

ELECTROPHYSIOLOGY

SURGICAL TECHNIQUE

Right Atrial Reduction Plasty Associated with the Cox-Maze Procedure

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ABSTRACT We performed a right atrial reduction plasty combined with the Cox-maze procedure in a patient with a giant right atrium and permanent atrial fibrillation. The reduction plasty involved excisions of the redundant atrial wall along two ablation lines of the maze procedure, and excision of the redundant thin septum primum. This procedure achieved a 60% dimension reduction and an 80% volume reduction. The reduced atrial size and sinus rhythm were maintained after 3.5 years. doi: 10.1111/jocs.12542 (*J Card Surg* 2015;30:544–546)

A giant right atrium is sometimes associated with chronic atrial fibrillation and severe tricuspid regurgitation.¹ Tricuspid valve repair cannot sufficiently reduce the volume of dilated right atrium (RA), and this large volume may render the Cox-maze procedure ineffective. Giant left atrial volume reduction is common,^{2–4} while giant right atrial volume reduction is rarely reported. Giant RA correction requires a logical volume reduction that enables effective maze creation. Here we describe a novel technique that achieved both atrial volume reduction and creation of atrial mazes in a patient with a giant RA and permanent atrial fibrillation.

SURGICAL TECHNIQUE

A 70-year-old female presented with a one-year history of a New York Heart Association class III–IV symptoms associated with neck vein engorgement, leg pitting edema, and hepatomegaly. Preoperative transthoracic echocardiography revealed a giant RA

(dimensions, 7.2 cm × 7.4 cm; area, 43.5 cm²; volume, 225.4 mL) (Fig. 1A), severe tricuspid regurgitation, moderate mitral regurgitation, left ventricular ejection fraction (LVEF) of 70%, and a moderately dilated left atrium (dimensions, 5.3 cm × 5.4 cm). The patient provided written informed consent prior to the procedure, and this study was approved by the Institutional Review Board at Chonbuk National University.

Through a median sternotomy, the procedure was performed under cardiopulmonary bypass with standard aortic cannulation, direct cannulation of two venae cavae, and moderate hypothermia. On the beating heart, a Devon™ Surgical Marker (Covidien Inc., Mansfield, MA, USA) was used to mark two right atrial parts for removal along two ablation lines for the Cox-maze procedure (Figs. 2A and 3A, B). One part was marked with an ellipse along the original ablation line in the upper right atrial appendage. The other was marked with a “T” shape from near the atrioventricular groove to the sinus venosus in the lower third of the RA. After inducing cardiac arrest with antegrade cold blood cardioplegia, these two marked portions were excised (Fig 2B).

A left atriotomy was made through the interatrial (Sondergaard’s) groove, and the left atrial appendage was externally excised. The left atrial maze procedure was performed with combined use of a bipolar radiofrequency electrode (Medtronic Inc., Minneapolis, MN, USA) and a cryoablator (Cooper Surgical, Trumbull, CT, USA). The base of the left atrial appendage was externally closed with double rows of a continuous 4–0 polypropylene suture. The mitral regurgitation was corrected with a posterior annuloplasty using a 55-mm ML strip (ScienCity, Seoul, Korea),⁵ and the left atriotomy was closed with running 3–0 polypropylene sutures. The remaining right atrial maze procedure was

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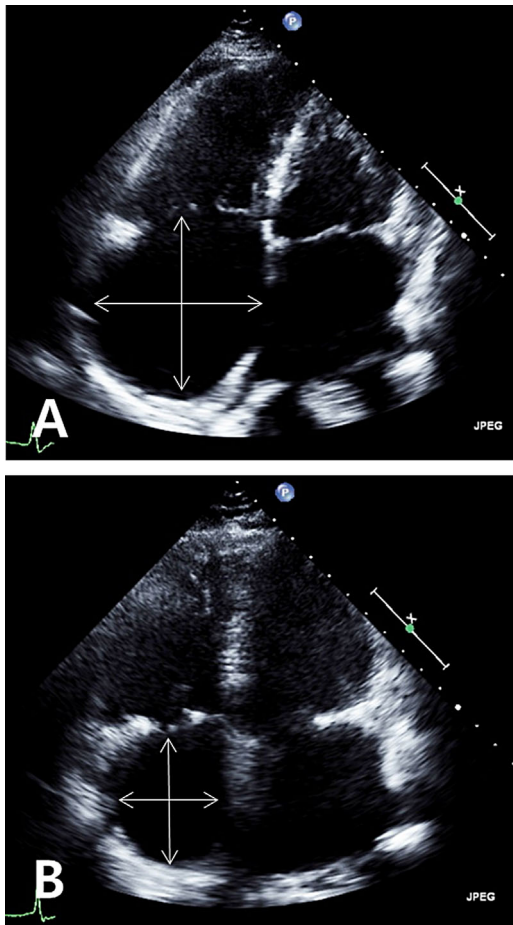


