

Thirty-Three Years Old Modified Senning Operation

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Numerous technical modifications and various complications of the Senning procedure have been described in the literature. We describe the excellent clinical status and anatomic result of a 33-year-old patient who underwent a modified Senning operation using the left atrial appendage for reconstruction more than 30 years prior to presentation.

Key words: 1. Transposition of the great arteries
2. Cardiac surgical procedure
3. Congenital heart disease (CHD)

CASE REPORT

A 33-year-old male was born with transposition of the great arteries (TGA). At the age of 1 month, he underwent Rashkind septostomy. There was also 'unroofing of the coronary sinus' and persistent draining of the left superior caval vein directly to the left atrium between the appendage and the left pulmonary veins. There was also a large opening at the expected site of the mouth of the coronary sinus. Taking into account this anatomic variation, a modified Senning operation was performed by using the left atrial appendage for the construction of the new atrial pathway so that the blood of both the left superior caval vein and the coronary sinus would be drained to the newly created venous atrium (Fig. 1). The surgery was performed with deep hypothermia (16°C) and cold crystalloid cardioplegia. His postoperative course was uncomplicated, and he was discharged from the hospital on postoperative day 10.

During his regular follow-up, 33 years after the operation, he remains without symptoms in New York Heart Association (NYHA) class I. The quality of his life is excellent, and he is attaining a normal level of education and employment. He is in sinus rhythm, and the cardiac echocardiography (including transesophageal echo) and cardiac magnetic resonance imaging show mild distention of the right arterial atrium with trivial regurgitation of the tricuspid valve (systemic atrioventricular valve). The left (subpulmonary) ventricle has normal function with an ejection fraction of 65%, while the right (systemic) ventricle shows mild distention and an ejection fraction of 68%. The aortic and pulmonary valves are competent, and the baffle is completely patent without leaks. The caval and the pulmonary venous system showed no signs of stenosis or thrombosis (Figs. 2, 3).

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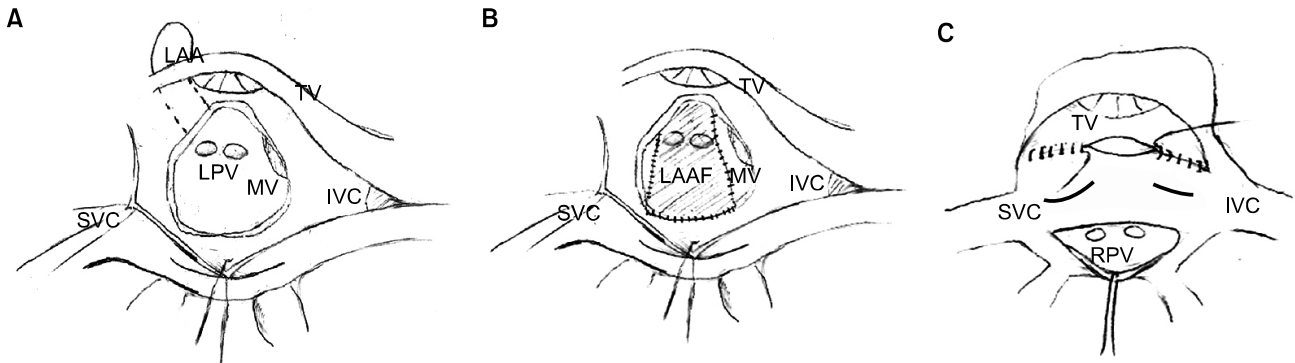


Fig. 1. (A-C) Schematic representation of the procedure. LAA, left atrial appendage; TV, tricuspid valve; MV, mitral valve; LPV, left pulmonary veins; IVC, inferior vena cava; SVC, superior vena cava; LAAF, left atrial appendage created flap; RPV, right pulmonary veins.

