Left Atrial Appendage Resection Versus Preservation During the Surgical Ablation of Atrial Fibrillation

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Background. **Left atrial appendage (LAA) resection during the Maze procedure may decrease thromboembolic risks, but its preservation may improve left atrial contractile function. This study compared the clinical effects of LAA resection and preservation after the Maze procedure.**

Methods. **A retrospective review was made of 379 patients (mean age 53.3 ± 12.6 years, 244 females) who underwent the cryo-Maze procedure in conjunction with mitral surgery from 1999 to 2011. The LAA was resected in 187 patients (resection group) but preserved in 192 patients (preservation group). Outcomes were compared using a propensity score study design based on 20 baseline characteristics to obtain well-matched patient pairs.**

Results. **Propensity score matching yielded 119 pairs of patients in whom there were no significant differences in baseline profiles between the two groups. During a mean follow-up of 3.1 ± 2.8 years, there were 16 deaths, 6 cases of stroke, and 39 cases of atrial fibrillation recurrence. There were no significant differences in stroke-free survival ($p = 0.88$) and freedom from AF while off antiarrhythmic drugs ($p = 0.46$) between the two groups. On serial echocardiographic assessments, patients in the preservation group showed a higher transmitral A-wave velocity (peak atrial contraction wave velocity; $p = 0.47$, 0.020, and 0.001 at 3, 6, and 12 months, respectively) and lower E/A ratio (peak early filling wave [E-wave] velocity / A-wave velocity; $p = 0.34$, 0.065, and 0.001 at 3, 6, and 12 months, respectively) at each timepoint compared with the resection group.**

Conclusions. **Preservation of the LAA during the Maze procedure resulted in similar clinical and rhythm outcomes, but LA contractile function superior to that of LAA resection.**

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The Maze procedure is widely accepted as a way to effectively restore sinus rhythm in patients with atrial fibrillation (AF) who are undergoing cardiac surgery for other indications. Since the introduction of the Maze procedure, efforts have been made to reduce the complexity of the procedure and procedural complications [1, 2]. Accordingly, various techniques, including the use of alternative energy sources for creation of ablation lesions and modified simpler lesion sets, were developed to replace the conventional complex cut-and-sew procedure. One of these modifications involves left atrial appendage (LAA) preservation during the Maze procedure. The LAA is reported to be a major source of thrombus formation and its embolization, and can contribute as an ectopic focus of AF trigger [3–5]. However, the LAA can contribute greatly to left atrial mechanical contraction after the Maze procedure [6]. Moreover, some researchers assert that the LAA is largely involved in atrial natriuretic peptide secretion and plays an important role in neurohormonal regulation [7, 8].

In these regards, few clinical studies exist that compare LAA resection with LAA preservation in clinical outcomes. In this study, we sought to compare the outcomes between LAA preservation and resection in terms of clinical and rhythm outcomes as well as atrial transport functions.

Patients and Methods

Study Population

Between January 1999 and January 2011, a total of 525 patients underwent mitral valve (MV) operations and concomitant biatrial cryo-Maze procedures at the Asan Medical Center, Seoul, Korea. Patients were excluded if they underwent concomitant multivessel coronary artery bypass graft surgery (n = 22) or aortic replacement (n = 8), or had a preoperative LAA thrombus (n = 116). In the end, 379 patients were enrolled. The decision to resect or preserve LAA was influenced by several demographic and procedural factors. For instance, patients with high thromboembolic risks such as old age, coexisting diabetes mellitus, and advanced degree of tricuspid regurgitation

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or pulmonary hypertension were more likely to undergo LAA resection. Nevertheless, the decision was finally at the discretion of the attending surgeon referencing those baseline profiles. This study was approved by the Institutional Ethics Committee/Review Board at the Asan Medical Center. The requirement to obtain informed consent was waived by the Board owing to the retrospective nature of the study.

