral valve disease remain in AF and this may justify the association of maze procedure. Pure regurgitation may be a single predictor for return to sinus rhythm after mitral valve operation in chronic AF.**

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It is well known that the majority of patients with atrial fibrillation (AF) secondary to mitral valve disease do not recover sinus rhythm (SR) postoperatively [1, 2]. Chronic AF compromises, on the other hand, late results after mitral valve operations [3]. The maze procedure could be well indicated in this setting [4–7]. An argument against routine association of maze procedure with mitral repair or replacement is that some patients recover SR and therefore, in those patients a more complex technique would add risk and no benefit. It is generally accepted that small left atrium and short duration could be associated with SR recovery [8–11]. However, at this time, this association has not been demonstrated after mitral procedures.

This study was undertaken for the purpose of identifying predictive preoperative parameters for late postoperative rhythm and help in identifying patients that could benefit more from a maze and mitral procedure.

Material and Methods

A historic cohort of 618 medical records of patients operated for mitral valve disease between 1990 and 1994 at the Instituto de Cardiologia do Rio Grande do Sul/Fundação Universitária de Cardiologia, was analyzed to find 100 patients who underwent mitral valve repair or replacement in chronic AF with more than 1 year of follow-up and whose records fitted in the previously established protocol. We determined the criteria of age, gender, type of mitral valve lesion (stenosis, regurgitation, mixed), associated aortic valve lesion, previous cardiac operation, left atrial size and left ventricular ejection fraction measurements by two-dimensional echocardiogram, the duration of preoperative AF, type of procedure (repair or replacement), and type of prosthesis implanted (biological or mechanic). As for duration of AF, a limit of 6 months was established to differentiate recent onset from chronic AF, as it is thought that those patients are more prone to recovery than those with longer duration AF.

All patients had been operated on by the same surgical team, under moderate hypothermia and cardiopulmonary bypass, established by ascending aorta and bicaval cannulation after median sternotomy. Aortic cross-clamp and crystalloid cardioplegic solution infusion was done previously to a left atrial incision parallel to the interatrial groove. Mitral repair or replacement was performed accordingly to each patient. After rewarming, bypass was terminated, the cannulas withdrawn, chest tubes and temporary pacing wires placed in the right ventricle, and

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Address reprint requests to Dr Kalil, Instituto de Cardiologia do Rio Grande do Sul, Unidade de Pesquisa, Av Princesa Isabel, 395 - Santana, 90.620-001 Porto Alegre - RS, Brazil.

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Table 1. Clinical Data of 100 Patients Operated for Mitral Valve Disease During Chronic Atrial Fibrillation

Clinical Characteristic	No. of Patients (%)	Mean ± SD
Female	66	
Male	34	
Age (y)		
< 45	43	46.0 ± 11.9
> 60	13	
Mitral stenosis	36	
regurgitation	18	
mixed lesion	46	
Aortic valve disease	31	
Previous cardiac operation	53	
Left atrial size		
< 50 mm	29	55.5 ± 10.4
> 50 mm	71	
AF duration		
< 6 mo	4	
> 6 mo	96	
LV ejection fraction		
< 40%	5	63.6 ± 12.6
> 40%	92	
Missing	3	
Mitral repair	30	
Prosthesis	70	
Mechanical	15	
Biological	55	

AF = atrial fibrillation; LV = left ventricular; SD = standard deviation.

the sternotomy closed. In the immediate postoperative period no special treatment was undertaken regarding the cardiac rhythm. Patients with persistent AF were anticoagulated and discharged usually on the eighth postoperative day. Follow-up was scheduled for 1 or 2 months after operation, when electrical cardioversion was attempted and amiodarone administration initiated. Those patients refractory to electrical cardioversion and amiodarone were maintained with rate-control medication and anticoagulation.

The 100 patients studied were 66 women and 34 men. Age ranged from 16 to 75 years (46.0 ± 11.9 years); 43 patients were less than 45 years and 13 more than 60 years of age. The lesions were 36 stenosis, 18 regurgitation, and 46 mixed. Aortic valve disease was present in 31 patients. Previous cardiac operation had been done in 53 patients, almost exclusively for mitral valve repair. Left atrial size varied from 40 to 80 mm, mean 55.5 ± 10.4 mm, with 29 patients with less and 71 more than 50 mm. Atrial fibrillation was present for more than 6 months in 96 patients. Left ventricular ejection fraction varied from 38.2% to 80.6%, mean 63.6% ± 12.6%, with 5 patients with less and 92 with more than 40% (in 3 patients, ejection fraction was not determined). Mitral repair was performed in 30 and replacement in 70 patients with 15 mechanical and 55 biological prostheses. The clinical data are summarized in Table 1.