Figure 1. (A) Preoperative transthoracic echocardiogram showing a giant right atrium measuring 7.2 cm × 7.4 cm with a right atrial volume of 225.4 mL. (B) Postoperative 3.5-year transthoracic echocardiogram demonstrating substantial reduction of the right atrial dimensions (4.2 cm × 4.7 cm) and volume (43.7 mL).

completed through the two right atrial openings. Through the “T” shaped opening in the lower RA, the redundant thin septum primum was excised in an ellipse and the atrial septal defect was closed. The dilated tricuspid annulus was repaired by annuloplasty using a No. 26- MC³ ring (Edwards Lifesciences, Irvine, CA, USA). The two right atrial openings were closed with running 4–0 polypropylene sutures (Figs. 2C and 3C).

On the postoperative 14th day, the patient was discharged home with sinus rhythm. At the one-month follow-up, echocardiography showed a significantly decreased RA size (dimensions, 4.1 cm × 4.7 cm; area, 15.8 cm²; volume, 46.2 mL), and EKG showed sinus rhythm. Electrocardiogram performed every three months showed that sinus rhythm was maintained. At 3.5 years postoperatively, the patient showed a NYHA class I–II clinical condition and sinus rhythm. Follow-up echocardiography revealed no change in RA size (dimensions 4.2 cm × 4.7 cm; area 16.2 cm²; volume 43.7 mL) (Fig. 1B) and trace tricuspid insufficiency with a systolic PAP of 26 mmHg.

Three additional patients with a giant RA and permanent atrial fibrillation have undergone the same reduction plasty and maze procedure. The patients received warfarin for 3 months postoperatively and some were briefly prescribed a beta-blocker for rate control. None of the patients received amiodarone HCl. Their mean right atrial dimensions were reduced from 7.1 cm × 7.0 cm to 4.2 cm × 4.4 cm, and sinus rhythms were maintained during the mean follow-up period of 25.3 months.

DISCUSSION

In patients with a giant RA and chronic atrial fibrillation, the typical maze procedure without atrial reduction cannot create effective mazes because the

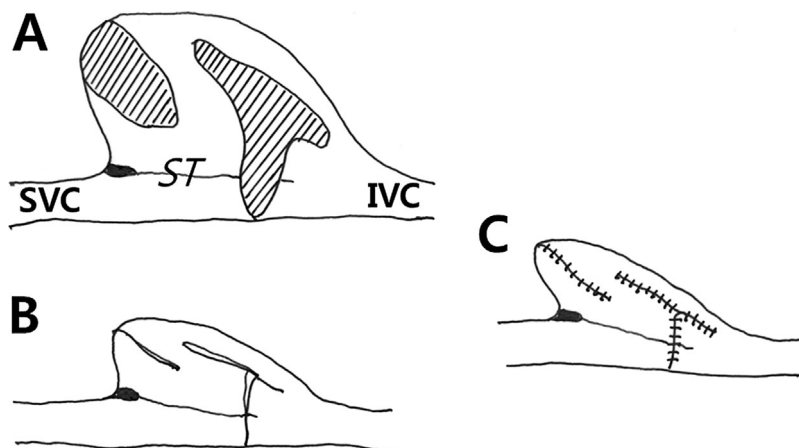


Figure 2. Schematic diagrams of the right atrial reduction plasty procedure. (A) Slashes mark the redundant atrial wall of the giant RA along the ablation lines of the Cox-maze procedure. (B) The redundant atrial wall is excised, creating ablation lines for the Cox-maze procedure. (C) The defects are sutured to remodel the reduced right atrium. SVC, superior vena cava; ST, sulcus terminalis; IVC, inferior vena cava.

