

Brief Research Reports

particularly evident among patients with complex lesions. Efforts should be undertaken to reduce the incidence of stroke, however, which remains higher in patients undergoing CABG. Aortic “no touch” off-pump CABG has been recently proposed as a means of minimizing the risk of perioperative stroke. The rate of off-pump surgery varied among the trials included, ranging from 1.8%⁵ to 63.8%.⁴ A trend toward an increased rate of stroke was found among patients undergoing CABG regardless of the rate of off-pump surgery. No data were available on manipulation of the ascending aorta or the use of epiaortic scanning, however, so whether off-pump surgery would truly be beneficial cannot be evaluated, and further studies are needed.

Despite these limitations, this meta-analysis demonstrates a significant reduction in repeated revascularization with CABG, which outweighs its detrimental increase in stroke rate. Only first-generation DESs were used in all

the included RCTs, however, limiting our ability to draw conclusions for second-generation devices.

References

1. Athappan G, Patvardhan E, Tuzcu ME, Ellis S, Whitlow P, Kapadia SR. Left main coronary artery stenosis: a meta-analysis of drug-eluting stents versus coronary artery bypass grafting. *JACC Cardiovasc Interv.* 2013;6:1219-30.
2. Morice MC, Serruys PW, Kappetein AP, Feldman TE, Stähle E, Colombo A, et al. Five-year outcomes in patients with left main disease treated with either percutaneous coronary intervention or coronary artery bypass grafting in the SYNTAX Trial. *Circulation.* 2014;129:2388-94.
3. Boudriot E, Thiele H, Walther T, Liebetrau C, Boeckstegers P, Pohl T, et al. Randomized comparison of percutaneous coronary intervention with sirolimus-eluting stents versus coronary artery bypass grafting in unprotected left main stem stenosis. *J Am Coll Cardiol.* 2011;57:538-45.
4. Park SJ, Kim YH, Park DW, Yun SC, Ahn JM, Song HG, et al. Randomized trial of stents versus bypass surgery for left main coronary artery disease. *N Engl J Med.* 2011;364:1718-27.
5. Buszman PE, Kiesz SR, Bochenek A, Peszek-Przybyła E, Szkrobka I, Debinski M, et al. Acute and late outcomes of unprotected left main stenting in comparison with surgical revascularization. *J Am Coll Cardiol.* 2008;51:538-45.

Single-center experience with a minimally invasive apicoaxillary external ventricular assist device

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Mechanical circulatory support (MCS) devices have become more popular in the treatment of cardiogenic shock (CS). Options for emergency support include venoarterial extracorporeal membrane oxygenation, percutaneous ventricular assist devices (VADs), and surgical VADs. Among MCS devices, surgical VADs have the advantage of providing sufficient circulatory support¹; however, the standard technique requires implantation through a median sternotomy.²

Previously, we described a unique configuration of the CentriMag (Thoratec Corporation, Pleasanton, Calif) left VAD (LVAD) that allowed rapid off-pump placement without performing a sternotomy.³ Here we present a series

of cases of patients who received this external apicoaxillary LVAD (AA-LVAD) as a bridge to decision.

MATERIALS AND METHODS

Our institutional review board approved this study. Between January 2007 and December 2013, a series of 198 patients underwent CentriMag VAD insertion for CS at our institution. The cases of 7 patients who received AA-LVADs were reviewed.

Indications

Indications for AA-LVAD placement include patients in CS who require VAD support but do not meet criteria for durable MCS device implantation at the time of evaluation. Our default strategy for device therapy in CS is to insert a short-term biventricular VAD, so this technique is reserved for those who can succeed with isolated LVAD support. Patients with CS who have peripheral vascular disease that precludes the use of a percutaneous MCS may also be considered for this support. Patients are excluded if there are mechanical obstacles to cannulation of their axillary artery or left ventricular apex.

