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Go with the Flow: Progress in Mechanical Circulatory Support

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Heart failure (HF) affects over 5 million Americans and approximately 50,000 HF patients die each year.¹ Advanced HF (i.e., New York Heart Association class 3-4) typically has a prognosis of less than two years and the limited treatment options include: palliative medical management, heart transplant or mechanical circulatory support (MCS) using left ventricular assist device (LVAD).² The vast majority receive primarily palliative medical management. Approximately 2,200 of these individuals are on the waiting list for heart transplant though limited availability of donor organs contributes to a low number of heart transplants.³ MCS technology is advancing and it is estimated that between 40,000 -200,000 HF patients may benefit from the support of a LVAD.⁴ In 2012, 2,113 LVADs were placed, and it is anticipated that insertion rates will continue to increase annually.⁵ Cardiovascular nurses need to be informed leaders in this rapidly developing field.

LVADs fall into a class of MCS devices that assume the responsibility of circulation in place of the failing heart. The LVAD is a pump that is attached to the left ventricle to support the failing heart. To power the device, a driveline extends from the pump through the abdomen and emerges percutaneously to connect to an external controller device. This controller attaches to either an AC power source or batteries. The LVAD does not have a role in the electrical firing of the heart, as do devices like automatic internal cardioverter defibrillators. LVADs are unique from other MCS because they are designed for management in the home setting.

Early LVADs were used exclusively for patients who needed a heart transplant but were decompensating and unable to wait for the donor organ. This use is commonly referred to as “bridge to transplant”. In 2001, a landmark study, the Randomized Evaluation of Mechanical Assistance of Congestive Heart Failure Trial published findings that supported use of LVADs as destination therapy.² Destination therapy means that a patients’ HF will be treated with LVAD and there is not an expectation that the patient will become eligible for transplant. In addition to bridge to transplant and destination therapy, some LVADs are inserted in acute refractory HF and these patients are “bridged to recovery”, meaning the device is removed after native pump function has been restored.

LVAD technology has advanced along with the increased indications for use. Early LVADs were pulsatile devices that mimicked the pooling and pumping of blood in the ventricle. Non-pulsatile, continuous flow devices have replaced pulsatile devices which are no longer manufactured due to a significantly higher occurrence of stroke.⁶ In 2010, the first continuous flow device was approved for destination therapy.⁷

The good news is that patients do benefit from LVADs. Although patients are frequently decompensated prior to insertion and the surgery to insert the device requires a sternotomy, it has been demonstrated that functional status and quality of life improve significantly with LVAD regardless of bridge to transplant or destination therapy indication.⁸⁻¹² As the technology and management techniques have advanced, so has survival in this population with three month survival for LVAD patients recently reported to be 89%.⁵

In February 2013, the International Society for Heart and Lung Transplantation Guidelines for MCS were released.¹³ This was the first comprehensive effort to synthesize research into practice guidelines for the selection and management of LVAD patients. These guidelines have clear implications for cardiovascular nursing practice.

Selection of advanced HF patients for LVAD and timing of insertion surgery has been much debated in the literature. The guidelines discourage LVAD surgery for patients with neurologic compromise, permanent dialysis needs, multi-organ failure or sepsis.¹³ Common co-morbidities such as diabetes, pulmonary hypertension, previously treated cancers, obesity and hypoperfusion-related organ dysfunction are not contraindications for LVAD, but do merit close evaluation. In addition, though bioprosthetic valves are not a contraindication for LVAD, mechanical valves should be replaced at the time of LVAD insertion. The guidelines further encourage sobriety both from illicit drugs and alcohol and suggest educating patients regarding smoking cessation prior to surgery. A critical component of selecting eligible patients is identifying and educating the primary caregiver alongside the patient. LVAD is not recommended for a patient without an engaged caregiver. In an effort to support decision-making in this area of rapidly advancing science and clinical practice, the Interagency Registry for Mechanically Assisted Circulatory Support data has been used to establish clinical profiles of MCS users and examine associated outcomes.¹⁴

The guidelines establish a systematic approach to guide patients and their families in decision-making regarding destination therapy versus a more palliative approach in the face of transplant ineligibility. Addressing palliative medical care options, advanced directives, and end of life issues are recommended as part of the pre-operative evaluation. It may be appropriate to involve an ethics board in some instances. Pre-op education should take a multi-disciplinary approach with informed consent to include common expectations and complications.¹³ For example, LVAD patients often experience frequent and lengthy hospitalizations. A recent study found that LVAD patients at one center spent 13% of their time in the first year after implant in the hospital, with an average of three readmissions of about 14 days each.¹² It is essential that patients and their families understand their options for management and potential implications of their decision.

Finally, outpatient management of LVAD patients is the ultimate goal of destination therapy. To ensure adequacy of the home environment, the guidelines suggest a home visit by a trained provider. Intrinsic to the success of LVAD home management is the contribution of the patient's caregiver. This person is identified and educated prior to surgery and in many cases signs a 'contract' of agreement to provide care. The caregiver is educated alongside the patient on all aspects of care including managing the batteries, alarms, dressing the driveline, pharmaceutical management, nutrition and mobility.

While nursing care of modern LVADs is highly specialized, there is important information that all cardiovascular nurses should know about LVADs (see Table 1). Cardiac ICU and telemetry nurses in academic, transplant centers typically undergo extensive training and annual competencies including hands-on skills demonstrations. There is evidence supporting the use of multi-disciplinary teams which often involve surgeons, other physicians, LVAD engineer, LVAD nurse/Nurse Practitioner, pharmacist, nutritionist, physical and occupational therapy. Nurses often are key advocates and care coordinators for LVAD patients. Table 2 lists recommendations for learning more about LVADs.

The future direction of LVAD technology is to develop batteries allowing for fully implantable devices. It is anticipated that advances in technology and evidence-based inpatient and outpatient management strategies will result in reductions in adverse outcomes related to infection as well as additional improvements in quality of life and functional status. As LVADs become more commonly used, particularly as destination therapy, we can expect to see an increase in the number of LVAD patients and a proliferation of LVAD programs. Nurses have an opportunity to be at the forefront of this rapidly progressing area of advanced HF care.

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Table 1

Information that every cardiovascular nurse should know about LVADs

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- Many LVAD patients will not have a pulse because the continuous flow device with minimal functioning heart may result in absence of a pulse.
 - With no pulse, blood pressure is difficult to obtain. Use a Doppler and manual cuff.
 - LVAD patients do NOT receive chest compressions because it can cause decannulation of the pump.
 - LVADs require an AC power source or batteries at all times.
 - The percutaneous driveline is delicate and a conduit for infection. Care should be taken to support the device so that it never tugs on the abdomen. Sterile technique is used in the hospital setting to change a driveline bandage.
 - Caregivers are essential contributors in LVAD care.
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Table 2

Recommendations for learning more about LVADs

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- Connect with an LVAD nurse to get a hands-on device demonstration
 - Check out the Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS) at www.intermacs.org¹⁵
 - Invite an LVAD patient to your next staff education meeting
 - Visit www.mylvad.com for patient education resources¹⁶
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