VENTRICULAR ASSIST DEVICES

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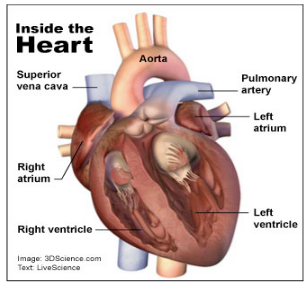
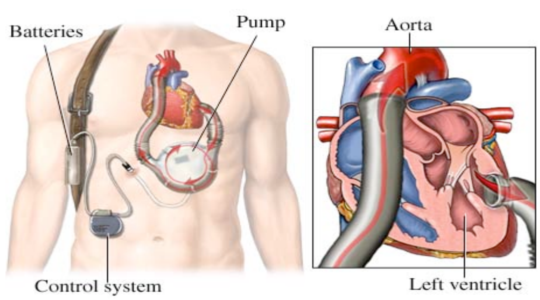
In the quest to defy aging and to enhance one's quality of life, many medical tools and procedures have been created and implemented around the globe. An example of a more recent and highly beneficial apparatus seen today is the ventricular assist device, a mechanical pump used to support the heart in circulating blood throughout the body. Primarily, these machines have been used to support patients with varying degrees of compromised heart function due to heart attacks, infection, or other complications. In 2004, 871,500 Americans died from a form of cardiovascular disease, indicating that this is a widespread medical dilemma. A ventricular assist device (or VAD) does not replace the heart in its entirety; instead, it assists the part of the heart that struggles to function. Depending on which portion of the heart is damaged, a VAD can be applied to the right ventricle (RVAD), the left ventricle (LVAD), or to both (BiVAD).



For a machine whose purpose is extraordinarily important, the VAD is simple in structure, consisting solely of the following components: a pump unit, a pair of inflow/outflow tubes, internal valves, and a power cord attached to an external controller and battery pack. Essentially, there are two main categories of VAD pumps: pulsatile and continuous flow. A pulsatile pump uses positive displacement to draw blood in from the ventricles before passing it on to the rest of the body. In contrast, a continuous flow pump passes the blood along through the pump at steady rate. Depending on the model, a continuous flow pump may have either a centrifugal rotor or an axial rotor. Using hydrodynamics, the rotor is freely suspended within the pump to minimize damage to blood cells and to the rotor itself.



The surgery required to install a VAD occurs under general anesthesia. The surgeon makes a small incision in the chest and inserts two catheters: one into the compromised ventricle and another into the corresponding artery (RVADs are connected to the pulmonary trunk while LVADs are connected to the aorta). Once the catheters are sutured in place, the inflow and outflow tubes are implanted to connect the catheters to the pump, which remains outside of the body cavity. After the surgery, patients are usually kept in intensive care for 5 – 7 days and monitored via blood, urine, and neurological tests. Also, patients are administered anticoagulants to prevent clotting and antibiotics to prevent infection. Other complications include excessive bleeding partial paralysis of the diaphragm, respiratory and kidney failure, coronary vessel damage, and stroke.

In spite of the risks associated with the surgery, the use of VADs has been an incredible success. The Cleveland Clinic Heart Center has implanted over 500 VADs (19 in 2004). Patients who had received VADs were able to participate in a cardiac rehabilitation program that included exercise to further facilitate their recovery. The survival rates for this type of therapy are 64% and 55% for patients living at least 1 year and 4 years respectively after beginning the program.

The ability to repair a partially malfunctioning heart has established a new age in cardiovascular treatment. To this day, cardiologists and biomedical engineers are working to develop new models of VADs that are safer, more efficient, and better suited to aid patients with various heart conditions. One of the many advantages to using a VAD is to provide an additional safety measure for patients undergoing a high-risk surgery, maintaining adequate blood flow and blood pressure. Another more significant advantage is that a VAD gives the heart an opportunity to heal while recovering from a heart attack or infection. If the heart has suffered too much damage to make a full recovery, the VAD will extend the time a patient has to wait for an available donor heart. This technique, commonly referred to as the "bridge-to-transplant," has been so successful that even intensive care patients could potentially leave the hospital as they wait and spend the time at home with few restrictions.

In some cases, patients have recovered so well that they avoid a heart transplant completely and continue to live the rest of their lives with a VAD or nothing at all. "As of July of 2007, 69 year old Peter Houghton was the longest surviving recipient of a VAD for permanent use. He received an experimental Jarvik 2000 LVAD in June 2000." The hundreds of other patients like Peter Houghton are witnessing today what will become a common practice for the future of medicine.

References:

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