



ROHINI

COLLEGE OF ENGINEERING AND TECHNOLOGY

Approved by AICTE and affiliated to Anna University Chennai (An ISO Certified Institution)

Accredited by NAAC with A+ Grade

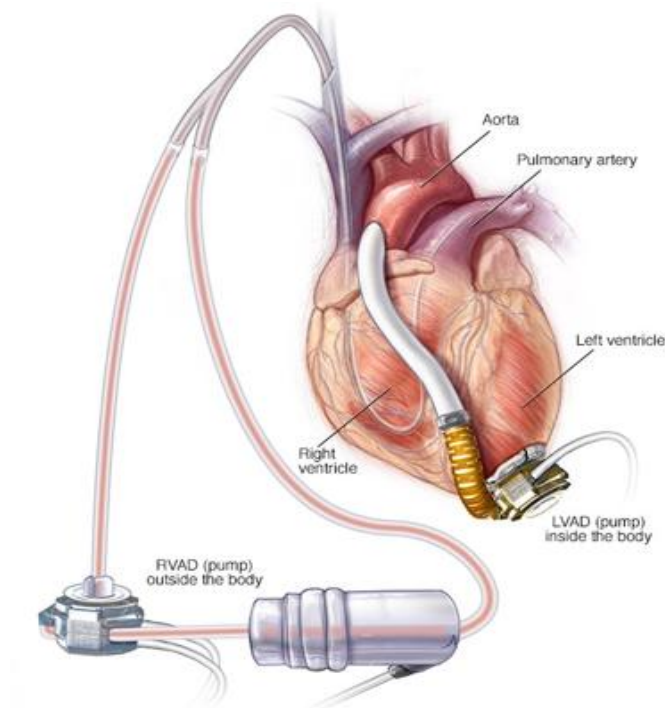
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CBM352 Human Assist Devices

UNIT-II CARDIAC ASSIST DEVICES

2.1 Right and Left Ventricular Bypass Pump

Ventricular assist devices (VADs) are mechanical pumps that are surgically implanted on the heart to help it pump blood to the rest of the body. They are used in patients with a weakened heart or heart failure to temporarily maintain heart function before receiving a heart transplant, or until the heart's function recovers. VADs may also be used as a permanent support therapy. As with all surgical procedures, VAD implantation has several risks. However, the procedure may be lifesaving and can significantly improve a patient's quality of life. An implanted left ventricular assist device (LVAD) helps pump blood from the left ventricle of your heart and on to the rest of your body. An external right ventricular assist device (RVAD) helps support the right ventricle's function.



The two basic types of VADs are a left ventricular assist device (LVAD) and a right ventricular assist device (RVAD). If both types are used at the same time, they may be called a biventricular assist device (BIVAD).

2.1.2 Right Ventricular Bypass Pump

RVADs usually are used only for short-term support of the right ventricle after LVAD surgery or other heart surgery. An RVAD helps the right ventricle pump blood to the pulmonary (PULL-mun-ary) artery. This is the artery that carries blood to the lungs to pick up oxygen.

Right ventricular failure is often a secondary effect of left ventricular failure or other causes of pulmonary hypertension.

There are different types of RVADs, and they can be used either as a temporary solution to support the heart during a specific medical condition or as a more permanent solution for patients with chronic heart failure. Some of the commonly used RVADs include:

1. **Extracorporeal Membrane Oxygenation (ECMO):** While ECMO is a more general device used for both left and right ventricular support, it can be configured to specifically assist the right ventricle. In this case, ECMO provides both oxygenation of blood and circulatory support.
2. **Impella RP:** The Impella RP is a percutaneously inserted micro axial pump specifically designed for right ventricular support. It is placed through a catheter into the right side of the heart to assist with pumping blood.
3. **Tandem Heart:** The Tandem Heart system is an extracorporeal circulatory support device that can be used to provide both left and right ventricular support. It involves cannulation of the atria and connects to an external pump.
4. **Centri Mag:** The Centri Mag system is a temporary circulatory support device that can be used for both left and right ventricular support. It uses a magnetically levitated centrifugal pump.

