Surgical Techniques

Tunneling a Pulmonary Artery Graft:

A Simplified Way to Insert and Remove a Temporary Right Ventricular Assist Device

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Right ventricular failure can occur early or late after left ventricular assist device implantation. Support with a right ventricular assist device is needed in patients whose right ventricular failure does not respond to conservative management. The use of a temporary right ventricular assist device can enable the recovery of right ventricular function and avoid the use of a more permanent biventricular assist device, which is associated with complications and higher costs. We present our technique of instituting temporary right ventricular assist device support in patients who have undergone left ventricular assist device implantation. ***(Tex Heart Inst J 2015;42(6):540-2)***

Right ventricular (RV) failure can occur in the early or late postoperative period after the implantation of a left ventricular assist device (LVAD). The use of a temporary RV assist device (RVAD) at that time can enable the recovery of RV function and avoid the use of a more permanent biventricular assist device, which carries associated complications and high costs. We here present our technique of instituting temporary RVAD support in patients who have undergone LVAD implantation. A technique similar to ours was first reported by Cohn and colleagues in 2007.[1]

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Exposure is attained through a primary or secondary median sternotomy, depending upon the timing of RVAD implantation. The main pulmonary artery (PA) is mobilized by separating its plane from that of the ascending aorta. Adequate anticoagulation is ensured. Cardiopulmonary bypass might not be required if the procedure is performed after LVAD implantation. A small side-biting clamp is applied to the main PA, and a longitudinal arteriotomy is performed. An 8-mm Dacron graft is sutured in an end-to-side fashion to the PA at the point of incision (Fig. 1A), with the use of 5-0 Prolene suture (Ethicon, a Johnson & Johnson company; Somerville, NJ). With the aid of a Roberts clamp, the surgeon tunnels the graft through the rectus sheath to the subcostal area. A 21F or 23F wire-reinforced arterial cannula (MAQUET Cardiovascular, LLC; Wayne, NJ) is used to cannulate the graft. Heavy silk sutures are used to tie the cannula to the graft and to secure the cannula to the skin. A 23F or 25F wire-reinforced venous cannula (MAQUET) is placed percutaneously or through a cutdown over the right femoral vein, with its tip in the mid-right atrium. Transesophageal echocardiography (TEE) is useful in positioning the venous cannula. Both of the cannulas are de-aired and are connected to a ROTAFLOW centrifugal pump (MAQUET) through tubing used for the institution of extracorporeal membrane oxygenation support (Fig. 1B). The median sternotomy wound is closed at the end of the procedure.

Subsequent decannulation of the RVAD system does not require reopening the median sternotomy. The patient is weaned from the RVAD with the aid of TEE guidance. The femoral venous cannula is then removed, and hemostasis is ensured with a percutaneous silk purse-string suture and direct pressure. Silk sutures securing the PA cannula to the graft are cut. The cannula and graft are gently retracted by 1 to 2 cm to ensure that a sterile section of the graft enters the operating field. The cannula is then removed from the graft, and a curved vascular clamp is applied to the sterile part of the graft (Fig. 2A). The graft is trimmed in such a manner that all the unsterile section is removed and the sterile graft is oversewn with a 2-layer suture line

Key words: *Device removal/methods; heart assist devices; ventricular assist device, right; ventricular dysfunction, right/surgery*

