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Original Article

Internal Medicine Section

Sinus Rhythm in Rheumatic Mitral Stenosis after Balloon Mitral Valvotomy: Is it Feasible?

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ABSTRACT

Introduction: Atrial Fibrillation (AF) is largely present in patients with rheumatic valvular disease, leading to hospitalizations.

Aim: We aimed to study the restoration and maintenance of Sinus Rhythm (SR) in rheumatic patients with Mitral Stenosis (MS) and AF after Balloon Mitral Valvotomy (BMV) and evaluated the factors which affect the maintenance of SR.

Materials and Methods: A total of 50 patients who underwent BMV at U. N. Mehta Institute of Cardiology and Research Centre from 2010 November to 2013 January were included in the study. Subsequently, all patients were treated with amiodarone and electrical cardioversion was applied in patients in whom it was necessary. The patients were followed for six months for conversion and maintenance of SR.

Results: Total 34 (68%) patients reverted to SR. Twelve patients reverted to SR with amiodarone and 22 patients with electrical cardioversion and amiodarone. Out of the total, 29 patients and 26 patients remained in SR at the end of follow up at 3 months and 6 months respectively.

Conclusion: Smaller Left Atrial (LA) size and greater Mitral Valve Area (MVA) are the chief predictors of restoration and maintenance of SR. Combining BMV with an aggressive anti-arrhythmic strategy offers the best prospect of rhythm control.

Keywords: Amiodarone, Atrial fibrillation, Rheumatic heart disease

INTRODUCTION

Rheumatic Heart Disease (RHD), an undesirable outcome of valvular damage caused by an excessive immune response to Group-A streptococcal infection, usually during childhood, yet remains a major challenge in developing countries [1]. It is anticipated that no less than 15.6 million people have clinically recognized RHD with yearly mortality rate between 3% and 12.5% [2,3]. Mitral valve is majorly affected in patients with RHD. In the developing countries, Mitral Stenosis (MS) evolves more rapidly, possibly because of severe or repeated streptococcal infections, genetic influences, or economic conditions and might lead to occurrence of symptoms in the late teens and early twenties [4].

In India, RHD even now portrays considerable number of hospital admissions and one-fourth of patients with rheumatic valvular heart disease have Atrial Fibrillation (AF) [5]. Probability of development of AF is high in patients with MS, owing to Left Atrial (LA) dilatation in response to valve obstruction and the inflammatory and fibrotic changes caused by the rheumatic process [6,7]. Along with its advent, AF tends to become persistent over time. With the onset of AF, there is an unexpected loss of the atrial involvement to ventricular filling and about 30% reduction in cardiac output. Moreover, there is a potential for a sudden increase in LA pressure, particularly with rapid ventricular rates due to a critical drop-off in diastolic filling times and the probability for a significant rise in the associated risk of thrombo-embolism [8].

Various anti-arrhythmic drugs are available for management of rheumatic AF [9]. One of which is amiodarone. Though amiodarone is one of the most effective anti-arrhythmic agents in maintaining Sinus Rhythm (SR), only a small number of studies have concentrated on its efficacy in AF associated with rheumatic MS. However, the optimal strategy to treat the condition has not yet been established. Thus, we aimed to study the restoration and maintenance of SR rheumatic patients with MS and AF after Balloon Mitral Valvotomy (BMV) and evaluate the factors which affect the maintenance of SR.

MATERIALS AND METHODS

Study Design and Patient Population: This was an observational study in which a total of 50 patients who underwent BMV between November 2010 and January 2013 at U. N. Mehta Institute of Cardiology and Research Centre, India were enrolled. Patient characteristics were recorded at baseline, procedure, post-cardioversion and follow ups. The study complies with Declaration of Helsinki and was approved by Institutional Ethics Committee.

Patients with rheumatic MS and AF who underwent BMV were included in the study if the duration of AF was at least one week. Informed consent to receive amiodarone and/or Direct Current (DC) cardioversion was taken from all patients. Patients with left atrial size of >60mm, AF of more than one year duration and with contra-indication to BMV/amiodarone or DC cardioversion were excluded.

