Emergent Mechanical Support in the Community: Improvement With Early Transplant Center Referral

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Emergent mechanical support for the failing ventricle, with eventual transfer for definitive care, is often required at non-transplant centers. Transfer for definitive care, in terms of bridge to transplant, may require ventricular assist device (VAD) placement at the primary institution or at the transplant center. Review of consecutive single transplant center referrals was conducted to decipher optimal management. From January 1997 to December 2000, 104 patients were transferred to the University of Pennsylvania Heart Failure/Transplant Service. Most were transferred from active cardiac surgical programs, with 56 patients having post-cardiotomy failure at the primary site. A VAD was placed in procedures done at the outside hospital (OSH) in 28 patients, most commonly (60%) an Abiomed device. Of the 76 patients that received a VAD at the transplant center (TxpC), 86% received a TCI or Thoratec device. Biventricular support was required in 34 patients. Overall survival was 57%, with 54 patients bridged to transplantation and 5 patients undergoing recovery. Patients having a VAD placed at the OSH had a 32% (9 of 28) survival, whereas at the TxpC survival was 65% (45 of 76) ($p < 0.05$). Mid-term follow-up showed that all 5 patients weaned are presently alive, and 52 patients are alive at >1-year post-transplant. The most common cause of death was multi-system organ failure (19 of 45), followed by major neurologic event (15 of 45). Infection was the cause of death in only 6 patients. Left ventricular failure can be treated by emergent VAD placement. Overall survival is substantial if these patients are referred to a transplant center with multiple options. In contrast to previous reports, survival rates may be improved by earlier referral, before VAD placement at non-transplant centers and use of a VAD with longer-term capability. J Heart Lung Transplant 2005;24:764–8. Copyright © 2005 by the International Society for Heart and Lung Transplantation.

Acute failure of the left ventricle, whether primary or secondary to cardiac surgery, has been shown to have a high mortality.[1,2] Optimization of hemodynamics by medical intervention has been well-described, but eventually a small percentage of patients will require further intervention. Intra-aortic balloon counterpulsation has classically been the initial method espoused, but is limited by length of support, and concomitant co-morbid conditions, such as peripheral vascular disease. Mechanical circulatory assistance, in terms of ventricular assist devices (VADs), has been shown to affect both early and late survival.[3] Most cardiac surgery is conducted in hospitals where there is no transplant center. This necessitates transfer of the acute cardiac failure that occurs in these hospitals to a regional transplant center. To delineate the optimum timing of transfer and management of these patients, we reviewed a consecutive cohort of patients that were transferred to the University of Pennsylvania Heart Failure/Transplant Service over a period of 4 years.

METHODS

From January 1997 to December 2000, 104 patients were referred to the University of Pennsylvania Heart Failure/Transplant Service for acute cardiac failure that required emergency mechanical support. All but 3 patients were transferred from hospitals with active cardiac surgical programs. Cohort 1 consisted of 76 patients who required a VAD within 24 hours of transfer to the transplant center (TxpC). Cohort 2 consisted of 28 patients who had a VAD placed before transfer. Both cohorts were compared for demographics, risk factors, morbidity and mortality. Patients were followed until death, transplantation or weaning from the device.

RESULTS

Demographics of the 2 cohorts are displayed in Table 1 No significant difference was found for age, gender or incidence of co-morbidities. Patient ages ranged from 25 to 70 years, although most were in their fourth or fifth decade of life. Acute myocardial infarction was seen more often in Cohort 1 (69% vs 64%), but was not

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Table 1. Patient Demographics

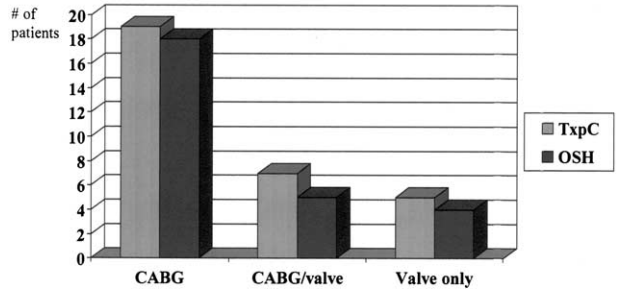
Characteristic	Cohort 1	Cohort 2
Number	76	28
Male:Female ratio	60:16 (79%)	21:7 (75%)
Age	51.8 (26–70)	54.0 (25–68)
Surgical procedures	31 (41%)	27 (96%)
DM/HTN	43%/41%	50%/54%
Acute MI/shock	53 (69%)/6 (8%)	18 (64%)/2 (7%)

DM, diabetes; HTN, hypertension; MI, myocardial infarction.

statistically significant. Similar percentages of patients in both cohorts presented in severe shock.