It's important to note that the choice of the right ventricular assist device depends on the specific clinical situation and the underlying condition of the patient. These devices are often used in conjunction with other therapies and interventions to manage heart failure effectively. Medical professionals assess the patient's condition and determine

the most appropriate treatment plan, which may include the use of RVADs when necessary. As medical technology evolves, new devices and improvements to existing ones may continue to be developed.

2.1.3 Left Ventricular Bypass Pump

A left ventricular assist device (LVAD) is a pump that can be used for patients who have reached end-stage heart failure. Doctors surgically implant the LVAD, a battery-operated, mechanical pump, which then helps the left ventricle (main pumping chamber of the heart) pump blood to the rest of the body. LVADs can be used as:

- **Bridge-to-transplant therapy:** This is a life-saving therapy for patients awaiting a heart transplant. Patients use the LVAD until a heart becomes available. In some cases, the LVAD is able to restore the failing heart, eliminating the need for a transplant. Learn more about heart transplant.
- **Destination therapy:** Some patients are not candidates for heart transplants. In this case, patients can receive long-term treatment using an LVAD, which can prolong and improve patients' lives.
 - A left ventricular assist device works by pumping blood from left ventricle to aorta. aorta is the large artery that takes blood from heart to the rest of the body.
 - A surgeon implants the left ventricular assist device's pump unit at the bottom of heart inside the chest. The device receives blood and sends it through a tube to aorta.

Parts of a left ventricular assist device:

Parts of a left ventricular assist device include:

- i. **Pump:** Attaches to a driveline (cable) and control system (controller).
- ii. **Driveline:** Passes from the device through the skin on your belly (abdomen) to the controller (a small computer) on the outside of your body.
- iii. **Controller:** Runs the pump. Messages and alarms from the controller help you operate the system.
- iv. **Power supply:** Keeps the LVAD running with rechargeable batteries or a cord that plugs into an electrical outlet. Batteries can provide up to 14 hours of power, depending on the device. When the batteries are low on power, you need to replace them.

Bridge to transplant (BTT):

- i. While you wait for a heart transplant, your medical condition may continue to get worse. This may lead to hospital admission, increased symptoms and damage to other organs such as your kidneys, liver and lungs.
- ii. Bridge to transplant (BTT) helps you survive until you can receive a donor's heart. The LVAD assists your heart and allows you to have a better quality of life and fewer symptoms. A surgeon removes the device at the time of your transplant.
- iii. The amount of time you receive support from an LVAD until heart transplantation varies and depends on your medical condition, blood type and body size.

Destination therapy (DT):

- i. Destination therapy (DT) is for people with heart failure who aren't candidates for heart transplant surgery. Healthcare providers consider this only for people after they've tried everything else (like medications, lifestyle changes and heart procedures).
- ii. A left ventricular assist device supports heart's function and improves the quality of life for the rest of our life.
- iii. The health care provider will determine if a left ventricular assist device is an appropriate treatment option, based on medical condition, symptoms, body size and presence of other medical conditions.



Procedure

The LVAD is implanted through open-heart surgery. The surgery lasts about four to six hours but may vary depending on the patient's cardiac health and history.

Generally, there are four basic parts to the LVAD:

1. The pump unit is placed in the chest and attached to the apex of the heart where it receives blood.
2. A tube then delivers this blood from the device to the aorta.
3. A driveline (cable) passes from the device through the skin on the abdomen to the controller on the outside of your body.
4. A controller (computerized control system) runs the pump and provides messages to help operate the system. A power supply of two rechargeable batteries keeps the LVAD running and allows the patient to be mobile for up to 20 hours without recharging.

What Are the Benefits of an LVAD?

- An LVAD restores blood flow to a person whose heart has been weakened by heart disease. This helps relieve some symptoms, such as being constantly tired or short of breath.
- In rare cases, it lets the heart recover its normal ability by giving it a chance to rest. It maintains or improves other organs, helps with doing exercise, and lets the person go through cardiac rehabilitation.