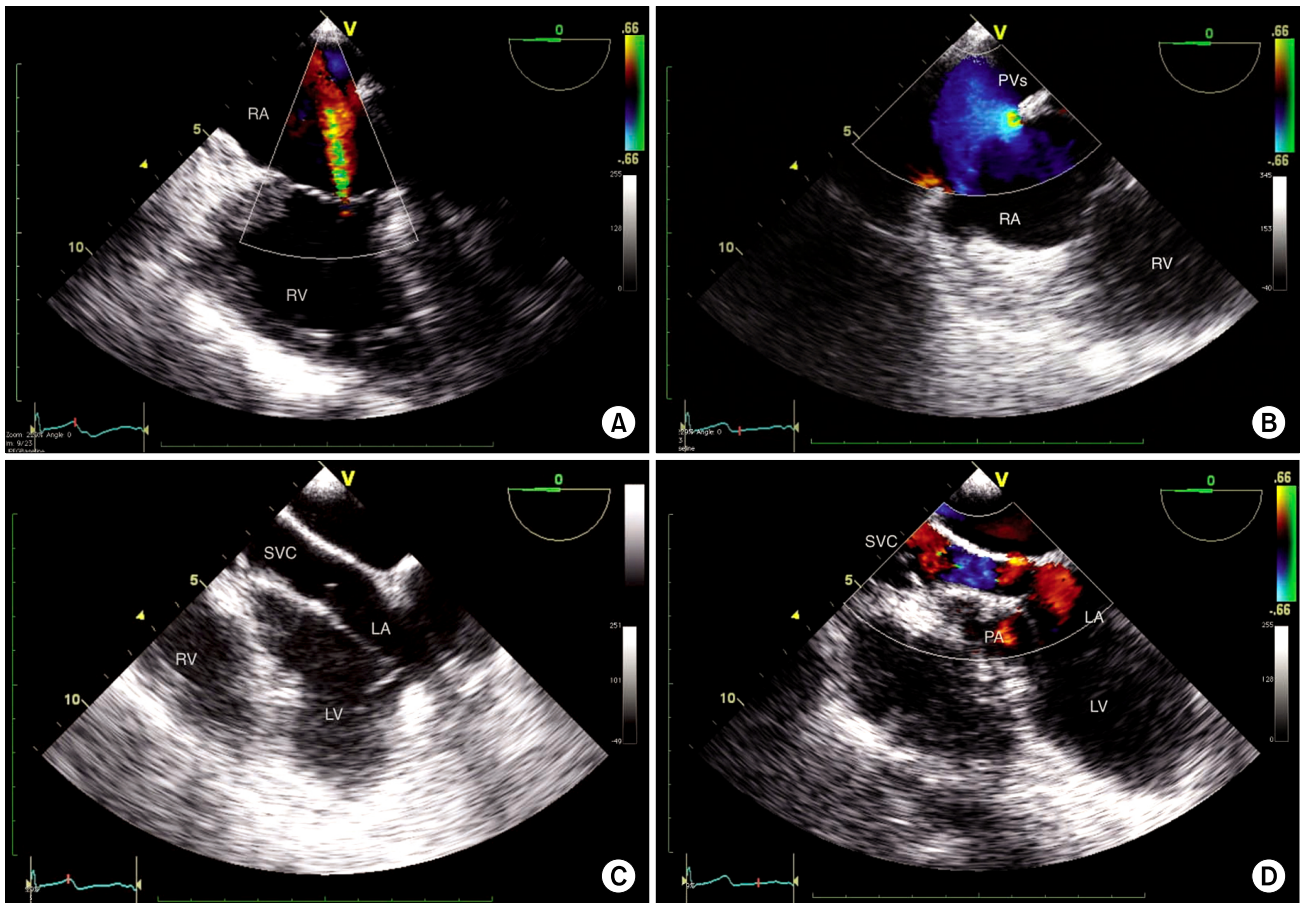


Fig. 2. (A) Mild tricuspid regurgitation (systemic atrioventricular valve) indicating good right (systemic) ventricular function 33 years after the atrial switch procedure. (B) The pulmonary venous baffle connection to the right atrium is depicted as wide open with unobstructed flow. (C, D) The systemic venous baffle connection to the anatomic left atrium through the unroofed coronary sinus is seen with normal, unobstructed flow. RA, right atrium; RV, right ventricle; PVs, pulmonary veins; SVC, superior vena cava; LA, left atrium; LV, left ventricle; PA, pulmonary artery.