Study Procedure: The duration of AF was evaluated by taking a detailed history corroborated by an ECG. All the patients underwent a detailed echo-color doppler study. Left atrial size was measured in the parasternal long axis view as the maximum distance from trailing edge of aortic wall of LA to leading edge of posterior wall of LA at the end of ventricular systole. Tricuspid Regurgitation (TR) was evaluated. Mitral Valve Area (MVA), peak and mean transmitral gradients and Left Ventricular Ejection Fraction (LVEF) were estimated. Trans-thoracic and trans-esophageal echocardiography was performed again in all the patients one day before BMV to assess suitability. BMV was performed using Inoue balloon technique. The hemodynamic data, including Left Atrial Pressure (LAP), Left Ventricular End Diastolic Pressure (LVEDP) and trans-mitral gradient were obtained before and after BMV. Procedure success, achieved in all patients, was defined by a

Mitral Valve Area (MVA) ≥ 1.5 cm^2 or ≥ 50 % increase in MVA with no mitral regurgitation >2/4 Seller's grade.

All the patients received amiodarone 200mg thrice daily in the first week and thereafter a maintenance dose of 200mg once daily. All were given warfarin to maintain International Normalized Ratio (INR) between 2 and 2.5.

After the end of one month, patients were evaluated for conversion to SR on the basis of a 12-lead ECG and 24 hour Holter. Patients who remained to be in AF were attempted for cardioversion to SR using electric DC shock. Electrical cardioversion was performed under deep sedation with intravenous diazepam or midazolam, the first synchronized DC shock was attempted with 100 J (biphasic); if it failed to restore SR, further shocks of 200 and 360 J were given. Regardless of rhythm, all the patients in the trial continued to receive amiodarone 200mg daily. Amiodarone was continued in the same dose in all patients for a total duration of six months from the time of inclusion. Patients were followed up at one, three and six months. At every follow up, a 12-lead ECG was recorded, 24 hour Holter was done to document the conversion to SR, intermittent AF and patients were evaluated for adverse effect of amiodarone. After three months of amiodarone therapy, and subsequently at next follow up, thyroid function test, chest X-ray, serum transaminase levels, pulmonary function test and a slit lamp examination for corneal opacities were done. Anti-coagulation was continued indefinitely in patients with AF and for minimum of three months who reverted to SR.

STATISTICAL ANALYSIS

Continuous variables were expressed as mean±standard deviation and categorical variables as absolute and relative frequencies. Normally distributed quantitative data were analyzed using the Student's t-test (two tailed, independent) to compare means; otherwise the Mann-Whitney U test was used. The Chi square test (or Fisher exact test for cells less than 5) was used to analyze differences between categorical variables. A p-value of < 0.05 was used as a cut-off for statistical significance. All data were analyzed using the Statistical Package for Social Sciences (SPSS; Chicago, IL, USA) program, version 15.

RESULTS

Total 50 patients, who were enrolled in the study, mean age of the patients was 37.48±9.82 years. Nineteen (38%) patients were males and 31 (62%) patients were females. Breathlessness (100%), palpitations (76%) and fatigue (64%) were the predominant complaints. Baseline demographics of patients are outlined in [Table/Fig-1]. End diastolic murmur due to aortic valve disease was present in 15 (30%) patients. While pulmonary hypertension was present in 46 patients; with most patients (n=31) having mild pulmonary hypertension. Baseline echocardiographic and electrocardiographic details of patients are shown in [Table/Fig-2].

Pre-BMV characteristics of patients were recorded one day before procedure [Table/Fig-3]. Pre-BMV echo also revealed that even though both groups of patients had similar valve areas, those patients who regained SR had lesser Wilkinson's score (9.03±1.64 vs. 10.62±1.39, p<0.001), lesser peak and mean transmitral gradients (20.93±5.16 vs. 28.57±8.80, p<0.001 and 12.48±3.16 vs. 17.43±6.94, p=0.001), smaller the LA size (43.86±2.78 vs. 53.48±4.67, p<0.001) and lesser PA pressures (54.96±11.14 vs. 61.67±13.65, p=0.062). The chief parameters like LAP, LVEDP and trans-mitral gradient were measured both before and after BMV. There was a significant difference (p<0.001) in these parameters before and after BMV. Mean LAP was 27.24mmHg and 16.20mmHg; mean LVEDP was 7.94mmHg and 11.72mmHg; trans-mitral gradient was 19.36mmHg and 4.60mmHg at before and after BMV, respectively. All patients were given amiodarone and digoxin. Additionally, 41 and 15 patients were given beta-blockers and calcium channel blockers, respectively.

