

New Procedure for Treatment of Atrial Fibrillation in Patients with Valvular Heart Disease

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Abstract- Patients with valvular heart disease suffer from atrial fibrillation for more than 12 months after valve surgery and have a low probability of remaining in sinus rhythm. We performed an intra-operative procedure similar to surgical maze III procedure for conversion of this arrhythmia to sinus rhythm. We did this study to evaluate the efficacy of this procedure to restore the sinus rhythm in patients with valvular heart disease. 28 patients with valvular heart disease and chronic persistent atrial fibrillation underwent different combinations of valve surgery and concomitant reduction of left and right atrial size and resection of both atrial auricles in Shahid Madani cardiothoracic center from September 2004 to October 2008. The procedure for atrial fibrillation treatment was performed with cardiopulmonary bypass and after mitral valve replacement. There was one in-hospital death postoperatively because of respiratory failure, but no other complication till 6 months after the operation. Out of 28 patients, 23 were in sinus rhythm one week after the operation, one patient had junctional rhythm after the operation that restored to sinus rhythm and 4 patients had persistent atrial fibrillation. During the 12-month follow up, atrial fibrillation was corrected in 82.14%. Doppler echocardiography in these patients with sinus rhythm demonstrated good atrial contractility. This procedure on both atria is effective and less invasive than the original maze procedure to eliminate the atrial fibrillation, and can be performed in patients with valvular heart disease without increasing the risk of operation.

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Introduction

Atrial fibrillation (AF) is a common arrhythmia that affects 0.4% of the general population and up to 10% of persons older than 65 years of age. Mitral valve disease can predispose patients to persistent atrial fibrillation (AF). Sixty percents of patients admitted for mitral valve surgery are known to have chronic persistent AF. In general, the arrhythmia will persist even after the valve surgery. This arrhythmia affects the patients in an adverse way to reduce the ejection fraction. Multiple side effects occur with atrial fibrillation, including tachycardia, thromboembolism, and 15% to 20% decrease in cardiac output due to loss of ventricular filling. Because developing AF signifies pathologic

degradation and symptomatic deterioration in these patients, simultaneous treatment of AF and organic lesions has long been desired and expected to improve prognosis. At the same time, studies have provided data that a heart rate more than 120 beats/min over a prolonged period of time may lead to left ventricular dysfunction (1). During the last decade, several techniques have been designed to either ablate the arrhythmia or ameliorate its detrimental effects. Attention has been focused on the development of catheter ablation technique for reversal of AF rhythm, but it has several limitations to apply a linear ablation. The only proven technique that cures all forms of atrial fibrillation is the Cox Maze III procedure. This operation is the result of decades of research by James

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Surgical therapy for AF

Cox. He proposed that atrial fibrillation is due to simultaneous presence of multiple, randomly wandering reentrant wavelets. He reported a 99% success rate with his operations. The length of time it takes to do this operation is significant. Increased pump time and aortic cross clamp time, and significant bleeding complications from the suture lines and due to its technical complexity it has been performed on a limited number of the patients. Melo et al did radiofrequency pulmonary vein isolation in association with mitral valve surgery. Radiofrequency energy produces lesions on the heart, eliminating the incisions necessary in the Maze procedure. Atrial contractility recovered in 70% of their patients after the operation (1). We performed this procedure in such a way to reduce the pump time and aortic cross clamp time, and without risk of bleeding from the suture lines. As this surgical procedure is not done routinely in Iran, we decided to evaluate the efficacy of this procedure in patients with AF and concomitant valvular heart disease at Madani Heart Center in Tabriz and Behsat Hospital in Tehran.

Patients and Methods

This study was reviewed and approved by the Institutional Review Board (IRB) and written informed consent was obtained from each patient. 28 patients with different forms of valve pathologies and permanent AF were studied in Shahid Madani cardiothoracic center (Tabriz University of Medical Sciences) from September 2004 to October 2008. All patients had chronic permanent AF for more than 12 months. Patients with paroxysmal AF were excluded from this study. These patients underwent simple procedure with reduction of both right and left atrial size and auricular resection, combined with valvular surgery. These patients were submitted to different combinations of valve surgery. In all patients, rate control medications such as a calcium channel blocker and/or digoxin were continued until the day before surgery. Patients with paroxysmal AF or with persistent AF lasting less than 12 months were excluded from this study. ECGs were recorded during recovery and before discharge. Standard 12 lead-ECGs and TTE were performed 1, 3, 6 and 12 months after operation.

