

## Pulmonary Vein Isolation for Chronic Atrial Fibrillation Associated with Mitral Valve Disease: The Midterm Results

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**Objective:** The Cox Maze procedure is widely performed for the surgical treatment of atrial fibrillation. However it requires numerous incision lines and therefore is a time-consuming operation. We report a simplified operation for chronic atrial fibrillation associated with mitral valve disease.

**Methods:** Pulmonary vein isolation procedure was performed on atrial fibrillation associated with mitral valve disease in thirteen patients. This simple procedure consisted of isolation of the four pulmonary veins only. Combined mitral valve surgery involved mitral valve plasty, mitral valve replacement with or without aortic valve replacement and tricuspid annuloplasty.

**Results:** Eleven patients returned to sinus rhythm (84.6%). Mean follow-up time is 32.7±11.7 months. Three patients required a DDD pacemaker implant for sick sinus syndrome but two out of these three resumed sinus rhythm most of the time recently. Left atrial contraction was detected in eight cases by trans-esophageal echo. One patient died of liver failure two months postoperatively. Eight patients had no blood transfusion. Twelve patients are classified as New York Heart Association class I.

**Conclusion:** Compared with the Maze procedure, this operation was less invasive and preserved the atrial appendage and was thought to have a normal level of secretion of atrial natriuretic peptide. This study suggests that the pulmonary vein isolation procedure may be an effective and simple maneuver for atrial fibrillation associated with mitral valvular disease. (*Ann Thorac Cardiovasc Surg* 2002; 8: 88–91)

**Key words:** pulmonary vein isolation, atrial fibrillation, mitral valve disease

### Introduction

The Maze procedure is widely performed for the surgical treatment of atrial fibrillation (AF). However the most famous Cox Maze procedure<sup>1</sup> requires numerous incision lines and therefore is a time-consuming operation. The restoration rate of sinus rhythm with the Maze pro-

cedure was reported to be about 70 to 80% and amputation of the atrial appendage has the disadvantage of secretion of atrial natriuretic peptide (ANP).<sup>2</sup> There are less invasive operations such as atrial isolation technique<sup>3</sup> or the corridor method<sup>4</sup> but those procedures do not achieve the contraction of the left atrium even though the patient returns to sinus rhythm. We report a simplified operation for chronic AF associated with mitral valve disease.

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### Patients and Methods

From June 1997 to August 2000, thirteen patients with AF caused by mitral valve disease underwent pulmonary vein isolation with a mitral valve operation (Table 1). There were four men and nine women, their ages ranging

**Table 1. Cases of the pulmonary vein isolation procedures**

Case	Sex	Age	Op. date	Dx	Operation	F-wave (mV)	LAD (mm)	CTR (%)	AF (yr)
1	M	68	6/97	MR, TR	MVP (ac), TAP (ra)	0.1	48	65	1
2	F	63	9/97	MS, LAt	MVR	0.2	59	64	1
3	F	46	10/97	MR	MVP (wr)	0.2	48	69	0.5
4	M	66	10/97	ASR, MSr	AVR, OMC	0.1	49	66	5
5	M	58	2/98	MS, LAt	OMC	0.2	50	50	10
6	F	67	5/98	MS, TR	MVR, TAP (ra)	0.15	62	64	3
7	F	46	6/98	MR	MVP (ac)	0.2	52	53	2
8	F	55	8/98	AsR, MSr, TR	AVR, MVR, TAP (DV)	0.2	56	65	7
9	M	53	9/98	MS, LAt	OMC	0.25	56	58	4
10	F	57	1/99	MSr, TR	MVR, TAP (DV)	0.1	56	50	10<
11	F	74	9/99	MS	MVR	0.1	65	55	0.25
12	F	75	2/00	MS, TR, LAt	MVR, TAP (ra)	0.2	49	62	0.25
13	F	72	8/00	MS, LAt	OMC	0.1	55	65	2
mean		62±10				0.16±0.05	54±6	61±7	3.5±3.4