Variables	n = 50 patients
Age, (Mean±SD, yrs)	37.48±9.82
Female, n (%)	31 (62%)
Predominant Complaints	
Breathlessness, n (%)	50 (100%)
Palpitations, n (%)	38 (76%)
Fatigue, n (%)	32 (64%)
Syncope, n (%)	1 (2%)
Pedal edema, n (%)	7 (14%)
Chest pain, n (%)	4 (8%)
Previous BMV/CMV, n (%)	26 (52%)
Cerebral Vascular Accident, n (%)	5 (10%)
Physical Examination	
Heart rate	
<60 per min, n (%)	1 (2%)
60 –100 per min, n (%)	21 (42%)
> 100 per min, n (%)	28 (56%)
Systolic blood pressure, (Mean±SD, mmHg)	107.80±12.64
Diastolic blood pressure, (Mean±SD, mmHg)	71.36±10.93
Increased jugular vein pressure, n (%)	25 (50%)
NYHA Class	
II, n (%)	30 (60%)
III, n (%)	19 (38%)
IV, n (%)	1 (2%)

[Table/Fig-1]: Baseline patient demographics.
BMV/CMV – Balloon mitral valvotomy/Closed mitral valvotomy; NYHA – New York Heart Association

Variables	n = 50 patients
Aortic Regurgitation	
Grade 1, n (%)	2 (4%)
End diastolic murmur, n (%)	15 (30%)
End systolic murmur, n (%)	1 (2%)
Tricuspid Regurgitation	
Pre systolic murmur, n (%)	1 (2%)
Mild, n (%)	8 (16%)
Moderate, n (%)	8 (16%)
Severe, n (%)	5 (10%)
Pulmonary Hypertension (Mean PA Pressure)	
Mild, n (%)	31 (62%)
Moderate, n (%)	10 (20%)
Severe, n (%)	5 (10%)
Left Ventricular Hypertrophy, n (%)	0 (0%)
Right Ventricular Hypertrophy, n (%)	18 (36%)
RBBB, n (%)	5 (10%)
QT interval, (Mean±SD, ms)	421.86±52.77

[Table/Fig-2]: Baseline echo-cardiographic and electrocardiographic details of patients.
RBBB - Right Bundle Branch Block

Atrial fibrillation in patients was reported before BMV, at one-month follow up, after cardioversion ECG, at 3-month and six-month follow up [Table/Fig-4]. Three months follow up was available in all the patients and six months follow up was available in 47 patients. At one-month follow up, 12 (24%) patients were pharmacologically converted to SR. Of the remaining 38 patients in AF, electrical cardioversion was successful in 22 (57.89%) patients. Most of the patients reverted to SR with 200 DC shock. Thus, at the end of one month 34 (68%) patients were in SR. The patient details regarding cardioversion ECG are reported in [Table/Fig-5].

Variables	n = 50 patients
MVA (PHT), (Mean±SD, cm^2)	0.88±0.17
Wilkinson Score, (Mean±SD, mmHg)	9.70±1.71
Gradient: peak, (Mean±SD, mmHg)	24.14±7.84
Gradient: mean, (Mean±SD, mmHg)	14.56±5.61
Left atrial size, (Mean±SD, mm)	47.90±6.03
LVEF, (Mean±SD, %)	55.10±3.57
PAP, (Mean±SD, mmHg)	57.78±12.58
LVEDP, (Mean±SD, mmHg)	7.94±2.99
LAP, (Mean±SD, mmHg)	27.24±10.03
Mitral Regurgitation	
Grade 1, n (%)	27 (54%)
Grade 2, n (%)	1 (2%)
Grade 3, n (%)	1 (2%)
Aortic Regurgitation	
Grade 1, n (%)	9 (18%)
Grade 2, n (%)	4 (8%)
Grade 3, n (%)	1 (2%)
End diastolic murmur, n (%)	1 (2%)
Tricuspid Regurgitation	
Mild, n (%)	21 (42%)
Moderate, n (%)	13 (26%)
Severe, n (%)	14 (28%)

[Table/Fig-3]: Pre-BMV characteristics of patients.
MVA - Mitral valve area; PHT - Pressure half time; LVEF - Left Ventricular ejection fraction; PAP - Pulmonary arterial pressure; LVEDP - Left ventricular end diastolic pressure; LAP - Left atrial pressure