Surgical Techniques

A median sternotomy approach (n = 280, 73.9%), a minithoracotomy approach using the AESOP 3000 system (Computer Motion, Santa Barbara, CA [n = 90, 23.7%]), or port-assisted minithoracotomy approach using the da Vinci robotic system (Intuitive Surgical, Irvine, CA [n = 9, 2.4%]) were used. The biatrial cryo-Maze procedure was performed as previously described [2, 9]. After snaring down the superior and inferior vena cavae, oblique right atriotomy was made on beating heart. Then, the cavotricuspid isthmus isolation was achieved by two cryoablation lines, and a linear lesion from posterior end of atriotomy to superior vena cava was made (Fig 1A). After aortic cross-clamping, the left side procedure began with a longitudinal right-sided left atriotomy, which was performed endocardially before the MV procedure. Left atrium ablation consisted of a single box lesion for pulmonary vein isolation and two posterior linear lesions, one from the pulmonary vein isolation line to the LAA orifice and one from the pulmonary vein isolation line to the MV annulus. Additional epicardial coronary sinus ablation was performed at the opposite side of the linear lesion to MV annulus. The left atrium size was reduced by resection of redundant atrial tissue between inferior pulmonary vein and posterior MV annulus (Fig 1B). An argon-based flexible cryoablation system (SurgiFrost; Medtronic, Minneapolis, MN) was used for ablation. The surgeons attempted to remain as much subvalvular tissue as possible in a chordae-sparing manner during MV replacement.

Echocardiography and Rhythm Follow-Up

Preoperative transthoracic echocardiography and transesophageal echocardiography were performed in all patients within 2 months before surgery using a Hewlett-Packard Sonos 2500 or 5500 imaging system equipped with a 2.5-MHz transducer (Hewlett-Packard, Andover, MA). During the postoperative hospitalization period, typical 12-channel surface electrocardiography was performed every day. For patients who had normal sinus rhythm, Holter monitoring was performed for adjunctive evaluation. Follow-up echocardiography was performed at 1, 3, 6, and 12 months after surgery and electrocardiography was generally performed at 1, 3, 6, 12, 24, and 36 months after surgery. Early AF events were defined as any AF episodes, including atrial tachycardia and atrial flutter, less than 3 months after the operation.

Postoperative Management

Patients who underwent valve repair or bioprosthetic valve implantation were routinely administered warfarin for 3 to 6 months postoperatively, with a target international normalized ratio of 1.5 to 2.5 at the discretion of the attending surgeon. Maintenance of anticoagulation therapy thereafter was determined according to the presence of thromboembolic risks and cardiac rhythm status in each patient. And then, to discontinue warfarin medication, the patient should have shown sinus rhythm at least for more than 2 consecutive visits and be free of symptoms. For patients with mechanical valve implantation, an international normalized ratio of 2.0 to 3.0 was the aim, regardless of cardiac rhythm status.

Postoperative atrial tachyarrhythmias (AF, atrial flutter, or atrial tachycardia) were managed with class I or III antiarrhythmic drugs including amiodarone, sotalol, flecainide, and pilsicainide in an effort to restore sinus rhythm. For patients who achieved "AF elimination," those drugs were withdrawn within 1 or 2 weeks. Patients who failed to achieve AF elimination despite antiarrhythmic medications for sufficient duration were taken off these drugs and switched to a "rate control strategy" involving digitalis, beta-blockers, or calcium-channel blockers to control ventricular rate in combination with anticoagulation therapy.

Any symptoms suggestive of neurologic deficit were evaluated by neurologists with adequate imaging studies.

Statistical Analysis

Categorical variables are presented as frequencies and percentages, and continuous variables are expressed as a mean with standard deviation or a median with range. To reduce the effect of treatment selection bias and

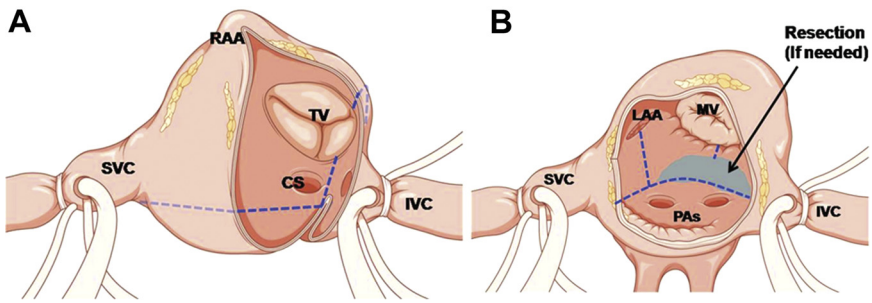

Fig 1. Schema of surgical ablation of atrial fibrillation. (CS = coronary sinus; IVC = inferior vena cava; LAA = left atrial appendage; MV = mitral valve; PAs = pulmonary veins; RAA = right atrial appendage; SVC = superior vena cava; TV = tricuspid valve.)