Prognostic Scoring Systems for Patient Evaluation Before Left Ventricular Assist Device Implantation

Hirokazu Akashi, MD, PhD; P. Christian Schulze, MD, PhD

Heart failure (HF) is a growing global health problem, with an estimated 150,000 new patients with end-stage HF in the United States annually. Heart transplantation (HTx) is the only curative therapy but limited to only approximately 2,200 candidates per year because of persistent donor shortages. Recently, long-term circulatory support with a left ventricular assist device (LVAD) has become an important therapeutic option for the expanding advanced HF population, both as a bridge-to-transplantation (DTT) and as destination therapy (DT). In Japan, long average waiting periods for donor hearts resulted in average bridging periods surpassing 800 days. Thus, patients who wait for a donor are in virtually the same situation as those receiving DT even if the initial purpose was DTT. As the clinical utilization of LVADs expands, technologies are developing and patient selection becomes ever more important for successful LVAD implantation and long-term outcome. Thus, LVAD risk assessment needs to be further developed in line with advances in LVAD technological and clinical developments.

In this issue of the Journal, Imamura et al demonstrate that in their patient population the TODAI VAD (TVAD) score could predict the 1-year prognosis after LVAD implantation better than previously known scoring systems.

Other scoring systems that have aimed to predict the outcome of patients undergoing LVAD implantation are based on preoperative factors. The Columbia Risk Score was developed by Rao et al using a cohort of 130 consecutive BTT HeartMate I LVAD patients. Their composite score assigns points to 5 preoperative factors that predict perioperative mortality. The score is limited to older generation pulsatile devices, with some of the factors representing non-modifiable risk factors.

Further, the inclusion of prothrombin time limits the score, because of the frequent use of anticoagulants in this patient population.

The Lietz Miller Score was developed by Lietz et al in a cohort of 222 XVE HeartMate I LVAD patients. They identified 9 preoperative factors that predicted 90-day in-hospital mortality. This score used a larger cohort of LVAD patients but was also limited to pulsatile devices. Again, inclusion of INR as a factor affected by anticoagulation is problematic, as is the use of factors such as vasodilator therapy and inotrope use, which are defined by the therapeutic standards of each institution.

The APACHE II score was developed by Knaus et al using a multi-institutional cohort of 5,815 critically ill patients and they sought to measure the severity of disease in intensive care unit patients. APACHE II consists of 13 preoperative variables, and as with the Lietz Miller Score, higher points are assigned to laboratory data that are easily and frequently modified by medical interventions. Also, the APACHE II score was developed in a large cohort of acutely ill patients and only secondarily applied to a cohort of LVAD patients.

The Seattle HF Model (SHFM) was developed by Levy et al from a cohort of 1,125 New York Heart Association class IIIB or IV patients to provide estimates of survival. It uses 21 preoperative assessments and Levy updated the SHFM for LVAD patients by adding 2 variables. This score also profits from its development in a large cohort but is less specific because of its secondary application to cohorts of LVAD patients. Of note, this stratification system is largely dependent on physicians’ decisions and is highly dynamic because patient status can change rapidly with the advancement of progressive HF symptoms.

Recently, models focusing on end-organ dysfunction have been applied to patients with HF undergoing LVAD evaluation and placement. The Model for End-stage Liver Disease (MELD) score is a risk stratification method that is calculated from total serum bilirubin and creatinine levels and the INR, and is objective, reproducible and easily computed. Pramod et al proposed using the MELD score as an indicator for VAD risk stratification and prediction of adverse events because it offers a simple and objective analysis of pre-implant end-organ dysfunction, which may be aggravated by severe HF having direct effects on hepatic and renal functions. Our group recently utilized the MELD-excluding INR (MELD-XI) score for risk prediction in LVAD patients on oral anticoagulation to avoid problems related to the use of oral anticoagulation agents.

Patient selection and timing of LVAD implantation are critical factors affecting the survival of these patients but determining the optimal timing at the lowest possible risk with the highest possible benefit of LVAD implantation remains a challenge. Although the timing of LVAD implantation for patients already listed for HTx is determined by the transplant physicians, the timing of referral for DT patients who are not eligible for HTx is largely determined by physicians without specific training or focus on the management of these devices.
Therefore, optimal LVAD scoring systems that could aid healthcare providers in the recognition of the optimal candidate for LVAD implantation would have the potential to facilitate timely referral of HF patients.

The difficulty in selecting patients for DT is identification of those who are “too sick” and those who are “too well”, and defining the time point and clinical status at which the risk of ongoing medical management outweighs the risks associated with LVAD implantation but before the surgical risk becomes prohibitive. This decision-making process may be aided by LVAD scoring systems that allow the assessment of risks associated with both continued medical management as well as surgical intervention, including LVAD implantation. Further, it is expected that such scoring systems would reduce medical expenses in patients with HF.

The degree of both end-organ involvement and dysfunction has been shown to be critically important for the prognosis of patients with HF and, not surprisingly, end-organ dysfunction also defines the outcome of patients undergoing LVAD placement. In particular, liver and renal dysfunction has emerged as an important prognostic factor for the evaluation of patients before LVAD placement. Low albumin levels reflecting poor nutritional status, inflammation and hepatic dysfunction seem to be a reliable marker of end-organ damage in HF. Of note, the interaction of hepatic dysfunction and right ventricular failure is of prognostic importance in this patient population.

In conclusion, the recent development of more robust and reliable LVAD technologies and the broader availability of this therapeutic option for patients with HF will lead to increased use of LVAD implantation as a surgical therapy of HF. Because of their unlimited availability, LVADs will partially replace HTx as the only and preferred therapy for patients with HF, at least for subpopulations associated with high risk following HTx. The use of scoring systems to predict risk and survival following LVAD implantation will allow reliable evaluation of patients eligible for LVAD implantation and improve overall outcomes.

References