Orthotopic Heart Transplantation in Patients With Persistent Left Superior Vena Cava: Bicaval and Biatrial Techniques

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Persistent left superior vena cava (LSVC) is the most common congenital venous abnormality. With the increasing number of children who survive into adulthood with congenital heart malformations, the recognition of persistent LSVC among patients with advanced heart failure is likely to rise. We present two cases of orthotopic heart transplantation in the setting of LSVC successfully managed with biatrial and bicaval techniques.

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Technique

Patient 1: Biatrial Technique
A 58-year-old man with dilated cardiomyopathy and heart failure (ejection fraction of 10% to 15% and New York Heart Association class III/IV) was found to have left superior vena cava (LSVC) with absent right superior vena cava (RSVC) as part of the transplant evaluation. An implantable cardioverter defibrillator had been introduced into the coronary sinus via the LSVC. No other congenital cardiac abnormalities were found. After midline sternotomy, cardiopulmonary bypass was established using an arterial cannula in the ascending aorta and inferior vena cava cannula for venous drainage. After decompression of the heart, the LSVC along with a large vertical vein draining into the coronary sinus was easily identified, cannulated, and incorporated into the venous limb of the bypass circuit. After cross clamping, cardiectomy was performed leaving cuffs of left and right atrium. The vertical vein connecting the LSVC to the coronary sinus (CS) was preserved because it ran on the posterior aspect of the left atrial cuff (Fig 1). The CS and its junction in the remaining right atrium were left intact during cardiectomy. The atrial cuffs of the recipient and donor were fashioned for atrial-to-atrial anastomoses. After removing the native heart, a biatrial anastomosis was performed. At the end of right atrial anastomosis, the patient had two coronary sinuses (CS); the recipient’s CS draining the recipient’s LSVC and the donor’s CS draining the normal donor heart. The postoperative course remained uneventful. The patient was discharged home on the ninth postoperative day with the standard immunosuppressive therapy. On 2.5-year follow-up, the patient remains well without hospitalizations or major complications.

Patient 2: Bicaval Technique
The second patient was a 67-year-old man with known situs inversus totalis and idiopathic dilated cardiomyopathy. His condition was diagnosed at 19 years of age when he left his native country and immigrated to the United States. At 65 years of age, the patient became symptomatic and developed end-stage heart failure. A preoperative venous angiogram demonstrated LSVC without RSVC.
The patient was taken to the operating room. Following a standard sternotomy, typical CS anatomy was confirmed with an LSVC, midline inferior vena cava (IVC), and left-sided right atrium. There was no RSVC. Aortic and bicaval cannulation was performed. During dissection of heart, the LSVC was divided at its junction with the left-sided RA. The IVC, which was near the midline, was divided leaving a large patulous portion of the right atrium to allow easy reach to the donor’s IVC. The implantation of donor heart was started with left atrial anastomosis using a Prolene 3-0 suture in the usual fashion. Next, the redundant left-sided IVC cuff was anastomosed to the donor IVC in running fashion with minimal torsion at the anastomosis. This was followed by end-to-end pulmonary artery and aortic anastomoses. To direct the blood from the LSVC to the normal donor heart, we constructed a pericardial baffle with a donor’s pericardium over a Hegar’s dilator, with a size matching the recipient’s SVC. The baffle was then anastomosed to LSVC in end-to-end fashion and brought anteriorly to the great vessels and anastomosed to the donor SVC in an end-to-end fashion (Fig 2). The patient was weaned from cardiopulmonary bypass without difficulty. He had an uneventful postoperative recovery, and the usual immunotherapy was instituted. He was given daily aspirin (325 mg) without coumadin. Posttransplant endomyocardial biopsies were performed.
through the femoral route. His graft function remained stable for several years without evidence of baffle stenosis or closure. He developed progressive kidney disease and eventually required dialysis.

**Comment**

Several approaches have been advanced for the management of LSVC at the time of transplantation. Deuse and Reitz [4] preserved the donor innominate vein to connect to the recipient’s LSVC in a retroaortic configuration in a case of situs inversus totalis undergoing heart-lung transplantation. Length and frailty of the innominate vein can render this approach difficult, and it can be compressed by the greater vessels. Vricella and colleagues [5] described transplantation in 15 patients with situs inversus in which the donor SVC-innominate vein complex was anastomosed end-to-end to the LSVC across the greater vessels [5]—the same route used by us with our pericardial baffle. This experience was limited mostly to infants and children and in the authors’ judgment is less likely to be useful in adults in whom the innominate is frail and the length of conduit necessary to reach the LSVC precludes a tension-free anastomosis. Rabago and colleagues [6] described a bicaval anastomosis in a recipient with LSVC. The authors performed a bicaval anastomosis isolating the patient’s native CS to drain the LSVC into the IVC in a manner similar to our approach. Michler and Sandhu [7] described the use of complex systemic and pulmonary venous intracardiac rerouting in a pediatric patient with visceroatrial situs inversus.

Reproducible surgical techniques exist to achieve bicaval or biastral anastomoses in patients undergoing transplantation in the presence of a LSVC. The biastral anastomosis preserves the natural LSVC-to–coronary sinus drainage and avoids the use of intracardiac or extracardiac conduits; however, the documented superiority of bicaval technique in terms of postoperative arrhythmia, tricuspid valve geometry, and mortality [8] suggests that efforts aimed at a bicaval anastomosis even in LSVC situations may be warranted.

**References**