allow for adequate distance from the aortic valve annulus to the sheath insertion site. This is less of a concern for Sapien device placement owing to the short profile of the prosthesis (<2 cm). Preoperative imaging will map the calcium free areas, and angiography should be used before puncture. A calibrated pigtail catheter will provide landmarks for the puncture-to-annular distance, and this can be placed in the distal ascending aorta through a 6F sheath placed within a purse string suture of pledgetted 3-0 Prolene. The aorta is then punctured at the center of 2 pledgeted 3-0 polyprolene purse string sutures taken around the chosen point. The procedure should be performed in a manner similar to that described; however, the 18F sheath should be carefully placed to avoid excessive introduction into the aorta or slippage outside. Thus, we have used a silicon ring from an aortic cannula to mark the 1-cm depth on the sheath. Each purse string suture is tightened around the sheath using a tourniquet, and one is tied to the sheath and the other left loose. This allows for rapid tightening in case the sheath slips. The sheath is then sutured to the skin for more security. The rest of the procedure will be similar to that described. Remember one can perform rapid pacing as the aortic cannula is removed and the sutures can be tied, if desired. Direct access can be achieved without thoracotomy in many cases, and if an aortic repair was found to be necessary, most cardiac surgeons will find the aortic approach to be more familiar and less problematic than the left ventricular apical approach. We have generally noted easier implantation using non-ileofemoral techniques compared with the transfemoral technique owing to a shorter distance to the annulus. The system is then retrieved, the purse string sutures are secured, hemostasis is achieved under direct vision, and the chest is closed using a standard surgical technique and rigid sternal fixation using titanium plates (Biomet Microfixation, Jacksonville, Fla) to optimize stability and extubation before transfer to the cardiovascular intensive care unit (Figure 3).

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A new technique for venous unifocalization of the bilateral superior vena cava with the Glenn procedure

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The bidirectional Glenn procedure has been used as an intermediate stage for Fontan completion. In this staged operation, a bilateral, bidirectional Glenn procedure is performed in patients with a bilateral superior vena cava (SVC).[1] With the bilateral SVC anatomy, the small aperture of the bilateral SVC reduces blood flow volume, and unbalanced flow can cause the stasis of blood, unbalanced pulmonary blood flow, and thrombosis formation.[2] To resolve these issues, a new surgical technique, which we named the ‘‘unifocalization of bilateral SVC,’’ was tried as a part of the Glenn procedure. We hypothesized that single-vessel blood flow from the dual SVCs would distribute to both lungs in a manner similar to that of the unilateral Glenn procedure. In this study, we describe this new surgical procedure along with results and surgical limitations of this method.

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SURGICAL TECHNIQUE

We have performed the venous unifocalization in 9 patients since 2002. All patients who with a diagnosis of functional single ventricle with bilateral SVC can be subjected to this procedure. We used the novel method in patients in whom the inferior vena cava (IVC) and the larger or main SVC were on the same side; otherwise we performed a conventional bilateral bidirectional Glenn procedure, because the outcome of the new method had

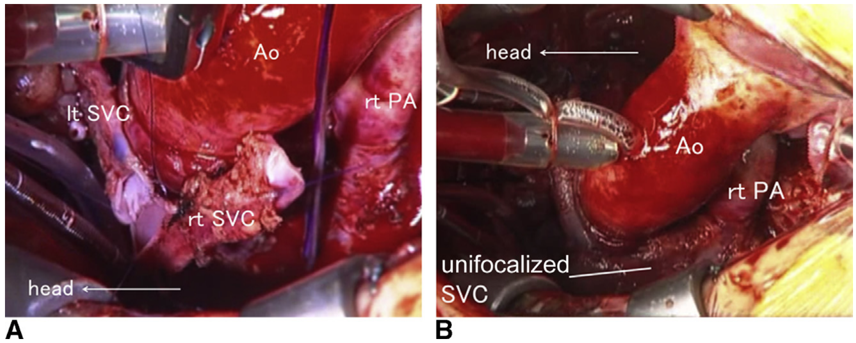

FIGURE 1. Intraoperative photographs depict the operative findings of this novel method. A, First, the left (*lt*), smaller superior vena cava (*SVC*) is anastomosed to the right (*rt*) main, larger superior vena cava. B, Then the unifocalized SVC is anastomosed to the upper side of the right pulmonary artery (*PA*). *Ao*, Aorta.

yet to be established. If patients had SVCs equal in size, we chose the SVC on the same side as the IVC to be the main vessel.