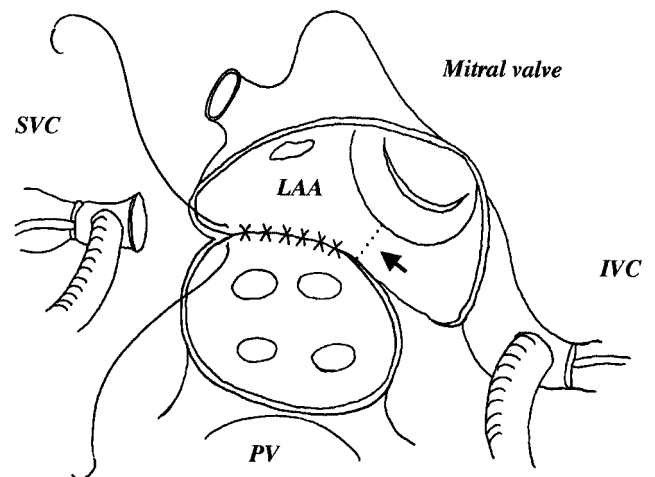
LAt: left atrial thrombus, ac: artificial chordae of anterior mitral leaflet, wr: wedge resection of posterior mitral leaflet, ra: ring annuloplasty, DV: DeVega annuloplasty

from 46 to 75 years with an average of  $61.5 \pm 9.9$  years. The causes of mitral valve disease were rheumatic ( $n=10$ ), and degenerative ( $n=3$ ) disease. Their mitral valve surgery consisted of mitral valve repair (artificial chorda in the anterior mitral leaflet, 2 cases; quadrangular resection of the posterior mitral leaflet, 1 case) and mitral valve replacement (5 cases) and mitral commissurotomy (5 cases) with tricuspid annuloplasty (5 cases). Combined aortic valve replacement was performed in three cases. Duration of AF ranged from 0.25 to 10 years with an average of  $3.5 \pm 3.4$  years. Maximum f-wave voltage in the V1 lead varied from 0.1 to 0.25 mV. CTR ranged from 50 to 69% with an average of  $60.5 \pm 6.5\%$ . Left atrial dimension ranged from 48 to 65 mm with an average of  $54.2 \pm 5.5$  mm.

We used  $32^\circ\text{C}$  cardiopulmonary bypass and continuous  $20^\circ\text{C}$  retrograde blood cardioplegia. Two venous cannulae were placed in the superior and inferior vena cavae. The superior vena cava was divided and the left atrium (LA) was incised in the interatrial groove and extended across the roof of the LA and encircling the pulmonary veins. From the encircling incision line, another incision to the posterior mitral leaflet was made in the first eleven cases and in the recent two cases, this incision was omitted (Fig. 1). The LA appendage remained untouched unless there was a thrombus. The incision was made with a surgical knife in the first four cases, but in the remaining cases cryosurgery ( $-60^\circ\text{C}$ , 2 min) was used. After the surgery, the status of all patients was checked in June 2001.

## Results

Sinus rhythm was restored in eleven out of thirteen cases (84.6%) (Table 2). The two persistent cases of AF had an AF history of over 10 years. Three patients required a DDD pacemaker implant for sick sinus syndrome but two



**Fig. 1.** The pulmonary vein isolation procedure.

The superior vena cava was divided and the left atrium (LA) was incised in the interatrial groove and extended across the roof of the LA and encircling the pulmonary veins. The left atrial appendage remained untouched if there was no thrombus.

↖: Additional incision to the posterior mitral leaflet was made in the first eleven cases and in the two recent cases, this incision was omitted.

**Table 2. Results of the pulmonary vein isolation procedures**

Case	Pump (min)	Arrest (min)	BTF	Rhythm	LA contr.	Result
1	280	166	non	SNR	+	NYHA I
2	235	159		SNR		D (2m)
3	196	133	non	SNR	+	NYHA I
4	223	158		SNR		NYHA I
5	143	105	non	af	af	NYHA I
6	289	189	non	SNR	+	NYHA I
7	248	192	non	SNR	+	NYHA I
8	266	187	non	SNR, PM		NYHA I (A-pacing)
9	179	127	non	SNR	+	NYHA I (DC)
10	236	177	non	af	af	NYHA I
11	282	179		SNR, PM	+	NYHA I (SNR)
12	292	187		SNR	+	NYHA I
13	251	227		SNR, PM	+	NYHA I (SNR)
mean	240±45	168±33				