Statistical Analysis

All the information obtained was stored in an EPI-INFO (version 6.04) (World Health Organization, Geneva, Switzerland) database. The statistical software SPSS (SPSS, Inc, Chicago, IL) was used for analysis. Continuous variables were expressed in means ± one standard deviation and, when necessary, categorized.

Comparisons of patients in AF or SR after operation were made using the χ^2 test for categoric variables and the *t* test for continuous variables. In these comparisons, a critical alpha value of 0.05 was considered significant. The EPI-INFO program was used to calculate relative risks and 95% confidence intervals.

Results

There were 74 (74%) patients in chronic postoperative AF and 26 (26%) in SR. Mean left atrial size was 55.2 ± 10.9 cm for those in SR and 55.6 ± 10.3 cm for AF ($p = 0.87$, not significant [NS]). Left atrial size was less than 50 cm in 29 patients and the return to SR was 34% as opposed to 22% returning to SR when the atria were more than 50 mm in diameter, but this tendency was not significant ($p = 0.21$).

The preoperative duration of AF was less than 6 months in 4 patients, 2 returned to SR and 2 remained in AF. Of the remaining 96 patients 24 (25%) presented SR and 72 (75%) AF ($p = 0.12$, NS). But this analysis carries the bias of a very small number of patients with less duration of AF.

Left ventricular ejection fraction was 63.2% ± 13.7% for SR and 63.7% ± 12.3% for patients remaining in AF ($p = 0.86$, NS), low ejection fraction (less than 40%) was present in 5 patients; of those, 2 (40%) presented SR and 3 (60%) AF, whereas 92 had ejection fraction more than 40%, 23 (25%) in SR and 69 (75%) in AF ($p = 0.45$, NS). This parameter was missing in 3 patients. Age at operation was 43.3 ± 13.9 years in the group returning to SR and 46.9 ± 11.1 years when AF persisted ($p = 0.18$, NS). Forty-three patients were less than 45 years, 12 (28%) in SR and 31 (72%) in AF, whereas 57 were more than 45 years of age, 14 (25%) in SR and 43 (75%) in AF ($p = 0.70$, NS).

Previous cardiac operation had been performed in 53 patients, of whom 14 (26%) returned to SR and 39 (74%) remained in AF. Of the 44 patients who had not undergone previous operation, 11 (25%) were in SR and 33 (75%) in AF ($p = 0.87$, NS). In 3 patients this information was missing. The relative risk for remaining in AF after mitral reoperation was 0.98, with 95% confidence limits of 0.77 to 1.24.

The surgical procedure was a valve repair in 30 patients; 8 (27%) returned to SR and 22 (73%) remained in AF. Valve prosthesis was implanted in 70 patients, 18 (26%) went to SR and 52 (74%) were in AF at follow-up control ($p = 0.92$, NS). The relative risk for remaining in

Table 2. Summary of Results. Preoperative Predictors for Return to Sinus Rhythm After Mitral Operation

Factor (%)	SR (%) (n = 26)	AF (%) (n = 74)	*p* Value	RR
Left atrial size (m ± SD)	55.2 ± 10.9	55.6 ± 10.3	0.87	
<50 mm	34	66	0.21	0.84 (0.63–1.13)
>50 mm	22	78		
Duration (mo)				
< 6	50	50	0.12	
> 6	25	75		
Ejection fraction	63.2 ± 13.7	63.7 ± 12.3	0.86	
< 40	40	60	0.45	0.80 (0.38–1.65)
> 40	25	75		
Age (y)	43.3 ± 13.9	46.9 ± 11.1	0.18	
< 45	28	72	0.70	0.95 (0.75–1.21)
> 45	25	75		
Previous operation				
Yes	26	74	0.87	0.98 (0.77–1.24)
No	25	75		
Procedure				
Repair	27	73	0.92	0.98 (0.76–1.27)
Replacement	26	74		
Aortic lesion				
Yes	16	84	0.13	0.82 (0.66–1.03)
No	30	70		
Type				
Mixed	26	74		
Regurgitation	44	56	x mixed 0.13	1.70 (0.84–3.46)
Stenosis	17	83	x mixed 0.30	0.64 (0.27–1.54)
			x regurg. 0.046	0.38 (0.15–0.92)

AF = atrial fibrilation; RR = relative risk; SR = sinus rhythm.