All patients in Cohort 2, except 2, were elective surgical procedures. These 2 patients were taken emergently to surgery after cardiac arrest in the catheterization laboratory. These were the only 2 patients in cardiogenic shock, both of whom were being intubated. There was a high preponderance of post-cardiotomy failure in Cohort 2. Of 28 patients in Cohort 2, 27 had previous surgery, with 21 having acute post-cardiotomy failure and inability to wean from cardiopulmonary bypass (CPB). The average time on bypass for these 21 patients, before LVAD placement, was 246 minutes. Cross-clamp times were not available for all referred patients. Six patients in Cohort 2 were returned to the operating room (OR), after an average of 9 hours, for left ventricular assist device (LVAD) support before transfer. One patient was taken electively for LVAD support only, without concomitant surgery. Although flows varied widely, all patients in Cohort 2 had VAD flows upon transfer that correlated with a cardiac index of >2.2 liters/min. Coagulopathy was common in these patients as 25 of 28 patients were taken to the OR within 48 hours of transfer to the transplant center for evacuation of hematomas and control of bleeding.

Only 31 of the 76 patients in Cohort 1 had antecedent surgery at the outside hospital. Overall, 58 of the 104 patients had previous surgical procedure, before VAD placement (Figure 1A). In Cohort 1, most patients (n = 19) had coronary bypass graft (CABG) only. Seven other patients had a combined CABG and valve procedure, and 5 patients had some type of valve procedure. In Cohort 2, 18 patients had CABG only, 5 had a combined CABG and valve procedure, and 4 had a valve procedure only. Mitral valve regurgitation was commonly seen in these patients pre-operatively, occurring in 51 patients overall. Thirteen of 28 patients (46%) in Cohort 2, and 38 of 76 patients (50%) in Cohort 1, had at least moderate mitral regurgitation on pre-operative echocardiograms. Only a small percentage had operative correction: 5 of 12 patients in Cohort 1 having surgery had concomitant mitral valve repair, and 3 of 9 patients in Cohort 2. Pre-operative ejection fraction (EF) in Cohorts 1 and 2 are displayed in Figure 1B.



(a)

	Cohort 1 (# of patients)	Cohort 2 (# of patients)
EF > 40%	6 (8%)	6 (22%)
EF 20-40%	61 (80%)	20 (71%)
EF < 20%	9 (12%)	2 (7%)

(b)

Figure 1. (A) Prior surgery. (B) Pre-operative ejection fraction.

Acute myocardial infarction was noted in most of these patients (71 of 104). Idiopathic cardiomyopathy was the eventual diagnosis in 11 of them. Acute myocarditis was eventually diagnosed in 4 of these patients—all of whom were eventually weaned from mechanical support.

It is of interest to note the cardiac surgical case volume at the outside hospital (OSH) before referral. Overall, 33 separate institutions referred patients to the transplant center. The cardiac surgical programs were split arbitrarily into small (<200 cases/year), mid-size (200 to 600 cases/year) and large (>600 cases/year) for purposes of analysis. The distribution of referrals was 14 (13.5%) from small programs, 54 (51.9%) from mid-size programs and 36 (34.6%) from large programs. No statistical significance was found in outcome vs referral volume. The survival in the 3 groups was 50%, 55% and 61%, respectively (Figure 2).

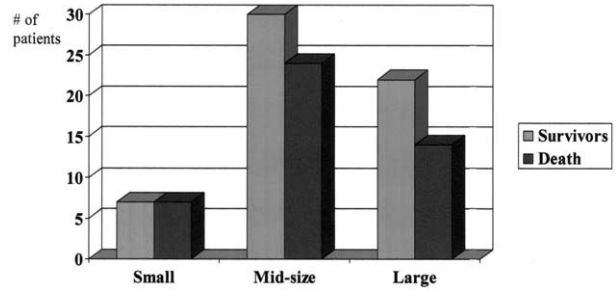


Figure 2. Outcome vs referral volume.