

# Rheumatic Valvular Heart Surgery and Maze III Procedure

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## Abstract

**Objectives-** Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia. Drug treatment of AF usually leads to an unsatisfactory rate of recurrence. The Cox-maze III procedure for atrial fibrillation has been effective in restoring sinus rhythm in patients with mitral valve disease.

**Methods-** From September 2000 to September 2002, 10 consecutive patients with rheumatic mitral valve disease and chronic AF underwent the Cox-maze III procedure concomitantly with mitral valve replacement. Associated procedures were tricuspid valve repair in 4 patients and aortic valve replacement in 2 patients. Our indications to perform the Maze-III procedure were chronic AF, medical history of previous thromboembolic events and large left atrium on preoperative transthoracic echocardiography.

**Results-** There were 2 men and 8 women with a mean age of  $40 \pm 8$  years. Mean aortic cross-clamp and cardiopulmonary bypass times were  $90 \pm 11$  and  $144 \pm 18$  minutes, respectively. There was no in-hospital mortality. Normal sinus rhythm was restored early post-operatively in 60% and late in 80% of the patients. Right atrial and left atrial contractility was found in 80% and 70% of the patients in transesophageal echocardiography 6 months postoperatively.

**Conclusions-** The maze III procedure associated with mitral valve replacement is a safe and effective surgical technique for conversing AF to sinus rhythm and restoring atrial contractility in rheumatic heart disease (*Iranian Heart Journal 2004; 5(3):11-15*).

**Key words:** Valvular heart disease ■ heart valve surgery ■ arrhythmia

Atrial fibrillation (AF) is a frequent complication in patients with mitral valve disease, causing systemic embolism, cardiac chamber dilatation and decreased cardiac output.<sup>1</sup> Adequate treatment of mitral valve disease often does not relieve the cardiac rhythm disorder, and atrial fibrillation persists or recurs in up to 80% of operated patients. Pharmacological and electrical cardioversion in this setting is often ineffective, and attempts to establish sinus rhythm by serial cardioversions are disappointing.<sup>2</sup>

Therefore, this arrhythmia is usually considered to be permanent, and Maze III

procedure is proposed as a surgical treatment for patients with sustained AF.<sup>3</sup>

In this report, we describe our initial experience with the Maze III procedure in patients with rheumatic valve disease.

## Methods

From September 2000 to September 2002, 10 consecutive patients underwent the Cox-maze III procedure concomitantly with mitral or other valve surgery. All the patients had an indication for cardiac surgery.

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Inclusion criteria for AF surgery were atrial fibrillation lasting for more than 1 year, medical history of previous thromboembolic events and large left atrium on preoperative transthoracic echocardiography. Exclusion criteria were non-cardiac disease; redo operation, severe left ventricular dysfunction and severe pulmonary artery hypertension.

Median sternotomy was the usual approach for surgery. Cardiopulmonary bypass (CPB) was established using two cannulae: one in the inferior vena cava (IVC) and the second directly in the superior vena cava (SVC).

Perfusion temperature was reduced to 25-28°C. After cross-clamping of the ascending aorta, the left atrium was opened for the decompression of the ventricle, and cold crystalloid cardioplegia solution was infused to the aortic root. In concomitant aortic valve disease, the ascending aorta was incised and cardioplegia was directly infused to coronary arteries. The left atrium (LA) incision was carried out behind the interatrial septum and extended encircling the pulmonary veins. The interatrial septotomy was made in the posterior to the orifice of the SVC. In large sized LA, reduction size operation was done. The LA appendage was excised, and an incision was made from its base to the encircling incision. This incision and remnant of LA appendage were closed. Extensive sutures were used to close the encircling incision. An incision from the left atrium to the mid-portion of the posterior mitral valve annulus was made until the coronary sinus was exposed. Fat tissues and remnant of muscle fibers around the coronary sinus and mitral valve annulus were cauterized. This incision was closed partially by 0/4 prolene suture. The mitral valve was excised and replaced with prosthesis or bioprosthesis valve according to the patients' condition. After mitral valve replacement, the encircling incision was completely closed. In cases with aortic regurgitation,

aortic valve replacement was carried out at this stage.

After the repairing of the ascending aorta, the aortic clamp was removed, and the right side portion of the maze III procedure was performed. A long incision from the upper part of the right atrium to IVC was made and extended the T-incision from the inferior right atrial free wall to the tricuspid annulus. At this point, tricuspid valve repair was performed. After cauterizing the fat tissue and muscle fibers around the tricuspid annulus, the incision was partially closed. An incision from the right atrial appendage to the immediate vicinity of the tricuspid annulus in the free wall of the right atrium was made, which was subsequently closed. The right atrial appendage was saved.

All the patients were weaned off CPB with low-dose inotropes. Standard 12-lead as well as right-sided leads of electrocardiography (EKG) was checked daily during the postoperative hospital stay and 1st, 3rd, 6th and 12th months postoperatively thereafter. After surgery, the sinus rhythm on EKG was defined when the P-wave was present.

In the early postoperative period and in order to evaluate cardiac function and the recovery of atrial function, transthoracic echocardiography was performed and a peak a wave velocity was considered as evidence of effective atrial contraction. In the late follow-up, left atrial contractility was assessed by transesophageal echocardiography.

## Results

There were 2 men and 8 women with a mean age of 40±8 years. All the patients had rheumatic mitral stenosis or regurgitation. Severe aortic regurgitation was found in 2 patients and tricuspid regurgitation in 4 patients. Table 1 shows the demographic data of the patients before surgery.