	Sinus Rhythm, n (%)	Atrial Fibrillation, n (%)
Before BMV (N = 50)	0 (0%)	50 (100%)
1-month follow up (N=50)	12 (24%)	38 (76%)
Post- cardioversion ECG (N = 50)	34 (68.0%)	16 (32.0%)
3-month follow up (N = 50)	29 (58.0%)	21 (42.0%)
6-month follow up (N = 47)	26 (55.3%)	21 (44.7%)

[Table/Fig-4]: Patients with atrial fibrillation before BMV, at 1-month follow up, post-cardioversion ECG, at 3-month follow up and 6-month follow up.

Variables	Sinus Rhythm (n = 34)	Atrial Fibrillation (n = 16)	p-value
Atrial Fibrillation			
Coarse	0 (0%)	15 (93.75%)	<0.001
Fine	0 (0%)	1 (6.25%)	
Left Ventricular Hypertrophy, n (%)	0 (0%)	0 (0%)	
Right Ventricular Hypertrophy, n (%)	13 (38.23%)	8 (50.00%)	0.011
RBBB, n (%)	0 (0%)	3 (18.75%)	
Axis			
RAD, n (%)	18 (52.94%)	13 (81.25%)	0.054
QT interval, (Mean±SD, ms)	418.18±37.90	425.69±48.13	0.843

[Table/Fig-5]: Patient characteristics after cardioversion ECG.
RBBB - Right bundle branch block; RAD - Right angle deviation

At the end of three months 29 (58%) patients remained in SR. None of the 16 patients who were in AF after cardioversion ECG converted to the SR. The variables that were significantly different in patients with SR and those with AF were: mitral valve area (PHT), trans-mitral gradient (peak and mean), left atrial size, left ventricular end-diastolic diameter, pulmonary atrial pressure, TR, right ventricular hypertrophy, and right angle deviation in ECG axis [Table/Fig-6]. Follow up of 47 patients was completed at six-month. At the end of six months 26 (55.3%) patients remained in SR. The

Variables	Sinus Rhythm (n=29)	AF Present (n=21)	p-value
MVA (PHT), (Mean±SD, cm^2)	1.74±0.17	1.58±0.16	0.002
Gradient: peak , (Mean±SD, mmHg)	10.14±2.63	14.09±4.53	0.001
Gradient: mean, (Mean±SD, mmHg)	5.03±1.67	6.86±2.90	0.025
Left atrial size, (Mean±SD, mm)	42.07±2.07	49.28±4.7	<0.001
LVEF, (Mean±SD, %)	54.66±4.42	55.71±1.79	0.566
PAP, (Mean±SD, mmHg)	38.34±8.58	46.95±12.24	0.009
Mitral Regurgitation			
Grade 1, n (%)	17 (58.60%)	17 (81.00%)	0.315
Grade 2, n (%)	4 (13.80%)	1 (4.80%)	
Aortic Regurgitation			
Grade 1, n (%)	6 (20.70%)	2 (9.50%)	0.681
Grade 2, n (%)	3 (10.30%)	2 (9.50%)	
Grade 3, n (%)	1 (3.4%)	0 (0%)	
End diastolic murmur, n (%)	1 (3.4%)	0 (0%)	
Tricuspid Regurgitation			
Mild, n (%)	24 (82.80%)	7 (33.30%)	0.001
Moderate, n (%)	5 (17.2%)	13 (61.90%)	
Severe, n (%)	0 (0%)	1 (4.8%)	
Atrial Fibrillation			
Coarse	0 (0%)	20 (95.20%)	<0.001
Fine	0 (0%)	1 (4.8%)	
Left Ventricular Hypertrophy, n (%)	0 (0%)	0 (0%)	
Right Ventricular Hypertrophy, n (%)	9 (31.00%)	12 (57.10%)	0.004
RBBB, n (%)	0 (0%)	3 (14.3%)	
Axis			
RAD, n (%)	14 (48.30%)	17 (81.00%)	0.019
QT interval, (Mean±SD, ms)	420.10±37.79	421.71±46.29	0.782