Technique

The details of AA-LVAD implantation are described elsewhere.³ Briefly, after intubation, the axillary artery (right or left) is exposed through a small infraclavicular incision, and the left ventricular apex is exposed through a left anterior thoracotomy. Heparin of 5 to 10,000 units is given. An 8-mm Dacron polyester fabric graft is sewn end to side to the axillary artery, and the arterial cannula (24F EOPA; Medtronic, Inc,

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TABLE 1. Patient characteristics and operative data

	Characteristics						Operative data			
	Age (y)	Sex	Sternotomy			INTERMACS level	LV cannula	EBL (mL)	PRBCs (units)	
			(No.)	MCS	CVVH					Etiology of heart failure
1	50	M	2	None	No	NIDCM	1	40F	—	0
2	52	F	1	None	No	ICM	1	34F	300	2
3	62	M	2	ECMO	Yes	ICM	1	36F	200	1
4	28	F	3	None	No	Rheumatic disease, ICM	1	24F	300	4
5	53	M	2	ECMO	No	Rheumatic disease	1	32F	25	0
6	68	M	1	IABP	No	ICM	1	36F	50	0
7	65	M	1	IABP	No	ICM	1	36F	50	0

MCS, Mechanical circulatory support; CVVH, continuous venovenous hemofiltration; INTERMACS, Interagency Registry for Mechanically Assisted Circulatory Support; LV, left ventricle; EBL, estimated blood loss; PRBCs, packed red blood cells; NIDCM, nonischemic dilated cardiomyopathy (secondary to congenital bicuspid aortic valve); ICM, ischemic cardiomyopathy; ECMO, extracorporeal membrane oxygenation; IABP, intra-aortic balloon pump.

Minneapolis, Minn) is inserted into the graft. Double purse-string sutures buttressed with felt pledgets are placed at the left ventricular apex, and the inflow cannula (Table 2) is inserted 2.5 to 3 cm into the left ventricle through a stab wound. The cannulas are then connected to a CentriMag circuit. No cardiopulmonary bypass support is required. Heparin is started (goal of a partial thromboplastin time of 60-80 seconds) when chest tube output is minimal. Blood pressure is monitored through an arterial line in the contralateral upper extremity when possible. If a femoral line is required, it is revised before the patient reaches the stage of ambulation. The patients participate in ambulatory rehabilitation when feasible and, when their general condition is stable, undergo next step evaluation for explantation, device exchange, or heart transplantation.

RESULTS

Seven patients received AA-LVADs through the right axillary artery. The average (±SD) age was 54 ± 12 years (range, 28-68 years). All were in CS as a result of acute decompensated heart failure, and all had had previous sternotomies. At the time of implantation, 4 patients were receiving MCS with either an intra-aortic balloon pump (IABP) or venoarterial extracorporeal membrane oxygenation (Table 1). The IABP was removed within 24 hours after the operation. Among the 3 patients who were not receiving MCS, IABP was contraindicated in 1 case because of a type B aortic dissection, and attempts at IABP insertion failed in the other 2 cases because of incompatible vasculature.

All insertions were done off pump with minimal blood loss (Table 1). The average flow during the first 72 hours was 4 ± 0.9 L/min. Five patients (71%) were weaned from mechanical ventilation within 72 hours (3 within 24 hours, 2 within 48 hours). Four patients participated in ambulatory rehabilitation, and 2 were able to be out of bed to a chair. Four patients (57%) were free of any major complications. Two patients had infections develop. Three had neurologic complications, although only 1 of those was major (Table 2). Two patients had bleeding complications requiring reoperation. One patient underwent a colectomy for colon cancer. One patient had clinically observed hyperperfusion of the right upper extremity but did not require revision of the arterial outflow tract. There were no other adverse events associated with the axillary cannulation.

Five patients (71%) survived to the next step: 1 to transplant and 4 to durable LVAD implantation (2 as destination therapy and 2 as bridge to transplant). Two patients died of multisystem organ failure (Table 2).

