Ventricular Assist Devices: The Basics

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ABSTRACT

As the cases of heart failure continue to rise, more ventricular assist devices are likely to be implanted. Providers in a variety of care environments are more likely to see patients with ventricular assist devices because they are living longer; therefore, it is necessary for providers to understand the unique care and complications related to these devices, such as thrombosis, stroke, bleeding, right-sided heart failure, ventricular dysrhythmias, and infection. The current literature regarding the complications and management of patients with these devices was reviewed and summarized, with a focus on HeartWare (HeartWare International Inc, Framingham, MA) and HeartMate II (Thoratec Corp, Pleasanton, CA).

Keywords: anticoagulation, continuous flow, gastrointestinal bleeding, heart failure, intracranial hemorrhage, ischemic stroke, left ventricular assist devices, mechanical circulatory support

The first durable ventricular assist device (VAD) was approved as a bridge to transplant in 1994. Since then, the use of VADs as treatment for end-stage heart failure has risen with reports of 13,279 VADs implanted between the year 2012 and 2016.[1] Even though transplant remains the gold standard of treatment for end-stage heart failure, because of inadequate numbers of available organs and multiple health conditions that make transplant an unfit option, an implantable device such as a VAD becomes a viable alternative that has helped many patients live longer with their end-stage heart failure than medical management alone.

Familiarity with the management and implications of left ventricular assist device (LVAD) therapy is increasingly important because more than 5.7 million people in the United States are living with heart failure.[2] With 168 hospitals registered with the Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS), the national registry for mechanical circulatory support, and 2,347 LVADs implanted in 2016, the chances of a provider encountering a patient with 1 of these devices is increasing.[1]

Right ventricular assist devices and biventricular assist devices exist but are used far less frequently; therefore, patients with durable, continuous-flow LVAD therapy, namely the HeartWare (HeartWare International Inc, Framingham, MA) and HeartMate II (Thoratec Corp, Pleasanton, CA), will be the focus of this article. Nurse practitioners in a variety of settings including outpatient, inpatient, and perioperative are likely to encounter a patient with a VAD. As patients implanted with VADs become more numerous and live longer, they are accessing health care for reasons beyond their heart disease, and health care providers must be prepared to care for them.[3]

INDICATIONS FOR VAD

VADs were originally approved as devices to bridge a patient to heart transplant, a durable way to support the patient's heart and prevent further end organ damage because of heart failure. However, because they were shown to improve survival and quality of life in this population, their use has expanded to include bridge to recovery, bridge to decision, and destination therapy.[3]

Destination therapy, or the use of VAD support until the end of life, is the fastest growing use of LVAD therapy and the most common reason for implantation in recent years.[1] Because these patients continue to live longer and as other patients who will never be eligible for heart transplant continue to have end-stage heart failure, the number of LVADs as destination therapy will continue to grow.

LVAD as a bridge to transplant continues to be the major part of many VAD programs. Patients are

waiting longer and longer for heart transplants because the need for transplants continues to outpace the availability of organs. These patients are actively listed for transplant; however, depending on their blood type, percent reactive antibodies, body size, and a variety of other factors, patients may wait for months to years to be successfully matched and transplanted.

Bridge to decision is another indication for VAD implantation. These patients include those with severe heart failure, many of whom have an acute need for additional support but for a variety of modifiable reasons they may not be eligible for transplant at the time of implantation. Some patients, such as those with a high body mass index or complex social situations, need time to modify these variables before they can be deemed eligible and listed for transplant,[4] and a VAD can support end organ function for a time while patients work toward being successful candidates for transplant.

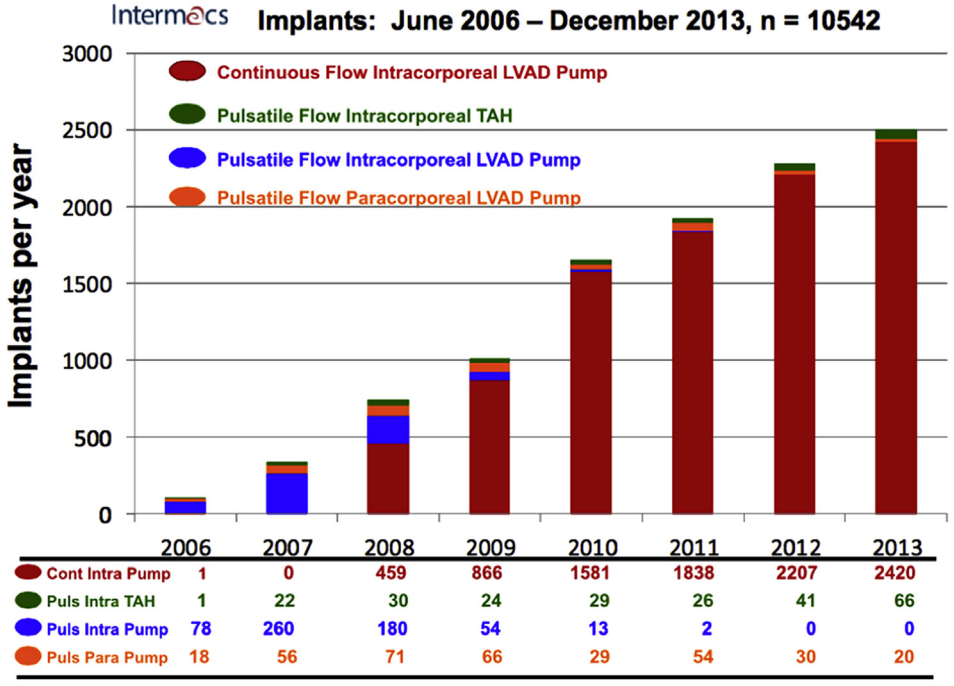
Some patients receive VAD therapy as a bridge to recovery. After a period of weeks, months, or years, some patients may experience enough recovery of their left ventricular function to have their LVAD be successfully explanted.

VAD PHYSIOLOGY

VADs can be divided into 2 categories: pulsatile or nonpulsatile. As suggested by their name, pulsatile devices create arterial pulsatile flow and were among the first generation of VADs. After showing a reduction in complications and a longer life span of the device, pulsatile VADs have been largely replaced with continuous-flow VADs when durable cardiac support is needed.[3] Currently, continuous-flow VADs are being implanted in much greater numbers than pulsatile VADs (Figure).

It is important to remember when caring for the LVAD patient that VAD therapy is preload dependent and afterload sensitive. Although the reason why patients have a VAD is because they are being treated for severe heart failure, these patients can be safely treated with volume to achieve hemodynamic stability when appropriate, such as in patients with septic shock. In fact, VADs depend on having adequate ventricular filling (preload) to generate

Figure. Adult INTERMACS implantations by device type and year.



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