Original Article

Surgical Radiofrequency MAZE III Ablation for Treatment of Atrial Fibrillation During Open Heart Surgery

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Abstract

Background: *Atrial fibrillation is a common arrhythmia in patients with rheumatic mitral and other valve diseases who are candidates for valve repair surgeries. Conversion of rhythm to sinus has positive effects on quality of life and lower use of medications. The aim of this clinical study was to evaluate the effectiveness of the radiofrequency ablation Maze III procedure in the treatment of atrial fibrillation associated with rheumatic heart valve disease.*

Methods: *We applied a modified Cox III Maze procedure using radiofrequency ablation in the treatment of atrial fibrillation associated with rheumatic heart valve disease and evaluated the outcome of 20 patients of atrial fibrillation associated rheumatic valve disease who underwent radiofrequency ablation Maze III procedure plus heart valve surgery. Demographic, echocardiographic, Electrocardiographic and Doppler study data were calculated before surgery, six month and one year after surgery..*

Results: *No perioperative deaths occurred in the study group. Duration of additional time for doing radiofrequency ablation was about 22 minutes. Freedom from atrial fibrillation was 85% and 75% at six months and one year follow-up respectively..*

Conclusions: *The addition of the radiofrequency ablation Maze procedure to heart valve surgery is safe and effective in the treatment of atrial fibrillation associated with rheumatic heart valve disease..*

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Introduction

Among the varieties of supraventricular arrhythmias that confront electrophysiologists, atrial fibrillation remains the most vexing affecting 0.4% of the general population and up to 10% of persons older than 65 years. Not only is atrial fibrillation extremely common, it is a progressive disorder that is often poorly controlled with antiarrhythmic medications.[1, 2]

More importantly, atrial fibrillation (AF) is often associated with other cardiac diseases that compromise the patient's clinical outcome. 60% of patients admitted for mitral valve surgery and up to 5% of patients undergoing coronary revascularisation are known to have chronic AF. Restoration of sinus rhythm (SR) with atrioventricular resynchronization may be difficult in patients with chronic or permanent AF or

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other risk factors for AF.[2,3] Over the past 5 years, increasing attention has been focused on the development of catheter ablation techniques and ablation systems to cure atrial fibrillation. The importance of this endeavor has been fueled by a number of factors including the clinical importance of atrial fibrillation because of its high prevalence in the general population, associated symptoms, stroke risk, and increased mortality; the limited efficacy, side effects, and risks associated with pharmacologic therapy; and demonstration of the feasibility of curing atrial fibrillation with open heart surgical procedures and also with catheter ablation techniques.[4] Cox and colleagues developed and applied the Maze procedure successfully in patients with lone atrial fibrillation (AF). Although isolated AF itself has been reported to carry a low risk of thromboembolism, AF increases the risk significantly when associated with organic disease. Once AF becomes sustained in these patients, it usually persists even after otherwise successful operation for the underlying lesions. Because developing AF signifies pathologic degradation and symptomatic deterioration in these patients, simultaneous treatment of the rhythm and organic lesions has long been desired and expected to improve prognosis. Nonetheless, Adding the Maze procedure may increase the risk because of extensive atrial incision and reanastomosis requiring longer cardiac arrest and cardiopulmonary bypass time. For this reason, we used radiofrequency ablation and modified the Maze atriotomy so as to shorten the operating time and preserve the sinus node artery. Moreover, myocardial changes and fibrosis derived from underlying diseases may render the Maze procedure less effective than in lone AF.[5,6] The operating time and preserve the sinus node artery. Moreover, myocardial changes and fibrosis Derived from underlying diseases may render the Maze procedure less effective than in lone AF.[5, 6]

Methods

Patients

From October 2003 to January 2005, twenty consecutive patients with a history of at least one year duration of chronic atrial fibrillation (AF) caused by mitral valve (MV) and other valvular disorders underwent a radiofrequency modified maze III procedure combined with MV and other valvular surgeries and left atrial reduction surgery when needed. All patients had documented AF for at least one year before operation. Demographic, echocardiographic, angiographic and catheterization data were collected before surgery. The average size of the left atrium was measured on M-mode tracing taken from a two-dimensional parasternal long-axis view (E 850, Ving Med echocardiograph system). In all patients ventricular rate control medication, i.e. calcium blockers and/or digoxin, was allowed until the day before surgery. Oral anticoagulant therapy (warfarin) for the prevention of thromboembolism secondary to chronic AF was discontinued 2 days before surgery. Beta-Adrenergic blockers were continued...

Surgical procedure

Radiofrequency energy unipolar was used to create long continuous endocardial lesions under direct vision with a hand-held cooled tip probe in all patients. The ablation procedure was done in a bloodless operating field and temperature guided energy applications were performed with a pre selected catheter tip temperature.