[Table/Fig-6]: Comparison of echocardiographic and electrocardiographic findings in patients at 3-month follow up.
MVA - Mitral valve area; PHT - Pressure half time; LVEF - Left ventricular ejection fraction; PAP - Pulmonary arterial pressure; RBBB - Right bundle branch block; RAD - Right angle deviation

variables like mitral valve area (PHT), trans-mitral gradient (peak and mean), left atrial size, left ventricular end-systolic diameter, pulmonary atrial pressure, right ventricular hypertrophy, and right angle deviation in ECG axis were significantly different in patients with SR and those with AF. The final mitral valve area achieved and LA size in patients who reverted to SR and those who remained in AF at the end of six months when compared is as follows: MVA (PHT) (Mean±SD, cm^2) 1.67±0.15 vs. 1.55±0.13 (p=0.005) and left atrial size, (Mean±SD, mm) 41.04±1.40 vs. 48.24±4.18 (p<0.001) respectively [Table/Fig-7]. On multivariate analysis, lesser LA size and greater MVA were found to be significant predictors of restoration and maintenance of SR. Holter was done at every follow up in all the patients who reverted to SR and no episode of intermittent AF was documented.

Out of 50 patients, only one patient developed hypothyroidism. Rest all the patients tolerated amiodarone. There were no hepatic, gastrointestinal or ophthalmic complications. No embolic complications related to cardioversion occurred in any of the patient. During the follow up, any embolic or transient ischemic attack events did not occur.

DISCUSSION

The association between AF, RHD, and particularly MS or mitral regurgitation, is well established [10]. The Framingham study depicted that the presence of rheumatic disease was the strongest predictor of AF [11]. AF is estimated to occur in about 40% of

Variables	Sinus rhythm (n=26)	AF Present (n=21)	p-value
MVA (PHT), (Mean±SD,cm^2)	1.67±0.15	1.55±0.13	0.005
Gradient: peak, (Mean±SD, mmHg)	10.58±2.26	13.81±3.28	0.001
Gradient: mean, (Mean±SD, mmHg)	5.54±1.30	7.86±2.56	0.002
Left atrial size, (Mean±SD, mm)	41.04±1.40	48.24±4.18	<0.001
LVEF, (Mean±SD, %)	54.62±4.67	55.48±1.50	0.922
PAP, (Mean±SD, mmHg)	36.96±6.65	43.10±11.39	0.037
Mitral Regurgitation			
Grade 1, n (%)	17 (65.40%)	17 (81.00%)	0.514
Grade 2, n (%)	4 (15.40%)	1 (4.8%)	
Aortic Regurgitation			
Grade 1, n (%)	7 (26.90%)	2 (9.50%)	0.304
Grade 2, n (%)	2 (7.70%)	1 (4.80%)	
Grade 3, n (%)	1 (3.80%)	0 (0%)	
Tricuspid Regurgitation			
Mild, n (%)	20 (76.90%)	10 (47.60%)	0.066
Moderate, n (%)	6 (23.10%)	10 (47.60%)	
Severe, n (%)	0 (0%)	1 (4.8%)	
Atrial Fibrillation			
Coarse	0 (0%)	20 (95.20%)	0.000
Fine	0 (0%)	1 (4.8%)	
Left Ventricular Hypertrophy, n (%)	0 (0%)	0 (0%)	
Right Ventricular Hypertrophy, n (%)	8 (30.80%)	10 (47.60%)	0.031
RBBB, n (%)	0 (0%)	3 (14.3%)	
Axis			
RAD, n (%)	12 (46.20%)	16 (76.20%)	0.037
QT interval, (Mean±SD, ms)	420.10±37.79	421.71±46.29	0.782

[Table/Fig-7]: Comparison of echocardiographic and electro-cardiographic findings in patients at 6-month follow up.
Mitral valve area; PHT - Pressure half time; LVEF - Left ventricular ejection fraction; PAP - Pulmonary arterial pressure; RBBB - Right bundle branch block; RAD - Right angle deviation

patients with MS and 75% in those with mitral regurgitation [12]. The primary management must be directed at optimization of fluid status, rate control of AF, anti-coagulation and inotropic support of right ventricular function (if required) and subsequent maintenance of SR [8]. Moreover, percutaneous BMV has transpired as a preferred modality for better chance of successful cardioversion and better maintenance of patients in SR [13].