Fig. 3. Four-chamber magnetic resonance imaging view, depicting the good size of the systemic right ventricle, with no particular dilation and the good size of the pulmonary venous and systemic venous baffles.

DISCUSSION

The Senning procedure was the first operation performed in patients with TGA [1] and changed the survival of these patients. It is an atrial switch operation diverting the venous drainage. Later, it was replaced by the arterial switch operation, which provides anatomic and physiologic repair. Despite the overall good outcomes after atrial level repairs, various complications have been reported [2]. Arrhythmias, systemic right ventricular dysfunction, systemic atrioventricular valve regurgitation, subpulmonary stenosis, and baffle problems are well-described complications of post-atrial switch techniques [3]. The use of the left atrial appendage for the construction of the new atrial pathway in the Senning procedure has rarely been described in the past [4-6]. In particular, to the best of our knowledge, only two papers have been published in English that report on the Senning procedure with the use of only autogenous tissue (that is, the left atrial appendage) [5,6].

Several studies have described the long-term outcomes of patients with Mustard and Senning repairs. Late survival is 84% to 95% at 10 years, 76% to 89% at 15 to 20 years, and 79.3% at 30 years [2,3,7,8]. Most of these studies report that

90% to 95% of the patients are in NYHA class I or II and almost all survivors are able to work and function normally in their social life [3].

Despite the overall good outcomes after atrial-level repairs, various complications may influence the long-term prognosis of these patients. Sinus node dysfunction, atrial flutter, sudden death, systemic right ventricular dysfunction, systemic atrioventricular valve regurgitation, subpulmonary stenosis, pulmonary hypertension, and baffle problems are well-described complications after these types of operations [3]. Moons et al. [7], in a retrospective review, reported that patients in the Senning cohort had a slightly better survival rate than in the Mustard cohort. Baffle obstruction occurred more often in the Mustard group, and arrhythmia-free survival did not differ between these two cohorts, although this might be determined by the complexity of the transposition. In addition, survivors after Senning repair had better functional status and tended to engage in more athletic activities [7]. Senning repair was the procedure of choice in our institution, with similar long-term results. Our patient, 33 years after the modified Senning repair, in an echocardiographic study, presents trivial systemic atrioventricular valve regurgitation and a mild distention of the right arterial atrium. Although severe tricuspid valve regurgitation was more prevalent in the Senning cohort and was positively correlated with the systemic ventricular function [7], the systemic right ventricular function is excellent and the patient remains in sinus rhythm. It seems that suboptimum myocardial protection during cardiopulmonary bypass may be a contributing factor to right ventricular dysfunction [3].

Several modifications of the Senning procedure using various materials (autogenous or not) for the construction of the new atrial pathway have been described in the literature [4-6]. The implantation of a prosthetic material should be avoided, whenever possible. The left atrial appendage is an alternative in some cases where the septal defect is large enough or anatomic variations are present, such as an unroofed coronary sinus. The inverted left atrial appendage could be incised and can be used as a flap for creating the atrial pathway [4-6]. In our technique, the base of the left appendage was invaginated and was used to create the septal flap in order to isolate the pathway of the pulmonary veins

from the overhead space. The lateral edge of the left atriotomy was covered with the right atrial wall. The entire procedure was facilitated by the presence of an unroofed coronary sinus. However, thus far, we have never performed this technique, as we have never encountered this anatomic variation in the TGA setting. This technique possibly has another advantage of the potential growth of the autologous tissue, and the created flap seems to participate in atrial contractility.

Throughout the years, this modification of the Senning procedure has been shown to be effective, and the long-term outcome of this patient is excellent. This modified technique could possibly generate renewed interest in atrial baffle procedures as part of a contemporary repair strategy for hearts with congenitally corrected TGA.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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