The heart was exposed through a median sternotomy and suspended in a pericardial cradle. Cardiopulmonary bypass was instituted using standard aortic and bicaval cannulation and moderate hypothermia. The operative procedure was based on the Maze III

procedure as described by Cox et al.[6] In our RF modification, all atrial incisions currently used in the maze III were replaced by endocardial linear ablation lines as illustrated in Figure 1 except for the incisions to enter the left and right atrial cavity.

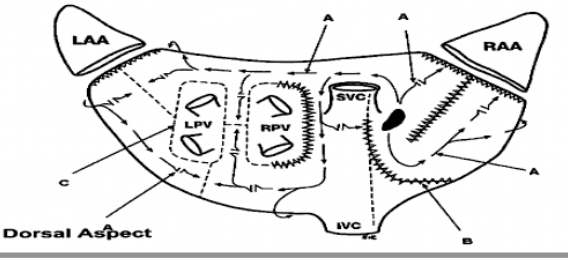

Figure 1. RF modified maze schematic view of the dorsal aspect of the heart. Line A, electrical activation: zig zag line B, incision in the atria; dotted line C, ablation lines. LAA, left atrial appendage; RAA, right atrial appendage; IVC, Inferior Vena Cava; SVC, Superior Vena Cava; LPV, Left Pulmonary Veins; RPV, Right Pulmonary Veins.

According to the original Maze III both appendages were excised as well. The right-sided maze was performed on the beating heart without cross-clamp. The left-sided Maze procedure was started after the heart was arrested with cold cardioplegic solution and the aorta cross-clamped. Both left and right pulmonary veins were isolated separately. Concomitant procedures, e.g. tricuspid valve repair, were performed immediately after aortic cross-clamping and prior to completing the left-sided Maze and the mitral valve procedure. During rewarming the left atrium was closed and the cross-clamp released. The heart was then de-aired extensively prior to defibrillation and to closing of the right atrium. Occasionally atrial pacing or ventricular pacing was needed to wean off bypass.

Follow-up

Early postoperative care was similar to that for routine

open-heart surgery. Cardiac rhythm was continuously monitored after surgery until

stable rhythm returned. Temporary epicardial wire attached to the right ventricle was used to pace the patient in case of severe bradycardia. We started infusion of amiodarone after surgery (150 mg loading dose and 0.5 mg/min) during the first day of ICU care and 200 mg orally per day for 6 months.[2] Postoperative atrial tachy arrhythmias were treated with additional doses of amiodarone and beta blockers which sometimes combined with DC cardioversion, if necessary. Patients were seen in the outpatient clinic monthly and at 6 months and one year after operation, or earlier when necessary. Antiarrhythmic drugs were tapered gradually after cardiac rhythm was considered stable. Amiodarone was stopped after 6 months. Transthoracic Doppler echocardiography was performed at 6 months and 1 year after surgery to assess atrial mechanical function. The AF after surgery is defined as AF which persists more than 48 hours.

Statistical analysis

Continuous variables were expressed as mean ± standard deviation. Means were compared using Student's t-test. In the case of non-normal distribution, the nonparametric Wilcoxon test was used. A P value less than 0.05 was considered statistically significant.

Results

Demographic data

We studied twenty patients (nine men and 11 women); mean age was 46.35 ± 10.6 years.

Operative data

The mean time for doing radiofrequency ablation was about 22±3 min.Concomitant cardiac procedures (Table 1) included mitral valve (MV) repair (n=2), MV replacement (n=18), tricuspid valve repair (n=3), aortic valve (AV) repair (n=1), AV replacement (n=9), and left atrial reduction (n=6). In three patients the surgery was redo operation. Atrial reduction (n=6). In three patients the surgery was redo operation.

Cardiac rhythm and atrial transport

Rhythm of all patients except one was sinus upon arriving to ICU and except two patients the rhythm of remaining patients were sinus at discharge. Two patients had low rate junctional rhythm during their stay in ICU, so amiodarone was discontinued and temporary ventricular pacing continued until patients' rhythm converted to sinus. During ICU stay, rhythm of 4 patients changed to AF: For two of them cardioversion converted their rhythm to sinus, while in one patient rhythm converted to sinus automatically. Rhythm conversion to sinus was unsuccessful in one patient. During follow up, five patients underwent DC-shock therapy for treatment of AF, which was successful in three patients and converted their rhythm to sinus. Rhythm of two patients converted to sinus automatically. One of our patients got atrial flutter during follow-up which treated was successfully with DC-shock therapy. All patients completed six month follow up and 85% of patients were free of AF. At six months follow up in patients who were in sinus rhythm, left atrial transport and contractility were assessed by transthoracic Doppler study: 82% had left atrial contraction. In patients who were free of AF, amiodarone (200 mg/day) was discontinued after six months. In patients with AF whose rhythm didn't convert to sinus by DC-shock or patients who were unwilling to undergo this rate control strategy.