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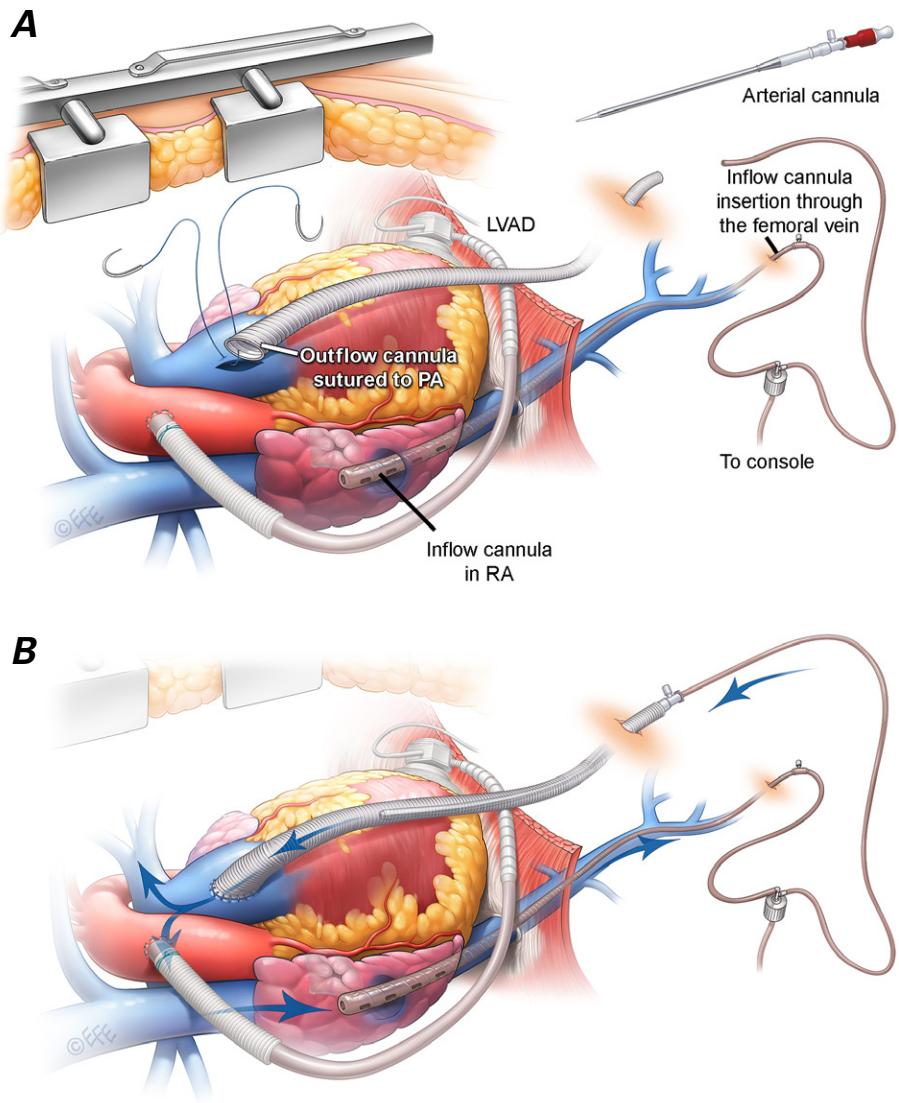

Fig. 1 *Cannulation technique.* ***A****) Operative drawing shows the HeartWare HVAD left ventricular assist system in situ, the suturing of the Dacron outflow graft to the main pulmonary artery, and the graft as it was tunneled through the subcostal area. Components of the temporary right ventricular assist device circuit (not all of which are portrayed) include a wire-reinforced arterial cannula, tubing, a pump, and the inflow part of the circuit, with a wire-reinforced venous cannula.* ***B****) This drawing shows the temporary right ventricular assist device circuit in use.*