AF after prosthesis was 0.98 with 95% confidence limits of 0.76 to 1.27.

Mechanical prostheses were implanted in 55 patients; 14 (25%) returning to SR and 41 (73%) in AF. Bioprothesis were used in 15 patients, 4 (27%) in SR and 11 (73%) in AF. There was no difference with the type of prosthesis ($p = 0.99$, NS).

Regarding the type of lesion, 36 patients were diagnosed with mitral stenosis, 6 (17%) went to SR and 30 (83%) maintained AF, compared to 46 patients with mixed lesions (12 [26%] went to SR and 34 [74%] maintained AF; $p = 0.30$, relative risk of 0.64, 95% confidence limits 0.27 to 1.54). When comparing mitral regurgitation to mixed lesion, there were 18 patients, 8 (44%) in SR and 10 (56%) in AF ($p = 0.15$, relative risk 1.70, 95% confidence limits 0.84 to 3.46). Comparing the groups of mitral stenosis versus regurgitation we found a significant difference, as 44% of patients with regurgitation returned to SR, compared to 17% of those with stenosis ($p < 0.05$, relative risk 0.38, 95% confidence limits 0.15 to 0.92).

Associated aortic valve lesion was present in 31 patients, 5 (16%) were in SR at follow-up and 26 (84%) in AF; this was not statistically different from patients with isolated mitral disease, 69 patients, 21 (30%) in SR and 48 (70%) in AF ($p = 0.13$, relative risk 0.82, 95% confidence limits 0.66 to 1.03).

The results are summarized in Table 2.

Comment

Since the first time, in 1987, Cox and colleagues [12] have used the maze procedure for treatment of atrial fibrillation, this technique was thought to be useful in association with mitral valve operation. It is well known that most patients remain in AF after surgical correction of the mitral valve lesion. But some patients recover SR. It is presumed that short duration [8, 9] and small left atrial size [10, 11] could be factors related to SR recovery, but definitive information with this regard is missing in the literature.

In recent years, many centers are combining mitral and maze procedures with a success rate of 85% to 98% of recovering atrial rhythm after mitral valve operation [5, 6, 13–15]. It is reasonable to expect that some of those patients would recover SR with only the mitral procedure, and a common critique for the association with maze is that some patients would have additional morbidity with no increased benefit. To address this subject, it is necessary to identify precisely those patients who would maintain AF despite mitral valve correction and conventional medical therapy postoperatively.

In a previous paper [15] studying a cohort of 50 patients, we were able to identify size less than 52 mm associated to valve regurgitation as present in a statistically significative portion of patients recovering SR, but

we did not demonstrate single factors as predictive of postoperative rhythm. In this study, we extended the retrospective analysis for 100 patients to look for more evidence of predictors for late atrial rhythm.

In a recent paper, Obadia and colleagues [3] found that operation for AF could be of value in patients with a long history of AF and that postoperative AF was associated with reduced long-term survival after mitral valve operation.

Previously, Flugelman and associates [16] reported evidence that restoration and maintenance of sinus rhythm after mitral valve operation for mitral stenosis was not achieved in patients with symptoms lasting more than 3 years, with a left atrial size more than 52 mm and recommended avoidance of cardioversion postoperatively in those patients.

The best subset of predictors of successful cardioversion included left atrial size, functional capacity, duration of symptoms, and left ventricular fractional shortening.

Chua and colleagues [17], studying the outcome of mitral valve repair in patients with preoperative atrial fibrillation, reported 80% persistence of AF in those patients with preoperative AF and 0% in the subset of recent onset AF, therefore, suggesting early operation for better long-term atrial rhythm. Large left atrial size correlated weakly with late AF. No other factors correlated with late postoperative rhythm. The 5-year survival rate however, was similar in groups with SR and AF. They suggested that concomitant operation for supraventricular arrhythmia must have negligible morbidity and no adverse effect on operative mortality to be justifiable.

Reports of our results with the maze procedure, alone or associated to mitral repair or replacement, show an acceptable mortality and low morbidity. It seems that the long-term benefit of maintaining sinus or atrial rhythm might outweigh the small increase in morbidity when the maze procedure is used.