At one year follow up, 75% of patients had sinus rhythm 24 hour ambulatory Electrocardiographic study and in patients with sinus, rhythm transthoracic Doppler study showed 80% atrial transport. The mean ejection fraction of patients was 51.25% ± 8.7 and 53.25% ± 6.3 before and one year after surgery: This difference was statistically significant (P= 0.035).. The LA size was 5.03 ± 0.74 before surgery which decreased to 4.4 ± 0.58 one year after surgery, which was statistically significant (P= 0.002) also.

Complication

Hospital and ICU stay didn't change significantly in our patients. There was no major bleeding or need for permanent pacing..

Table 1: Operative data of patients

Patients	MV Disease		AV Disease		TV Disease/ therapy	Therapy MV		Therapy AV	
	MS	MR	AS	AR		OMVC	MVR	AV Rep	AVR
Men	9	4	0	5	2	0	9	0	5
Women	10	5	1	4	1	2	9	1	4
Total	19	9	1	9	3	2	18	1	9

MV: Mitral valve, AV: Aortic valve, TV: Tricuspid valve, MS: Mitral stenosis, MR: Mitral regurgitation, AS: Aortic stenosis, AR: Aortic regurgitation, OMVC: Open MV comissurotomy, MVR: MV replacement, AV Rep: AV repair, AVR: AV replacement

Discussion

In the majority of patients who undergo MV surgery in chronic AF at the time of operation, the arrhythmia will remain after surgical correction of the underlying cardiac disease.[6,7,8] However, in patients with intermittent AF or AF duration of less than 1 year, MV surgery alone is sufficient to restore sinus rhythm in the majority of patients.[6,7,9] In this study we included only patients with a history of AF of at least 1-year duration, in whom it was unlikely for sinus rhythm to be Regained after valve surgery. The Cox's Maze procedure[6,10,11] has apparently remained an universally applicable and potentially effective treatment to restore sinus rhythm in patients with chronic AF and concomitant structural heart disease.[6,12,13] However, this surgical procedure involves extensive incision and suturing of the atria. In an attempt to simplify the original Maze, our group and others[4,14,15] used Radiofrequcucy (RF) energy intraoperatively to create linear ablation lines endocardially - under direct visual guidance - to eliminate AF. The RF pattern we used is based on the maze III concept,[11] and most of the atrial incisions of the original Maze procedure are replaced by RF lesions. As a consequence, the extra cardiac arrest time to complete the left-sided part of the Maze procedure was only 22 min.

The aim of AF surgery is restoration of sinus rhythm and reestablishment of atrial mechanical function. This was achieved in the majority of the patients in our study, which icomparable with the surgical maze III in patients with long-standing AF and structural heart disease.[16,17] Swartz reported that sinus rhythm could be maintained in long-term follow-up in >70% of patients with this approach.[1] Our study showed restoration of sinus rhythm in 75% of patients at one year follow up which is comparable with most other studies. Conduction gaps within the ablation lines may predispose patients to iatrogenic left atrial macro-reentrant arrhythmias that may necessitate a second ablation procedure in as many as 55% of patients,[1] in our study, one of patients had atrial flutter during follow up which was treated successfully with DC shock cardioversion permanently. Cox and associates [18] Demonstrated that preservation of atrial transport function was 85.1% in the left atrium after the Maze III when evaluated by transthoracic Doppler echocardiography, although when additional techniques such as transesophageal Doppler echocardiography or magnetic resonance imaging, were used, preservation of transport function was 94% in the left atrium. The high percentage of atrial contractility in this patient group in contrast to other studies[11,19,20] can be explained by the use of transesophageal Doppler echocardiography to assess atrial transport function while others have relied on transthoracic Doppler echocardiography as a means to show atrial contractility. Furthermore, we have observed recovery of left atrial function in the majority of patients undergoing intraoperative RF ablation which was about 80% with Doppler echocardiography study.[21] There is no significant difference in the postoperative sinus rhythm conversion rates between the classical 'cut and sew' and the alternative sources of energy, which were used to treat atrial fibrillation,[22] so we conclude that our results are not significantly different from conventional Maze procedure. Finally, some studies reported better results of conversion to sinus rhythm by radiofrequency ablation applied at limited epicardial and or endocardial sites in patients with AF during MV surgery,[14,23,24,25] but in contrast to our patient population, these studies also included patients with paroxysmal AF and AF duration

less than 1 year and, according to recent studies[9,26] these patients have a higher likelihood to remain in sinus rhythm after surgery.

We are continuing doing RF ablation in our patients with AF who are otherwise candidates for cardiac surgery, so these results are preliminary results of patients during the last couple of years: Hopefully with increasing with increase in patient number we will be able to reach more reliable result and conclusions regarding this ongoing study.

Conclusion

The Cox maze III radiofrequency ablation remains the gold standard for the treatment of atrial fibrillation and has excellent long-term efficacy.

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