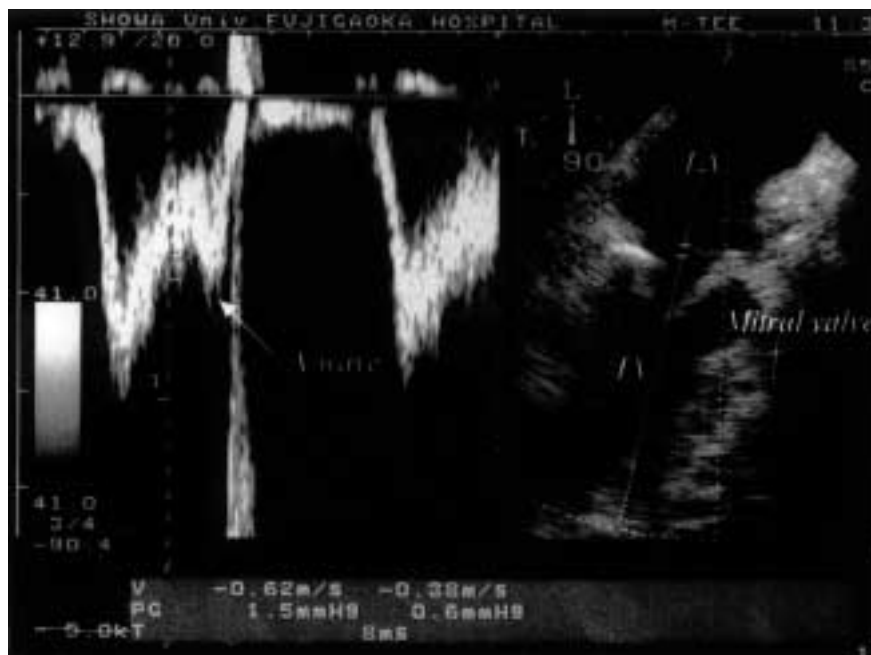
BTF: blood transfusion, SNR: sinus rhythm, PM: pacemaker implant, LA contr.: left atrial contraction, D: died, DC: DC shock

out of three patients resumed sinus rhythm most of the time three months later. One hospital death (liver failure) occurred 2 months later. Cardiac arrest time ranged from 105 to 227 minutes with an average of 168±32 minutes, necessitating cardiopulmonary bypass runs varying from 143 to 292 minutes with an average of 240±45 minutes. Eight patients had no blood transfusion. Basic rhythm was checked in June 2001. Mean follow-up time is 32.7±11.7 months (10-48 months). Left atrial contraction was detected in eight cases by trans-esophageal echo

(Fig. 2). Of thirteen patients, one patient required DC shock for atrial flutter 26 months later but returned to sinus rhythm. Twelve patients are classified as New York Heart Association class I.

**Discussion**

Cox reported the Maze procedure for lone AF.<sup>1)</sup> The principal of this procedure is that AF occurs by macro-re-entry so that a small division of both atriums could prevent



**Fig. 2.** Left atrial contraction detected by trans-esophageal echo (case 13). A-wave showed good contraction of left atrium.

its occurrence. Other surgical modifications like the Cox Maze procedure have been proposed,<sup>5,6)</sup> but these operations necessitate many incisions and require surgical skills and are time-consuming. We postulated that the numerous incision lines in the atrium have a negative effect on atrial contraction. Also amputation of the atrial appendage is reported to prevent the normal secretion of ANP.<sup>2)</sup> On the other hand, Harada et al. suggested that chronic AF associated with mitral valve disease might be caused by electrical discharges in the left atrium and the surgical procedure to ablate chronic AF should be applied to the left atrium only.<sup>7)</sup> Haissaguerre and associates reported that the pulmonary veins are important foci of AF and these foci respond to treatment with radio-frequency ablation.<sup>8)</sup> These findings seem to indicate that isolation of the pulmonary veins is sufficient to ablate AF associated with mitral valve disease. Therefore, we performed a modified method of the pulmonary vein isolation procedure reported by Sueda et al.<sup>9)</sup> Although they amputated the LA appendage and made two other incisions to the mitral annulus, we only performed isolation of the pulmonary veins. We reported the immediate results of these procedure,<sup>10)</sup> and this time studied midterm results. We confirmed sinus rhythm maintained during 10 to 48 months with a mean of  $32.7 \pm 11.7$  months after the surgery. Even with this limited experience and limited period, eleven out of thirteen cases returned to and maintained sinus rhythm, and left atrial contraction was detected in eight cases. Our procedure is the most simple, easy to accomplish and least invasive method which is effective in relieving AF. Not amputating the LA appendage or performing atrial incisions maintains atrial contraction and the appropriate secretion of ANP. If the treatment of AF with mitral valve surgery is an additional procedure and failure to ablate AF results in unnecessary surgical invasion, in such cases, pulmonary vein isolation procedure may be the most simplified effective maneuver for atrial fibrillation associated with mitral valvular disease.

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