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Case Report

Long-standing persistent effects of atrial volume reduction combined with pulmonary vein isolation

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ABSTRACT

Although surgical left atrial (LA) volume reduction combined with mitral valve surgery and/or surgical ablation for atrial fibrillation has been reported to be effective, its long-term outcomes in the absence of mitral procedure are not well established. A 74-year-old man with two previous sternotomies—the first for pericardiectomy due to constrictive pericarditis and the second for mitral valve replacement with mechanical valve and tricuspid annuloplasty—presented with heart failure and thrombus in his giant left atrium (1291 mL), complicated by cerebral infarction. His electrocardiogram showed rate-controlled persistent atrial fibrillation. His mechanical valve was functioning well. A third atrial volume reduction combined with pulmonary vein isolation, without valve surgery, was performed. The postoperative course was uneventful, and the patient has remained asymptomatic with regular junctional rhythm and without any episodes of thromboembolism or re-dilation of LA (approximately 550 mL). His left ventricular filling improved with end-diastolic volume (96 mL vs 140 mL) and forced vital capacity (2.60 L vs 2.89 L) increased. Both remained relatively constant for 6 years. The combination of atrial volume reduction with pulmonary vein isolation prevented thromboembolism, improved left ventricular filling, and continued to improve symptoms associated with heart failure and respiratory condition for 6 years.

<Learning objective: The long-term outcomes of surgical left atrial volume reduction combined with ablation for atrial fibrillation in the absence of mitral valve procedure are not well established. We hereby report a case of left atrial volume reduction combined with pulmonary vein isolation, without valve surgery, whose beneficial effects on symptoms associated with heart failure, particularly left ventricular filling, respiratory function, and stroke prevention, have persisted for 6 years postoperatively.>

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Introduction

Although left atrial (LA) remodeling has been proposed as a predictor of common cardiovascular outcomes such as atrial fibrillation (AF), stroke, and congestive heart failure, more data are required regarding whether surgical LA volume reduction translates into improved outcomes [1]. Although LA volume reduction surgery with mitral valve surgery and/or Maze procedure improve circulatory and respiratory functions related to reduction of compression to the left ventricle, bronchus, and pulmonary

parenchyma [2–5], no report included patients who did not undergo mitral valve surgery; little has been reported regarding its long-term effects. We hereby report a case of LA volume reduction combined with pulmonary vein isolation, without valve surgery, whose beneficial effects on symptoms associated with heart failure, particularly left ventricular filling, respiratory function, and stroke prevention, have persisted for 6 years postoperatively.

Case report

A 74-year-old male with a history of two previous median sternotomies was referred to us in 2012 due to heart failure with New York Heart Association (NYHA) class III symptoms and thrombus in his giant LA. In 1980, he first underwent sternotomy

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Fig. 1. Axial view of computed tomography. (a) Preoperative computed tomography showed marked left atrial enlargement. Left atrial volume was 1291 mL. (b) Postoperative computed tomography showed reduction of left atrial volume. Left atrial volume decreased to 256 mL.

for pericardiectomy due to constrictive pericarditis, the second being for mitral valve replacement using a mechanical prosthesis combined with tricuspid annuloplasty due to mitral stenosis and tricuspid regurgitation in 1993. The patient had been prescribed warfarin; his prothrombin time remained within therapeutic range. He had a long history of smoking (two packs per day for >30 years). Electrocardiogram showed rate-controlled persistent AF without obvious f wave (heart rate, 57 beats/min). Transthoracic echocardiography (TTE) showed marked LA enlargement with a diameter of 89 mm in long-axis view with a large thrombus (15 mm) in the LA appendage. Left ventricular (LV) end-diastolic and LA volumes measured using the disk method (with Simpson's rule) were 96 and 489 mL, respectively. Stroke volume was 64 mL, with ejection fraction of 67%. The patient's mechanical prosthesis was functioning normally. Respiratory function showed depressed forced vital capacity (FVC) of 2.60 L (81% of normal) and forced expiratory volume in 1 s (FEV1.0) of 1.24 L (54% of normal). Cardiac computed tomography (CT) showed marked LA enlargement with its volume of 1291 mL (Fig. 1a).

His treatment outcome was complicated by cerebral infarctions in his right frontal and parietal lobes. He recovered without obvious paralysis, and the thrombus in the LA disappeared on TTE. However, a marked spontaneous echo contrast was observed inside the giant LA, showing bloodstream stasis. The patient's cerebral infarction had occurred despite the presence of anticoagulation agents at levels within the therapeutic range; he remained in NYHA III. He was diagnosed as a surgical candidate for atrial volume reduction combined with AF surgery. The surgery was undertaken 6 months after his cerebral infarction.

The right axillary artery was used for arterial perfusion. Cardiopulmonary bypass was commenced using a long venous cannula inserted into the right femoral vein. The third median sternotomy was performed uneventfully. Another venous cannula was added to the superior vena cava. The ascending aorta was clamped, and complete diastolic arrest was obtained. We were unable to reach the posterior side of the heart due to posterolateral calcified pericardium with dense adhesion. The LA volume reduction was initiated by excising the LA appendage, where a small organized thrombus was observed. The right-side LA was opened longitudinally and extended to the orifice of the left inferior pulmonary vein. The roof of the LA was also incised and plicated. The previously implanted mechanical prosthesis looked

intact without any pannus formation. Excess LA tissue was excised in a diamond-shaped wedge with its 5-cm width uniting at the apex of the atriotomy (Fig. 2a). Pulmonary vein was isolated in a boxed shape using cryoablation. To avoid injury to his mechanical prosthesis, ablation was not applied to the mitral annulus or isthmus. Closure of the extended single atriotomy incision was performed with a double layer of 4–0 monofilament suture to bring the pulmonary veins closer to the mitral annulus, thus significantly reducing LA (Fig. 2b). The right atrium was obliquely opened, and the anterior wall excised with its 2-cm width. The right atrial wall was closed. The aorta was declamped, and the heart started beating. The cardiopulmonary bypass was weaned uneventfully.

His postoperative course was uneventful; postoperative CT at 2 months showed marked LA volume reduction of 256 mL (Fig. 1b). The reduced LA volume was maintained at 511, 603, 558, and 576 mL at 3–6 yearly follow-up. He has remained in NYHA I without any episodes of thromboembolism for 6 years. His postoperative electrocardiogram showed regular rhythm without P wave (heart rate, 42–91 beats per min). The TTE at 2 months showed marked LA volume reduction to 175 mL. His LV end-diastolic and stroke volumes increased (123 and 93 mL at 2 months, respectively) and remained at these levels (140 and 80 mL at 6 years, respectively) for 6 years (Fig. 3). Both FVC (2.89 L, 91% of normal) and FEV1.0 (1.54 L, 62% of normal) showed increases of approximately 300 mL at 6 years.

Discussion

LA volume reduction surgery with mitral valve surgery and/or Maze procedure improve circulatory and respiratory functions [2–5]. For giant LA cases, reducing compression to the heart and lungs is the possible mechanism underlying improvement [2,3,5]. However, no report included patients who did not undergo mitral valve surgery. Little has been reported regarding its long-term effects. In this case, CT revealed LA volume reduction >500 mL. TTE data showed a 44 mL (46%) increase in LV end-diastolic volume and a 16 mL (25%) increase in stroke volume, showing marked LV filling improvement. We consider that this 25% increase in stroke volume improved the patient's cardiac health. Additionally, respiratory function testing showed a 300 mL increase in lung capacity, which may have accelerated resolution of the patient's symptoms. These

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