Surgical technique

After the induction of anesthesia, the heart was exposed through the conventional median sternotomy. After heparin administration and cannulation, cardiopulmonary bypass with moderate hypothermia,

the heart was arrested by antegrade cold blood cardioplegia. The left atrium was opened and assessed for clot in the auricle. Then left auricle was resected. Mitral valve was evaluated and if necessary, was replaced with mechanical or biological mitral valve. After replacement of mitral valve, the space between the pulmonary veins was plicated with contious prolen sutures to reduce the size of left atrium and to interrupt the reentry pathway as shown in figure 1. Then left atrium was closed and right atrium size was also reduced with cutting the anterior wall in two separate directions and suturing these sites to plicate the right atrium. After decannulation of right atrium, the auricle was closed in a way to eliminate the right auricle as shown in figure 2.

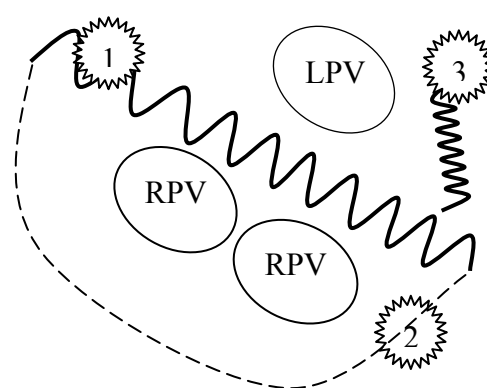


Figure 1. Surgical procedure on left atrium. (1) Suture line between the pulmonary veins. (2) Left atrial incision line. (3) Left auricle resection site

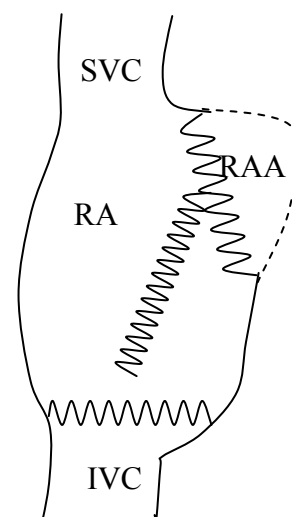


Figure 2. Site of suture lines on the right atrium. RAA: Right atrial auricle, SVC: Superior vena cava, IVC: Inferior vena cava, RA: Right atrium.

Antiarrhythmic prophylactic treatment was carried out on a routine basis. Amiodarone was begun after the induction of the anesthesia (300 mg i.v. bolus, followed by 1200 mg/24 h until the first post operative day, when oral administration of 200 mg/8 h was begun; after discharge, a maintenance regimen of 200 mg/24 h was continued up to 6 months). An anticoagulant was administered in the postoperative period.

Statistical analysis was performed with student's t-test and data are expressed as mean \pm standard deviation (SD). Left atrial diameter, cardio-thoracic ratio and AF duration before the operation were considered to be the variables that would affect the surgical result. In this procedure, there is no risk of damage to the surrounding structure, as in radiofrequency ablation such as damage to the esophagus, A.V node and coronary arteries.

Results

The preoperative characteristic of the patients are shown in Table 1. Twenty patients (71.42%) were in New York Heart Association (NYHA) class III. Mean ejection fraction was 46.00 ± 6.95 . Valve disease was the primary indication for surgery. Concomitant diseases are shown in Table 2. Three patients had previously undergone mitral valve surgery. The average size of the left atrium as measured by echocardiography was 55.2 ± 7.8 mm. The mean cardiopulmonary bypass time and aortic cross clamp time were 120.93 ± 34.36 min and 90.35 ± 29.50 min, respectively, including 15.17 ± 3.67 min ischemic time to perform this additional procedure. Twenty eight patients underwent both atrial size reduction and concomitant cardiac procedures (Table 2), including mitral valve replacement (n=26), aortic valve replacement (n=4), tricuspid valve repair (n=4), and coronary artery bypass (n=4). Three patients (10.71%) had previously undergone mitral valve surgery. Bioprosthesis was implanted in 2 of 26 patients undergoing mitral valve replacement.

Table 1. Preoperative patients' characteristics

Variables	
Number of patients	22
Age (years) (mean \pm SD)	48.10 ± 9.84
Gender(male/female)	10/12
EF (%) (mean \pm SD)	46.00 ± 6.95
LA size(mm) (mean \pm SD)	55.2 ± 7.8

One patient had postoperative bleeding which was controlled with re-exploration. One patient with previous stroke had a postoperative pneumonia which responded to medical treatment. One patient died postoperatively because of respiratory failure and pneumonia. No patient needed permanent pacemaker implantation for postoperative A-V block or sinus node dysfunction. No complication was seen during this procedure.

During the hospital stay after this procedure, 8 patients showed different types of atrial arrhythmias. At the time of discharge, 23 patients (82.14 %) had sinus rhythm, and 4 patients (14.28%) had persistent AF which by no means converted to sinus rhythm. After 12 months, 4 patients (14.28%) were in AF rhythm and 23 patients (82.14%) presented with sinus rhythm. There has been no complication after this procedure. Atrial function checked at hospital discharge, showed bilateral contraction in 23 patients. At the end of the follow up, there was a recovery of atrial function in 23 patients (82.14%).

