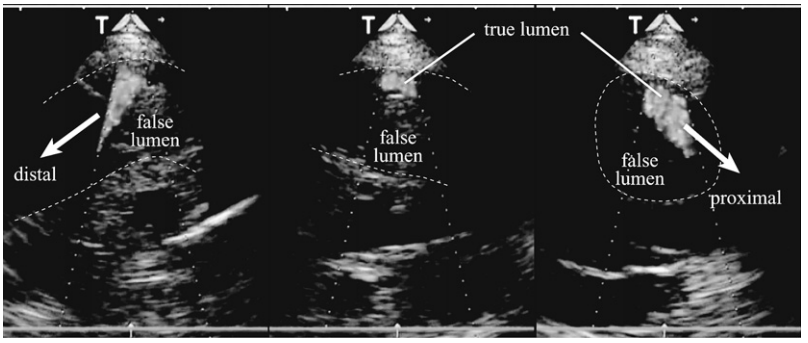

FIGURE 2. Intraoperative transesophageal echocardiogram demonstrating the narrow true lumen of the IA.

presence of reentry, we decided to add left AX-P because the bilateral axillary arteries had been routinely prepared for selective cerebral perfusion at the Hiroshima University Hospital. The addition of FA-P might be another strategy in other institutions.

Because there are unpredictable factors in acute aortic dissection, decisions need to be made stepwise and be based on real-time information at each step. Although our initial assessment was incorrect, TEE and orbital Doppler findings steered the subsequent management toward a good outcome.

Compression of IA can be a mechanism of malperfusion after right AX-P. In acute aortic dissection with many unpredictable factors, real-time, on-site information is essential for intraoperative navigation.

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Partial left ventricular support implanted through minimal access surgery as a bridge to cardiac transplant

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The clinical benefits of implantable left ventricular assist devices (LVADs) as a bridge to transplant and for destination therapy have been demonstrated.[1-3] The low rate of LVAD use is attributed to the invasive nature of the implantation surgery and the relatively high rate of complications.[4] If LVADs were used in less critical hemodynamic and clinical states, the flow requirements could be reduced.

The Synergy Micro-Pump (CircuLite, Inc, Hackensack NJ) is approximately the size of a size AA battery, weighs only 25 g, and can pump as much as 2.5 to 3 L/min. Its small size permits insertion through a right-sided minithoracotomy. The pump is then placed subcutaneously in the pectoral region, similar to a pacemaker. This is the first clinical report describing the Synergy Micro-Pump's implantation procedure, hemodynamic effects, and clinical results.

CLINICAL SUMMARY

The patient was a 46-year-old man (weight 85 kg, height 184 cm, body surface area 2.01 m^2) without significant illness in his medical history who had a large anterior myocardial infarction in March 2007. New York Heart Association

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Synergy Micro-Pump (CircuLite, Inc, Hackensack, NJ) was provided by the manufacturer.
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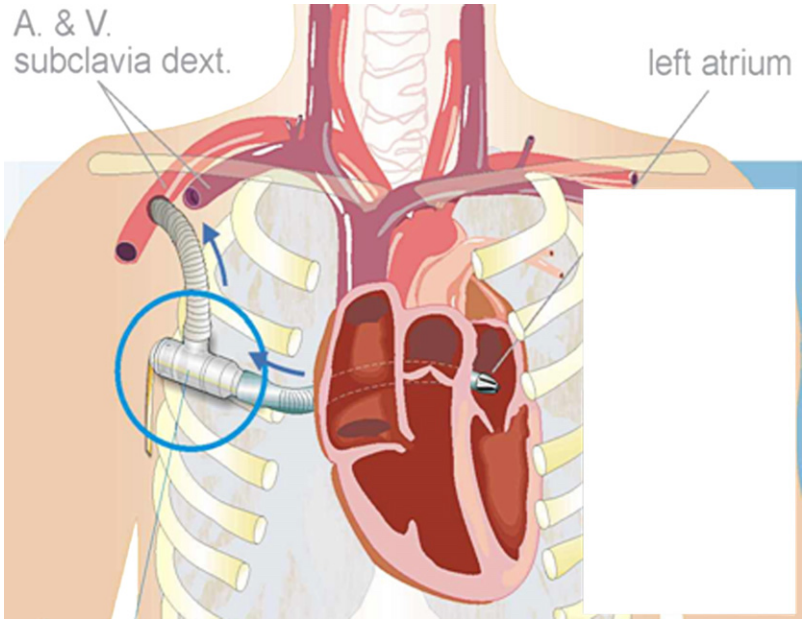

FIGURE 1. Drawing illustrating pump position and direction of pump flow with radiographic correlation in anteroposterior view. *A. & V. subclavia dext.,* Right subclavian artery *(red)* and vein *(purple).*

functional class IV symptoms developed within 2 months (cardiac index 2.2 L/[min/m^2], pulmonary arterial pressure 55/24 mm Hg, pulmonary capillary wedge pressure 31 mm Hg, maximum oxygen consumption 8.5 mL kg/min). The patient was listed for a heart transplant. His condition continued to deteriorate during the ensuing 6 weeks, however, and he was accepted for investigational study of the Synergy Micro-Pump. This study was conducted in accordance with the Declaration of Helsinki according to a study protocol approved by the Leuven University Ethics Committee and the Belgian Competent Authority. The study protocol was approved by the University Hospitals Leuven Ethical Committee on April 10, 2007.