**Table I. Patients' characteristics (n=10).**

Variable	
Male / female	2/8
Age (years)	37±8
NYHA	
Class 2	1
Class 3	9
LAD(mm)	68±15
PAP(mmHg)	
Systolic	55
Diastolic	19
LVEF (%)	50% ± 7
Mitral stenosis	8
Mitral regurgitation	1
Mixed lesion	6
Aortic valve disease	2
Tricuspid valve disease	4
History of embolic event (case)	2
AF duration (year)	> 1

Values presented as mean ± SD NYHA: New York Heart Association, LAD: Left Atrial Dimension, PAP: Pulmonary Artery Pressure, LVEF: Left Ventricular Ejection Fraction, AF: Atrial Fibrillation

Mean aortic cross-clamp time was 90±11, and mean CPB times were 144±18 minutes. Table II demonstrates operative variables and concomitant cardiac procedures.

**Table II. Operative variables and concomitant cardiac procedures.**

Variable	
CPB time (min)	90±11
AXC time (min)	144±18
Prosthesis Mechanical	10
Biological	2
MVR	8
MVR + AVR	2
TAP	3
TVR	1
Need to permanent pace maker	0

Values presented as mean ± SD CPB: Cardio Pulmonary Bypass, AXC: Aortic Cross Clamp, MVR: Mitral Valve Replacement, AVR: Aortic Valve Replacement, TAP: Tricuspid Annuloplasty, TVR: Tricuspid Valve Ring

In the early postoperative period, 2 patients needed reoperation due to suture line bleeding. Normal sinus rhythm was restored in 6 patients, and atrial contractility was demonstrated in 5 patients. There was no low cardiac output syndrome, thromboembolic events, stroke or need for permanent pacemaker implantation.

All the patients were followed up for 470±230 days. Six months

postoperatively, normal sinus rhythm was restored in 8 patients, and left atrial contractility was shown in 7 patients by transesophageal echocardiography. None of the patients suffered supraventricular tachycardia or thromboembolic events whether in the early or late postoperative periods. All the patients with mechanical valve replacement received warfarin for anticoagulation, and no patients showed prosthetic valve dysfunction.

## Discussion

First, the Cox-maze procedure was applied to the patients with chronic AF as an isolated cardiac procedure.<sup>3</sup> Then, it was performed concomitantly with other cardiac procedures including non-rheumatic and rheumatic mitral valve disease.<sup>4,5</sup> Interruption of macro reentrant circuits responsible for atrial fibrillation requires the performance of several incisions in both atriums. Given this complexity of the technique, bleeding from less accessible suture lines has been a significant consideration.<sup>6</sup> In our early experience, two patients had bleeding from suture lines.

All the patients undergoing the maze procedure in our series referred specifically for the correction of rheumatic valvular pathology rather than for the correction of symptomatic atrial fibrillation. The New York Heart Association class in patients with rheumatic disease was higher than that in the other patients, and the technique of surgery was distinct from isolated AF with regard to mitral valve and multiple valve procedures. The combined valve procedure required a significantly longer aortic clamping time than the isolated maze procedure. Taking these problems into account, perioperative outcome was encouraging. In our early experience, the patients required low dose postoperative inotropic drug support with no early mortality. We think that the lower age of patients and preservation of heart have an effective impact on mortality.

In recent years, some surgeons have performed mitral valve and maze procedure with a high success rate of restoring atrial rhythm.<sup>7,8</sup> For a long time, it has been shown that some patients restore sinus rhythm with only the mitral valve procedure. Association of the maze procedure in those patients may have additional morbidity with no benefit. For this reason, it is necessary to identify carefully those patients who need the maze procedure preoperatively. In our series, the patients selected for the maze procedure had an enlarged left atrium and a long duration of AF. The left atrial diameter was  $68 \pm 15$  mm, and chronic atrial fibrillation lasted for more than one year.

The restoration of sinus rhythm in the early postoperative period occurred in 60% of the patients. By the end of month 6, the majority of the patients (80%) were in sinus rhythm, and apparent LA contraction was demonstrated by transesophageal echocardiography. According to Cox's definition,<sup>3</sup> the cure rate of atrial fibrillation has been 97%, and there has been equivalent success among combined and isolated maze III recipients. All of our patients had rheumatic heart disease, and in some cases the LA diameter was more than 75 mm. In patients with enlarged atria, we excised portions of the inferior and dome of the left atrium to reduce the left atrial size. In others, extensive suturing of the left atrium during the maze procedure led to a significant decrease in the LA dimension. In all the patients, we were faced with a relatively thin and fibrotic atrial wall. We suppose that a lower success rate of recovering atrial rhythm and contractility in our series has a relation to fibrosis in the atrial wall due to LA dilatation and rheumatic pathology.

It has been reported that LA function and sinus rhythm gradually recover after the maze procedure.<sup>9</sup> In the present study, both the electrical and mechanical atrial activities were recovered in the first six months and maintained for one year after surgery. We evaluated LA function by

transesophageal echocardiography. Cox<sup>10</sup> reported that some patients may show no apparent LA contraction by transthoracic echocardiography but may have LA contraction by transesophageal echocardiography.

We suppose that the reduction in the size of the left atrium by excision or wide suturing during the maze procedure would maintain LA function for a long period.

### Conclusion

Our early success supports the use of the maze procedure in addition to valvular operation in rheumatic heart disease. It seems that a lower success rate of recovering LA function and atrial rhythm has a relation to rheumatic cardiac pathology.

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