This study was able to identify mitral valve regurgitation, when compared to stenosis, as a possible predictor for SR recovery postoperatively. However, it failed to identify other lone predictors for return to sinus rhythm. All preoperative factors included in the protocol were evenly distributed among patients with SR or AF postoperatively, with the exception of regurgitation versus stenosis. As for duration, the small number of patients presenting AF with less than 6 months' duration does not permit to draw conclusions from this sample.

Regarding our findings and those of other investigators, it seems reasonable to recommend the maze procedure associated to mitral valve operation in every patient presenting chronic AF with the exception of those with pure regurgitation and atrial size less than 50 mm in diameter.

In conclusion, the majority of patients operated on for mitral valve disease in chronic AF maintain the arrhythmia at late postoperative follow-up, in addition to conventional therapy. There was no difference regarding recovering atrial rhythm or relation to preoperative sex, age, previous cardiac operation, left atrial size, left ventricular ejection fraction, type of repair, or prosthesis implanted. Mitral regurgitation seems to be more prone to correlate to SR recovery than stenosis.

References

1. Yang SS, Maranhão V, Monheit R, et al. Cardioversion following open heart valvular surgery. Brit Heart J 1966;28: 309–15.
2. Kahn DR, Krish MM, Ferguson PW, Sloan H. Cardioversion after mitral valve operations. Circulation 1967:35(suppI 1): 182–85.
3. Obadia JF, El Farra M, Bastien OH, Lièvre M, Martelloni Y, Chassignolle JF. Outcome of atrial fibrillation after mitral valve repair. J Thorac Cardiovasc Surg 1997;114:179–85.
4. Hioki M, Ikeshita M, Iedokoro Y, et al. Successful combined operation for mitral stenosis and atrial fibrillation. Ann Thorac Surg 1993;55:776–8.
5. Jatene AD, Sosa E, Tarasoutchi F, Jatene MB, Pomerantzeff PMA. Surgical treatment of atrial fibrillation with maze procedure: initial experience. Rev Bras Cir Cardiovasc 1992; 7:107–11.
6. Gregori F Jr, Cordeiro CO, Couto WJ, da Silva SS, de Aquino WK, Nechar AJ. Cox maze operation without cryoblation for the treatment of chronic atrial fibrillation. Ann Thorac Surg 1995;60:361–3.
7. Kosakai Y, Kawaguchi AT, Isobe F, et al. Cox maze procedure for chronic atrial fibrillation with mitral valve disease. J Thorac Cardiovasc Surg 1994;108:1049–54.
8. Renekov L, McDonald L. Apraisal of electroconversion in treatment of cardiac dysrhythmias. Brit Heart J 1968;30:786–811.
9. Bailey GW, Braniff BA, Hancock EW, et al. Relation of left atrial pathology to atrial fibrillation in mitral valvular disease. Ann Intern Med 1968;69:13–20.
10. SanFilippo AJ, Abascal VM, Sheenan M, et al. Atrial enlargement as a consequence of atrial fibrillation. Circulation 1990; 82:792–7.
11. Acar J, Michel PL, Cormier B, et al. Features of patients with severe mitral stenosis with respect to atrial rhythm. Acta Cardiol 1992;47:115–24.
12. Cox JL, Schuessler RB, D'Agostino HJ. The surgical treatment of atrial fibrillation III. Development of a definitive surgical procedure. J Thorac Cardiovasc Surg 1991;101: 569–83.
13. Sandoval N, Velasco VM, Orjuela H, et al. Concomitant mitral valve or atrial septal defect surgery and the modified Cox-Maze procedure. Am J Cardiol 1996;77:591–6.
14. Melo JQ, Neves JP, Abecasis LM, Adragão P, Ribeiras R, Seabra-Gomes R. Operative risks of the maze procedure associated with mitral valve surgery. Cardiovasc Surg 1997;5: 112–6.
15. Maratia C, Kalil RAK, Sant'Anna JRM, et al. Predictive factors to sinus rhythm recover after mitral valve surgery in patients with atrial fibrillation. Rev Bras Cir Cardiovasc 1997; 12:17–23.
16. Flugelman MY, Hasin Y, Katznelson N, Kriwisky M, Shefer A, Gotsman MS. Restoration and maintenance of sinus rhythm after mitral valve surgery for mitral stenosis. Am J Cardiol 1984;54:617–9.
17. Chua YL, Schaff HV, Orszulak TA, Morris JJ. Outcome of mitral valve repair in patients with preoperative atrial fibrillation. J Thorac Cardiovasc Surg 1994;107:408–15.