The present study demonstrates that following BMV, amiodarone and cardioversion can be utilized with good success rate and very fewer complications in patients with AF and rheumatic MS. Twelve patients (24%) were converted to SR with amiodarone alone at the end of one month. We found that electrical cardioversion after BMV has a success rate of 57.89%. In our study, no embolic complications related to cardioversion occurred. Total 34 (68%) patients reverted to SR. By the end of six months follow up, 26 (55.3%) patients remained in SR.

A previous study by Kapoor et al., reported the safety and efficacy of low dose amiodarone in the management of persistent AF following BMV, as 39% of the patients were converted to SR with amiodarone alone [14]. The Pharmacological Intervention in AF (PIAF) trial was a randomized trial in 252 patients with AF of between 7 days and 360 days duration, which compared rate (group A, 125 patients) with rhythm control (group B, 127 patients). Amiodarone administration resulted in pharmacological restoration of SR in 23% of patients [15]. Krittayaphong et al., also demonstrated effectiveness of cardioversion in patients with rheumatic MS and AF [16]. They documented a success rate of 71% and stated that, cardioversion should be performed early after BMV, if the AF was of short duration and LA was moderately enlarged.

If we compare the pre-BMV echo of patients who converted to SR to those who remained in AF, they had higher MVA, smaller LA size and lesser transmitral gradients. Probably they had lesser electrical remodeling of the LA which helped them to get converted to SR and maintain it. They also had lesser Wilkinson's scores which might have helped to achieve a higher MVA after BMV in these patients.

In our study, lesser LA size and greater MVA were found to be significant predictors of restoration and maintenance of SR. Previous studies state various factors to be associated with conversion and maintenance of SR. Studies by Eid Fawzy et al., have shown that older age, larger LA and smaller MVA are predictors of AF [17]. Guo GB et al., have reported that a reduction in LA size and an increase in the MVA and not the duration of AF are independent predictors for successful maintenance of SR [18]. On contrary, Kavthale et al., have shown that lower age, shorter duration of AF, smaller atrial size are associated with successful restoration of the SR [19]. Several other studies also demonstrated that LA dimension has an impact on the incidence of AF after BMV in patients with SR [16,20,21].

All patients well tolerated amiodarone except one patient, who developed hypothyroidism. Several studies have reported remarkable tolerance of amiodarone in low maintenance doses [22-24] and also anticipated its relative safety as it does not decrease left ventricular function [25].

Management of patients with rheumatic MS and AF becomes essential as the mortality of untreated patients with MS is attributable to progressive heart failure in 60–70% of patients, systemic embolism in 20–30% and pulmonary embolism in 10% [26,27]. Hu et al., compared rate control and rhythm control strategies in patients with AF after percutaneous BMV [28]. They showed that patients benefited from restoration and maintenance of SR in terms of improved AF-related symptoms, six min walk tests and Quality of Life (QoL) and of LA size normalization. Rhythm control should therefore be considered as the preferred initial therapy for this group of patients. It must be noted however, that they excluded patients with LA size greater than 45mm. They decided for this as they believed that larger the LA size higher is the risk of AF recurrence. They felt that in patients with recurrent AF, rhythm control is not necessary before rate control in these patients. Thus, a conjunction of BMV with electrical and therapeutic interventions proposes safe and effective treatment of patients with MS and AF.

LIMITATION

Our sample size was small and follow up period of 6 months was too short to detect any long term outcomes of the treatment strategy. The risk of relapse to AF or side effects with amiodarone rises after 18 months. Prevention of AF has not yet been proved to prolong survival. Long-term benefits of rhythm control therapy are yet to be established and therefore await further investigation. The evaluation of the effect of amiodarone on the maintenance of SR after cardioversion requires a randomized study between amiodarone and the placebo. We also did not evaluated the effect of duration of AF on the restoration and maintenance of SR, as duration of AF can only be determined on the basis of available ECGs and there is a possibility to underestimate the duration of AF. We also did not monitor the plasma levels of amiodarone due to economic constraints.

CONCLUSION

Smaller LA size and greater MVA are the chief predictors of restoration and maintenance of SR. BMV helps in achieving a smaller LA size and electrical remodeling of the LA and has favorable

effect on the incidence of AF in patients with severe MS. However, most patients in chronic AF fail to revert to SR in the absence of an aggressive anti-arrhythmic strategy and cardioversion. Therefore, combining BMV with an aggressive anti-arrhythmic strategy offers the best prospect of rhythm control.

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