EDITORIAL COMMENT

Implantable Left Ventricular Assist Device Bridge-to-Transplantation: Natural Selection, or Is This the Natural Selection?*

Patrick M. McCarthy, MD
Cleveland, Ohio

The use of the implantable left ventricular assist device (LVAD) for patients before a heart transplant is evolving and becoming more common. Almost all U.S. cardiac transplant programs have an implantable LVAD, either the HeartMate (Thoratec, Oakland, California) or Novacor (World Heart, Ottawa, Canada). With better technology, more predictable clinical results and greater widespread acceptance, the role of these devices has changed from something you “have to do” to save the patient’s life to the provocative subject of the article in this issue of the *Journal* by Aaronson et al. (1) is this something you “should do” to ensure optimal utilization of scarce donor hearts?

Aaronson et al. (1) at the University of Michigan compiled data from their experience suggesting that patients bridged-to-transplantation with an LVAD were more likely to survive to transplantation than those receiving inotropes: 81 ± 5% in the LVAD group vs. 64 ± 11% for the inotrope group (p = NS). Post-transplant survival was significantly better for the LVAD group at three years (95 ± 4% vs. 65 ± 10%; p = 0.007). Therefore, overall survival was better for the LVAD group (77 ± 6% vs. 44 ± 9%; p = 0.01). In summary, patients at their institution who received an LVAD were more likely to be alive three years after the decision was made to bridge them to transplantation, than were patients who continued receiving inotropes before transplantation.

Analysis of the article is difficult because of the critical issues at the point of decision making, the time at which LVADs are chosen in favor of inotropic support. All of the patients who eventually ended up on LVADs were receiving inotropes, and many were receiving multiple inotropes, other assist devices or an intra-aortic balloon pump. If the conditions of the inotrope-dependent patients became worse, then most patients ended up in the LVAD group. The implication of this article is that perhaps patients were better off if their conditions became worse and they eventually required an LVAD. It is sometimes hard to convince the patient and his or her family (let alone the insurance company) that another operation would be better for them in the long run. However, there are many reasons to think that this may be true.

The implantable LVADs have improved so that the most commonly used devices are electric, portable, allow for hospital discharge before transplant and generally provide an acceptable quality of life (2–4). Patients can be rehabilitated from their end-stage cardiac condition with associated cardiac cachexia and undergo physical as well as physiologic rehabilitation (3–5). It is not uncommon to perform a transplant in an LVAD recipient who is exercising regularly, has rebuilt muscle mass and has normal laboratory values. While the patient’s condition is stable on LVAD support, the transplant team can wait for an ideal donor to be offered. The sense of urgency to perform a transplant in the patient before some major adverse event occurs has been diminished. While the earliest experience with the devices were sometimes troubled by mechanical or electrical failures or thromboemboli, recent experience with both the HeartMate and Novacor devices shows significant improvements with these complications due to device design changes and improvements (6). Continuing instead with prolonged inotropes before transplantation may lead to a very lengthy hospitalization for some patients, especially those with elevated preformed antibodies or large blood type O patients. Furthermore, the potential for rehabilitation can be very limited because of the patient’s overall physical activity level. The patient may become less active and, therefore, at risk for other complications such as deep vein thrombosis, pulmonary emboli, multiple organ dysfunction and sudden cardiac death. Because of this potential scenario, there is an urgency to perform transplantation in these patients. Therefore, the transplant team may choose “marginal” donors, older donors or donors without clearly defined coronary anatomy (example: a 50-year-old male donor with a smoking history or hypertension) (7). The demographics, height and weight of the donors in this report may not reflect the entire picture of the donor which includes factors such as the amount of inotropes required, the ejection fraction by echocardiography, size discrepancy vs. the recipient, the amount of “down time” and the risk factors for coronary artery disease. Perhaps the tendency to wait for ideal donors for patients in stable condition with LVAD may account for their higher late survival than inotrope-dependent patients at the University of Michigan.

However, all is not well with the current situation of LVADs. The patient has to undergo the psychological and physical trauma of another operation. For many patients

*Editorials published in the *Journal of the American College of Cardiology* reflect the views of the authors and do not necessarily represent the views of JACC or the American College of Cardiology.