After informed consent was obtained (June 28, 2007), the patient underwent elective surgery. Hemodynamics after anesthesia included an arterial pressure of 96/69 mm Hg, a cardiac output of 2.5 L/min, a pulmonary arterial pressure of 55/24 mm Hg, and a pulmonary capillary wedge pressure of 31 mm Hg. A 4-cm subclavicular incision was made to isolate the right subclavian artery. A small subcutaneous pocket,

TABLE 1. Clinical indices of heart failure and device function

	Preoperative	POD 3	POD 30	POD 70	POD 100
Body weight (kg)	83	85	88	85	88
Heart rate (beats/min)	96	94	92	85	78
New York Heart Association class	IV	IV	III	II	II
Arterial blood pressure (mm Hg)	85/65	94/69	97/70	92/64	11/78
Cardiac index (L/[min · m^2])	1.38	2.7	1.7	2.0	2.38
NT pro-BNP (ng/L)	4698	—	4020	3129	2754
Renal function					
Serum sodium (mmol/L)	131	135	137	135	133
Serum creatinine (mg/dL)	1.15	0.68	1.19	1.06	1.27
Blood urea nitrogen (mg/dL)	56	22	47	44	66
Plasma free hemoglobin* (mg/dL)	<5	7	<5	<5	<5
Pump speed (rpm)	—	22,000	20,000	22,000	22,000
Estimated pump flow (L/min)	—	2.5	2	2.5	2.5
Medication					
Bumetanide (mg)	2.5 bid	—	—	1 bid	2.5 bid
Furosemide (mg)	—	40 qd	40 qd	—	—
Perindopril (mg)	2 bid	2 bid	2 bid	4 bid	4 bid
Carvedilol (mg)	3.125 qd	3.125 bid	3.125 bid	6.25 bid	6.25 bid

POD, Postoperative day; *NT pro-BNP*, N-terminal pronormone brain natriuretic peptide; *bid,* twice daily; *qd,* daily. *As index of hemolysis.

similar to a pacemaker pocket, was formed for the pump anterior to the right pectoralis major muscle. An incision was then made in the right fourth intercostal space to gain access to the left atrium through the Waterson groove. The nitinol-reinforced silicone inflow cannula was inserted into the left atrium between the insertions of the right upper and lower pulmonary veins. The inflow cannula was tunneled through the second intercostal space to exit the thorax in the area of the subcutaneous pocket. The 8-mm expanded polytetrafluoroethylene outflow graft was anastomosed to the subclavian artery. The electrical wire of the pump was then tunneled to exit the body over the right lower quadrant of the abdomen. Pump speed was set at 22,000 rpm (pump flow approximately 2.5 L/min), the surgical wounds were closed, and the patient was taken to the intensive care unit. The duration of the surgery was approximately 2 hours. Pump position is illustrated in Figure 1.

The patient recovered well from the surgery. Daily therapy was started with warfarin sodium (target international normalized ratio 2.5) and low-dose aspirin (80 mg). The patient is currently ambulatory. He continues to improve his exercise capacity at home, makes visits, and climbs stairs. Table 1 summarizes the evolution of clinical parameters during the first 100 days after the procedure.

The patient had only minor complications. A hematoma developed at the subclavicular wound site on postoperative day 1 but had resolved by postoperative day 4. Transient swelling developed in the right upper extremity on postoperative 4 but had resolved by postoperative day 7.

DISCUSSION

We summarize here the first use of the Synergy Micro-Pump in a patient as a bridge to transplant. This device provides partial left ventricular support (2-3 L/min) and is specifically designed to be implanted in patients who are not as critically ill as the patients now typically receiving full support LVADs. Because of the small size of the device, the surgery was relatively short and significantly less traumatic than with other LVADs. The combination of the patient's intrinsic cardiac output of 3.6 L/min with the 2.5 L/min provided by the pump summed to a total cardiac output in excess of 6 L/min, a normal resting value. No significant hemolysis was noted, and there were no serious adverse effects.

There are several unique features of the device. This pump is the smallest implanted assist device ever used as a bridge to transplant. This is the first implanted device with the inflow cannula placed in the left atrium and the outflow cannula connected to the subclavian artery. Because of the unique anatomic position, the procedure was anticipated to be less invasive. As a result, flows of only 2.5 L/min were able to produce clinically significant and sufficient acute hemodynamic effects.

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A bilobed thoracic outlet mass: Options for resection

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Complete resection of thoracic outlet tumors is challenging because of limited access and close proximity of vital neurovascular structures. We present a hemiclamshell approach with removal of the first rib to facilitate resection of a bilobed mass compressing the right subclavian artery and brachial plexus.

CLINICAL SUMMARY

A 31-year-old African-American man presented with a 1-year history of increasing shoulder pain and right forearm paresthesias. He denied any upper limb weakness, weight loss, fever, or dyspnea. Clinical examination revealed

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