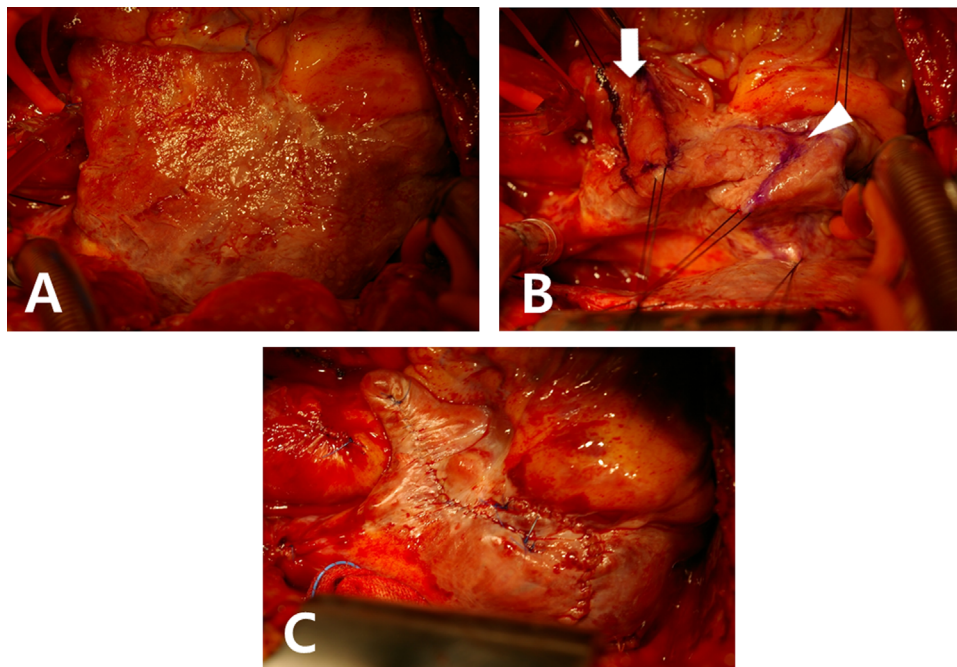


Figure 3. Operative findings. (A) A giant right atrium. (B) Under cardiopulmonary bypass, two redundant portions of the RA wall (white arrow and arrowhead) were marked with a medical pen to determine the extent of excision along the ablation lines of the Cox-maze procedure. (C) The two redundant portions were excised and the defects were sutured, creating the ablation lines.

maze widths are too great. Furthermore, a simple RA reduction technique cannot enable the right atrial maze procedure to be effective. Effective mazes must be narrow enough to interrupt most small and large reentrant circuits.⁶ The present RA reduction plasty achieved a 60% dimension reduction and an 80% volume reduction, simultaneously enabling the creation of effective mazes that can interrupt the progression of most reentrant circuits in the RA.

Previous studies reported reduction of dilated RA via elliptical resection of redundant wall following a typical oblique atriotomy incision, but this resulted only in transverse reduction of the RA without creation of RA mazes.^{7,8} Our presently described atrial reduction plasty obtained reduction of both the vertical and transverse RA dimensions. Excision of the redundant thin septum primum achieved greater symmetrical reduction of the RA volume. Additionally, the lower T-shaped defect provided a sufficient entry for performing other intraatrial procedures, such as tricuspid annuloplasty. In a normal RA that requires the maze procedure, a T-incision is sufficient for intraatrial procedures without atrial wall excision. The presently described reduction plasty should be performed in patients who have an enlarged RA of ≥ 7.0 cm and require the maze procedure. Since the maze is placed between the appendage excision and the T-shaped defect, the amount of atrial wall excision should be limited.

The present study has some limitations, including its small sample size. It is possible that factors other than the reduction atrioplasty contributed to the success rate of achieving normal sinus rhythm in these patients. Moreover, it should be noted that one potential

complication of the presently described procedure is the possible need for a pacemaker due to the violation of the RA corridor and increased potential for damage to the SA and perinodal areas.

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