From the Department of Thoracic and Cardiovascular Surgery, Kaufman Center for Heart Failure, Cleveland Clinic Foundation, Cleveland, Ohio.
with ischemic cardiomyopathy, the LVAD implantation is a second or even third operation (8). Perioperative bleeding is a significant complication. Furthermore, the bleeding may lead to increased preformed antibodies that makes transplantation extremely difficult in some patients (9). Perhaps the most common morbidity, however, is blood stream infection. In a recent report, over 60% of patients had blood stream infections during LVAD support (10). Furthermore, in the results from the Randomized Evaluation of Mechanical Assistance Therapy as an alternative in Congestive Heart failure (REMATCH) trial, permanent destination therapy using LVADs, 41% of the deaths in the LVAD recipients were related to infection (11). Although the risk of stroke and device failure have been reduced, they have not been eliminated. Also, the logistics of arranging outpatient care requires a well trained medical team who are available at all times. The coordination of hospital discharge includes extensive training of the patient, usually with a family member or close friend, arrangements for outpatient housing or maintenance of the patient at home, training of emergency paramedical personnel near the patient so that the patient can be emergently returned to the medical center if there is a problem and a team of LVAD coordinators who manage outpatient education as well as the outpatient clinic (12). Aside from the cost of the device itself (approximately $70,000 U.S. dollars), the implant surgery, intensive care unit and hospital stay and coordination of outpatient care may contribute to a very high bill. This is especially true if the patient is developing multiple organ failure and requires prolonged ventilatory support or dialysis. Therefore, for inotrope-dependent patients who are being carefully monitored in the hospital setting, who are active and exercise with supervision, who have no evidence of impending multiple organ failure, and who have no unusual reason so that their wait for a donor would be exceptionally long, most clinicians will continue with inotropes until transplantation and will not proceed with LVAD insertion unless one of those conditions changes.

A single-center study, such as this from the University of Michigan, always has to be interpreted in light of more general results. In particular, the difference in three-year survival seen after heart transplantation in their patients was different than in other single-center studies, or from the registry of the International Society of Heart and Lung Transplantation or the Cardiac Transplant Research Database (CTRD) (9,13,14). In particular, in one large study, the CTRD compared 502 patients bridged-to-transplant with an LVAD vs. 1,514 who received intravenous inotropes (13). There was no significant difference in the early or late survival. The 65% three-year survival for the inotrope group in this report seems low compared to most contemporary registries in which one would expect survival of approximately 75% to 85%. When compared to the very high three-year survival in the LVAD group (95 ± 4%) this presents a strikingly significant difference (p = 0.007), but perhaps not reflective of broader experience.

Weighing all of these potential risks and benefits of LVAD versus prolonged inotropes for individual patients can be very difficult. Additional factors such as availability of donors in a particular region, the experience of the LVAD surgical team and even reimbursement from the insurance carrier for the LVADs are factors that impact on the decision. However, the picture is becoming clearer that once a patient evolves beyond the stage of being a “stable” inotrope-dependent patient, LVADs are not something that you “have to” use, but something you “should use.” The severity of the cardiac illness has provided a form of natural selection. The patients with the most severe disease are selected to require LVADs. Interestingly, this may favor some patients in the long run. Since the risks of the devices are lower than they have been before, and the opportunity to obtain an ideal donor will be higher, this will become the natural selection for patients with deteriorating end-stage cardiac disease. The implications are that more and more patients will become outpatients on LVADs waiting for transplant. Eventually, the day will gradually arrive when outpatients in stable condition are waiting for durable LVADs for scarce donor hearts that will not be expected to arrive. In this scenario, the LVAD may end up being a permanent implant or destination therapy because the patient and physician have decided that the LVAD is safer than the morbidity and mortality of immunosuppression and transplantation.

Reprint requests and correspondence: Dr. Patrick M. McCarthy, Department of Thoracic and Cardiovascular Surgery, 9500 Euclid Avenue, F25, Cleveland, Ohio 44195. E-mail: mccarpt@ccf.org.

REFERENCES