Discussion

Effective treatment of permanent AF is of greatest interest in cardiac surgery because AF leads to two times higher mortality rates, five times higher risk of stroke, reduced cardiac output and the need of systemic anticoagulation with the risk of bleeding. The incidence among patients scheduled for open heart valve surgery is particularly high and of special importance in mitral valve disease (2).

Table 2. Types of concomitant operations

Type of operation	Number (Percentage)
Mitral valve replacement	12 (54.54%)
Mitral and aortic valve replacement	4 (18.18%)
Mitral valve replacement and tricuspid repair	4(18.18%)
Mitral valve replacement with coronary artery bypass	2 (9.09%)
Reoperation on mitral valve	2 (9.09%)

Surgical therapy for AF

According to pooled analysis of controlled clinical trials with warfarin, anticoagulation therapy can only reduce the risk of stroke rate by 62% and there is a risk of bleeding in these patients (3).

In most patients with AF and valvular heart disease, the arrhythmia will remain after surgical correction of the valvular heart disease, but in patient with intermittent AF or AF with duration of less than 1 year, valvular surgery alone is sufficient to restore the sinus rhythm in majority of patients (3,4). The Cox's maze procedure involves extensive incision and suturing of the atria, and prolongs the arrest time in valvular heart surgery. The bleeding from the suture line in the posterior of left atrium is very difficult to control (6). In order to simplify the original maze procedure, as we do not have any incision inside the left atrium. Under direct vision, we only plicate the left atrium between the left and right pulmonary veins with prolene suture, so as to reduce the left atrium size and to interrupt the conduction pathway between the pulmonary veins. As a consequence, the extra arrest time to complete the ablation was about 15 min. Radiofrequency and cryo ablation are other methods which can convert the atrial fibrillation to sinus rhythm but have several disadvantages such as trauma to the esophagus and circumflex artery, new postoperative arrhythmia, and pulmonary vein stenosis. The ablation probe also has a high price that limits this usage. Discontinuous or non-transmural lesion is probably the most important factor in the outcome of RF ablation and could be the origin of the new postoperative arrhythmias (7,8). Studies have shown that AF treatment was effective in 85% of the patients with radiofrequency and cryo ablation (9). After radiofrequency ablation, early atrial arrhythmias occurs within the first weeks postoperatively, the majority of these events responses to antiarrhythmic therapy or DC cardioversion, if necessary. These arrhythmias seem to diminish when the healing processes completes. But in our method, we did not have any atrial arrhythmia except the atrial fibrillation that remained after the operation in 4 patients. Reduction of left atrial size can prevent thromboembolism in patients with left atrial thrombosis (10).

Other studies with simple AF procedures in patients with valvular heart diseases, such as epicardial and/or endocardial selective isolation of pulmonary vein, had a success rate of 50-85%(10). In our experience, we have obtained a sinus rhythm in 82.14% of the patients with biatrial size reduction. In epicardial ablation, fatty areas and epicardial fibrosis in re-operations are difficult

points for ablation (11). In our cases, we only reduced the atrial size by plication using prolene suture which was simple, fast and safe with no complication and can be performed in every patient with AF rhythm. In patients with cryo-ablation, in-hospital success rate of conversion to sinus rhythm is only 50% but in follow up the results of both radiofrequency and cryo-ablation methods are nearly the same. The aim of AF surgery is restoration of atrial contraction and sinus rhythm. In our study, we detected a bilateral contraction in 82.14% of sinus rhythm patients by trans-thoracic Doppler echocardiography. In addition, we have observed immediate recovery of left atrial function in majority of patients with trans-esophageal echocardiography after the operation in the operation room. Our procedure during valvular surgery, yielded a 82.14% success rate about 1 year after the operation, whereas spontaneous sinus rate restoration following conventional heart surgery occurs in 4.5 to 36% of patients with chronic AF. So we suggest this procedure for every patient with valvular heart disease and permanent AF rhythm.

Auricle resection was done in all of our patients to simplify the completion of ablation scheme and to decrease the risk of thromboembolism in cases with recurrent AF, even with appropriate anticoagulation regimen (12).

Different methods for conversion of atrial fibrillation to sinus rhythm nearly have the same results but in our technique, the time for the procedure is only about 15 minutes and bleeding complication is much less than Cox's maze procedure. Different arrhythmias seen with radiofrequency and cryo are not seen in our procedure and there is no need for ablation probes and devices. Conversion of AF to sinus rhythm has been demonstrated to improve the quality of life (14).

The small number of the patients, lack of regular follow up, and use of amiodarone in the first 6 months post-up are the limitations of this study.

Our data suggest that intraoperative atrial sizes reduction is a low risk and effective procedure to treat AF in patients undergoing valvular heart surgery. These techniques are extremely simple and we suggest them to be performed routinely in AF patients scheduled for open heart surgery in other heart centers in Iran.

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