DISCUSSION

Although recent studies have shown the benefit of early and aggressive use of MCS devices in patients with critical heart failure,⁴ durable MCS devices are known to result in both poor operative mortality and poor long-term outcomes in this same population.⁵ Percutaneous devices are an

TABLE 2. Outcomes

	Duration (d)	Pressor support		CVA	Infection	Reoperation	Survival to discharge	Primary outcome
		at 72 h (No. of drips)						
1	48	1		SAH	PNA	Bleeding from axilla	Yes	OHT
2	14	1		None	None	None	Yes	HMII BTT
3	17	4		VBI	None	None	No	Death
4	56	1		SAH	PNA, <i>Clostridium difficile</i>	Hemothorax ×2	No	Death
5	7	3		None	None	None	Yes	HMII DT
6	22	0		None	None	Colectomy	Yes	HMII BTT
7	20	1		None	None	None	Yes	HMII DT

CVA, Cerebrovascular accident; SAH, subarachnoid hemorrhage; PNA, pneumonia; OHT, orthotopic heart transplant; HMII, Heartmate II (Thoratec Corp, Pleasanton, Calif); BTT, bridge to transplant; VBI, vertebralbasilar insufficiency; DT, destination therapy.

appealing option, yet they may be too limited in flow and durability.² The AA-LVAD combines the benefit of a relatively quick insertion with sufficient circulatory support for restoration of end-organ function⁴ and avoids the hazards of re sternotomy and invasive surgery.

References

1. Werdan K, Gielen S, Ebelt H, Hochman JS. Mechanical circulatory support in cardiogenic shock. *Eur Heart J*. 2014;35:156-67.
2. Ziemba EA, John R. Mechanical circulatory support for bridge to decision: which device and when to decide. *J Card Surg*. 2010;25:425-33.
3. Takayama H, Naka Y, Jorde UP, Stewart AS. Less invasive left ventricular assist device placement for difficult re sternotomy. *J Thorac Cardiovasc Surg*. 2010;140:932-3.
4. Akay MH, Gregoric ID, Radovancevic R, Cohn WE, Frazier OH. Timely use of a CentriMag heart assist device improves survival in postcardiotomy cardiogenic shock. *J Card Surg*. 2011;26:548-52.
5. Rao V, Oz MC, Flannery MA, Catanese KA, Argenziano M, Naka Y. Revised screening scale to predict survival after insertion of a left ventricular assist device. *J Thorac Cardiovasc Surg*. 2003;125:855-62.

Are preoperative B-type natriuretic peptide levels associated with outcome after pulmonary artery banding and the double switch operation in patients with congenitally corrected transposition of the great arteries: A pilot study

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Pulmonary artery banding (PAB) for ventricular training followed by the double switch operation (DSO) is an attractive surgical option for suitable patients with congenitally corrected transposition of the great arteries (ccTGA). After repair, the systemic circulation is supported by the morphologic left ventricle (LV). Adoption of DSO was driven by the poor natural history of the systemic right ventricle (RV) and successful outcomes with DSO have been reported since the mid-1990s.¹ Although mortality after these operations is low with careful patient selection, the accurate prediction of adverse postoperative outcomes is difficult, and there remains an unpredictable risk of morbidity, takedown or reoperation.²

Recent studies have demonstrated that perioperative changes in B-type natriuretic peptide (BNP) levels may

predict postoperative morbidity and mortality after surgery for the repair or palliation of congenital cardiac defects.³ However, the potential usefulness of preoperative BNP levels as predictors of postoperative outcomes in patients undergoing repair for ccTGA has not been investigated.

This pilot study hypothesized that preoperative BNP levels could be associated with unexpected outcomes after PAB and DSO in patients otherwise deemed to be suitable operative candidates on the basis of standard preoperative clinical, echocardiographic, and hemodynamic assessments.

MATERIALS AND METHODS

Design and Participants

A pilot prospective cohort study was undertaken at Lucile Packard Children's Hospital Heart Center from November 2011 to November 2013. Eligible participants included all patients with ccTGA undergoing either PAB or DSO. Management followed standard institutional practices. Informed consent from the patients or their guardians was obtained before enrollment. The Stanford University Medical Center Institutional Review Board approved the study (IRB 22458).

Blood samples were obtained from a venous or arterial catheter less than 24 hours preoperatively and were assayed using a commercially available fluorescence immunoassay (Triage Meter Plus; Biosite Diagnostic, San Diego, Calif).

Outcome

The end point was a composite of adverse outcomes including death, cardiac arrest, need for extracorporeal cardiopulmonary life support or emergency reoperation.

Analysis

The 2-sided Fisher exact test was used to evaluate the association between increased BNP level (>300 pg/mL) and the binary composite

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