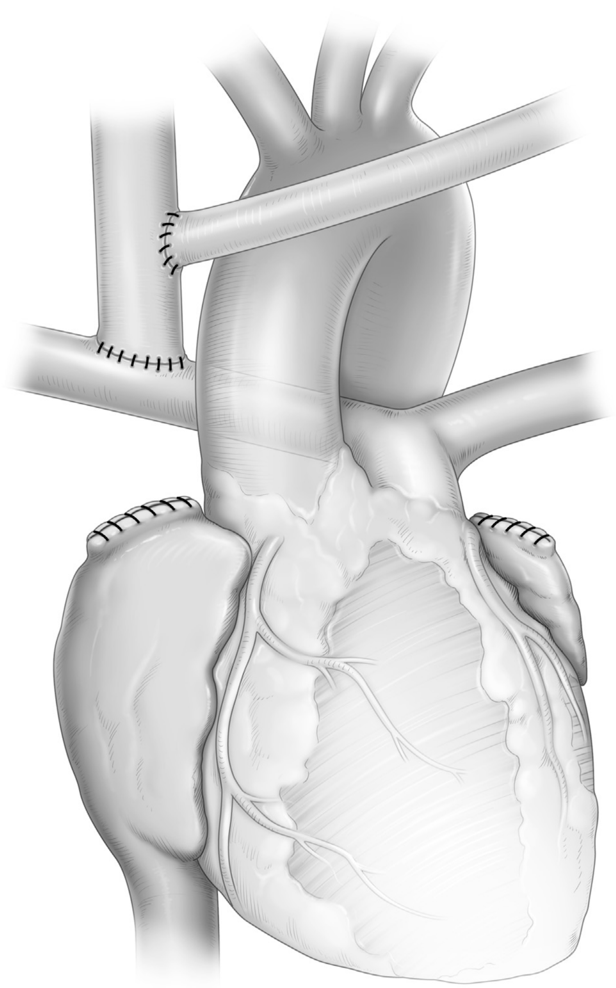

FIGURE 2. Both superior venae cavae are separated from the atrium, and the end of the larger superior vena cava is anastomosed to the lateral side of the smaller one. We then complete the procedure with a method similar to the unilateral Glenn procedure.

All patients undergoing the procedure were placed on cardiopulmonary bypass with moderate hypothermia, and the bilateral SVC and right atrium were cannulated. When cardiac arrest was required, myocardial protection was achieved by using cold crystalloid cardioplegia combined with topical cooling. We inserted cannulas into both SVCs as far apart as possible within the surgical site. We then separated the smaller SVC from the atrium and anastomosed it to the lateral side of the larger SVC, using in most cases 7-0 polydioxanone suture with continuous stitching (Figure 1, *A*). Finally, we made an anastomosis between the new, unifocalized SVC and the facing side of the pulmonary artery with a continuous 7-0 polydioxanone suture line (Figure 1, *B*). This created a configuration similar to that in a unilateral bidirectional Glenn procedure (Figure 2). The azygos vein was ligated to prevent it from reducing blood flow to the SVC. In this group, there was 1 early death related to desaturation, likely caused by obstructed Glenn shunt flow, in a patient who had not yet undergone the Fontan procedure.

DISCUSSION

In the bidirectional SVC anatomy, the imbalance of flow can cause the stasis of blood and thrombosis formation.[2] In addition, there is a concern that blood flow from the IVC might not distribute equally after the Fontan procedure, because there is a dimensional mismatch between the baffle and the connecting vessels. Unequally distributed IVC blood flow to the lungs can lead to pulmonary arteriovenous malformations, which continue to be a cause of considerable morbidity.[3] These facts suggest that undisturbed pulmonary blood flow from SVCs and the distribution of blood flow from the IVC are important factors in the prognosis of patients with single-ventricle anatomy. Our new method potentially resolves some of these issues that occur in patients with bilateral SVC.

Some considerations must be taken into account. First, if the main SVC is smaller than the other SVC, venous blood flow can be obstructed at the junction of the two SVCs. In the patient who died early in our study, the left, larger SVC was anastomosed to the right smaller SVC considering the anastomosis side of the Fontan conduit, because the IVC was positioned on the same side as the smaller SVC. This led to the elevation of the central venous pressure, and severe edema of the face was observed postoperatively. Second, if the length of the SVC is too short to anastomose, the time to perform the anastomosis with our new procedure should be similar to that of the bilateral bidirectional Glenn procedure. Third, the new innominate vein may be compressed from the posterior side, because the aortic arch was placed anteriorly with transposition of the great arteries. We had seen only a single case with apicocaval juxtaposition. We created the unifocalized SVC on the left side, because the route of the conduit was on the left side when the Fontan operation was performed. The postoperative course after the Fontan procedure in this patient was uneventful and satisfactory. This new surgical method of SVC unifocalization, would be effective in the staged Glenn procedure for patients with bilateral SVC.

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New approach to implantable cardioverter-defibrillators in small pediatric patients: Dorsal positioning of superior vena cava shock lead in a 3-year-old

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Video clip is available online.

The use of implantable cardioverter-defibrillators (ICDs) in pediatric patients is increasing, and the average age at implantation is decreasing.[1] Because the constraints of vascular and thoracic anatomy necessitate the adaptation of existing systems, which were developed for and tested in adults,[2] ICD implantation in pediatric patients remains a challenging procedure. Device-related complications occur in more than 10% of the pediatric ICD recipient population,[3] and the effectiveness of shock therapy varies,[4] emphasizing the importance of optimal lead and device positioning in such patients.

CLINICAL SUMMARY

A 3-year-old boy with a history of exertional or emotionally triggered syncopes was resuscitated from out-of-hospital cardiac arrest with ventricular fibrillation. No structural heart disease was found. One month later, a single-chamber ICD (St Jude Medical Ellipse; St Jude Medical, Inc, St Paul, Minn) was implanted. Because of the patient's size (height of 97 cm and weight of 15.8 kg) and the prospect of several reimplantations during his entire life span, neither a transvenous nor an epicardial approach for shock lead implantation was considered optimal. Instead, we chose an alternative approach. The ICD generator pocket was created under the rectus muscle in the upper left abdomen. A superior vena cava shock lead (Medtronic Transvene CS/SVC 6937 A; Medtronic, Inc, Fridley, Minn) was implanted subcutaneously in a dorsal position left to the upper thoracic spine and connected to the abdominal generator through a subcutaneous tunnel (Figure 1). This lead was fixed with sutures at its distal end, before its course under the costal margin, and as it entered the abdominal pocket. An epicardial lead (Medtronic CapSure EPI 4968; Medtronic, Inc, Fridley,

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