LVAD = left ventricular assist device; RA = right atrium

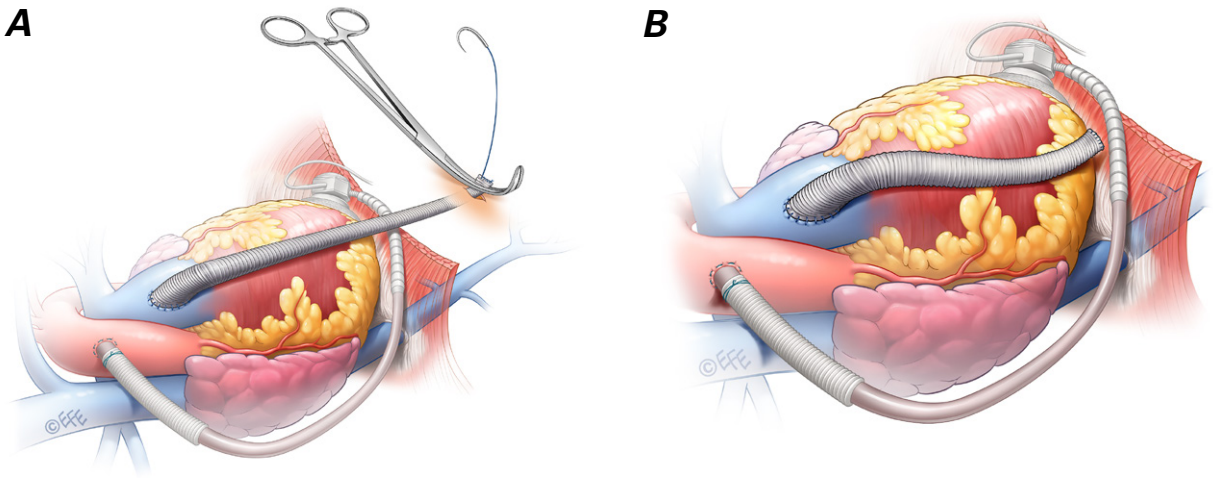

Fig. 2 *Removal technique. Illustrations show* ***A****) suturing of the pulmonary artery graft, which has been clamped at the level of the incision, and* ***B****) retraction of the graft into the mediastinum.*

TABLE I. Data on 10 Patients Who Underwent Temporary RVAD Insertion by Means of the Described Technique

Pt. No.	Age (yr), Sex	Type of Cardio-myopathy	Operative Procedure	LVAD Type	Time from LVAD to RVAD (d)	Prior Cardiac Surgical Procedure	Duration of RVAD Support (d)	Outcome*
1	57, F	Dilated	LVAD exchange	HeartWare	2	LVAD	11	Died 2 wk after LVAD implantation
2	55, M	Ischemic	LVAD; ECMO removal	HeartWare	1	CABG and VA ECMO	9	Died 4 wk after LVAD implantation
3	45, M	Dilated	LVAD exchange and RVAD	HeartWare	0	LVAD	9	On LVAD support
4	61, M	Dilated	LVAD and RVAD	HeartMate II	0	None	8	On LVAD support
5	57, M	Dilated and hemo-chromatosis	LVAD, RVAD, and ASD closure	HeartWare	0	None	7	On LVAD support
6	18, M	Ischemic after OHT	LVAD; ECMO removal	HeartWare	18	OHT	19	Transplantation
7	55, M	Dilated	LVAD, RVAD, and AVR	HeartWare	0	VA ECMO	10	Recovered LV function after LVAD removal
8	33, M	Dilated	LVAD, RVAD, and AVR	HeartWare	0	None	11	Transplantation
9	63, F	Dilated	LVAD and RVAD	HeartWare	0	None	14	Transplantation
10	22, M	Dilated	LVAD and RVAD	VentrAssist	0	None	8	Transplantation

ASD = atrial septal defect; AVR = aortic valve replacement; CABG = coronary artery bypass grafting; ECMO = extracorporeal membrane oxygenation; F = female; LVAD = left ventricular assist device; M = male; OHT = orthotopic heart transplantation; Pt. = patient; RVAD = right ventricular assist device; VA = venoarterial

*As of 31 December 2014

(5-0 Prolene). The graft is allowed to retract into the mediastinum (Fig. 2B). The skin incision at the site of the PA graft insertion is repaired with a skin suture.

Discussion

The use of a temporary RVAD after LVAD implantation is a relatively new concept in the management of postoperative RV failure. The technique presented here has the advantage of continuing temporary RVAD support for several weeks, with a closed chest. This can enable satisfactory recovery of the RV over a prolonged period of time. Removal of the PA cannula does not require reopening the sternotomy. We have encountered no problems with pulmonary thrombosis or infection in patients who have had a PA graft stump left in situ. Indeed we have since performed heart transplants in 4 patients whose PA grafts had been left in situ (Table I), and we have been able to remove those grafts in a straightforward manner at the transplant operation. The graft itself has been occluded with thrombus, but the PA at the anastomosis appears to have covered the graft lumen with a protective layer of endothelium. Similar techniques for the institution of temporary RVAD support have been reported to yield satisfactory results.[2,3]

We might add that the current technique also facilitates the use of the PA graft for permanent RVAD implantation, should the need arise after the discontinuation of temporary support.

References

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