

Ventricular Assist Device Program

Patient Education Brochure

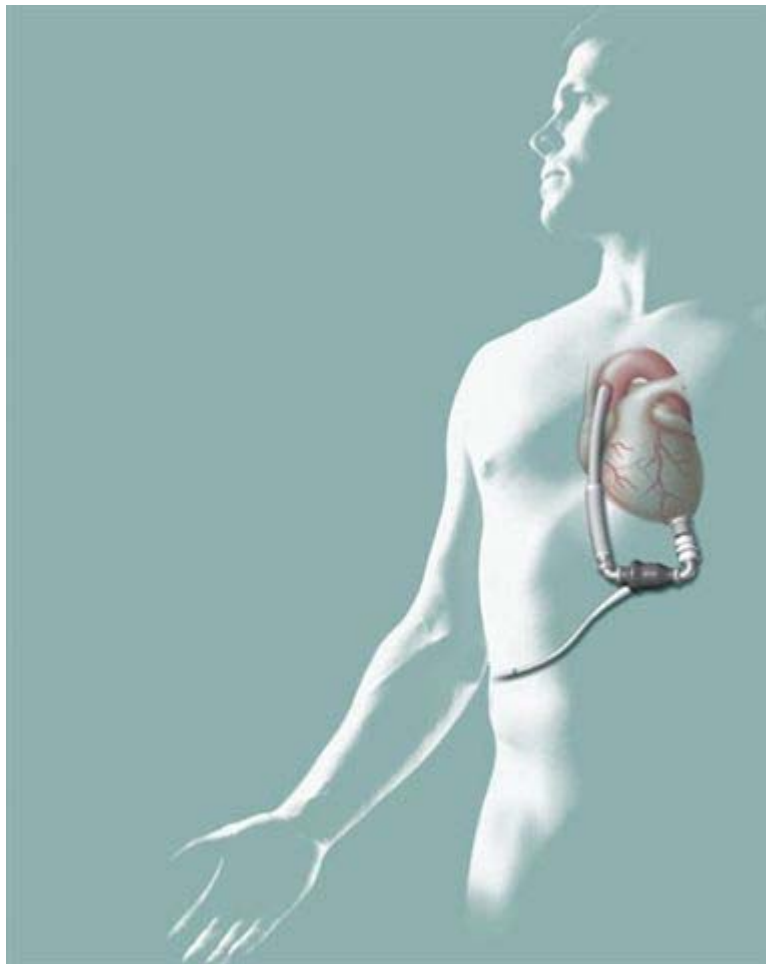


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INTRODUCTION

Certain diseases of the heart can decrease its ability to pump blood effectively. A Ventricular Assist Device, or VAD, is a device that can assist your heart in pumping blood. Your doctor may recommend a ventricular assist device (VAD) as part of your treatment. This patient education brochure will help you better understand what a VAD is, along with the risks and benefits associated with its use.

HOW THE HEART WORKS

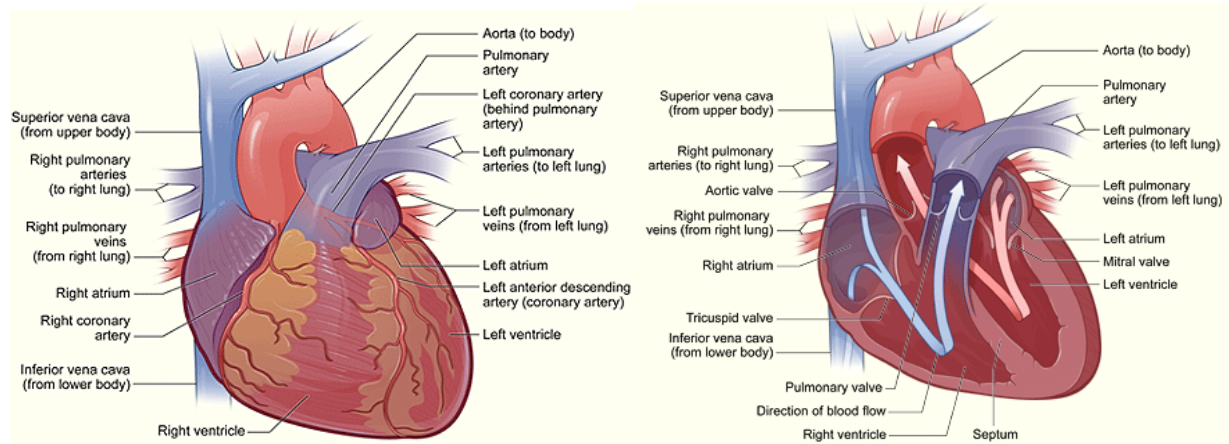


Figure 1: Cardiac anatomy

Anatomy

The heart is responsible for pumping blood to all of the organs in the body. The right side of the heart receives de-oxygenated blood from the body and pumps it to the lungs. The left side of the heart receives oxygenated blood returning from the lungs and pumps it to the body.

The heart has four chambers – two upper atria (singular: atrium) and two lower ventricles. The atria are the receiving chambers and the ventricles are the pumping chambers. The heart has four valves. The function of the valves is to ensure that blood flows in the correct direction through the heart.

How Blood Flows Through the Heart

De-oxygenated blood from the body returns to the right atrium of the heart. From the right atrium, blood passes through the tricuspid valve and into the right ventricle. When the right ventricle squeezes, blood is pumped through the pulmonary valve to the lungs. The tricuspid valve closes to prevent blood from flowing back into the right atrium. Blood picks up oxygen in the lungs and returns through four pulmonary veins (two on each side) to the left atrium of the heart. From the left atrium, blood passes through the mitral valve and into the left ventricle. When the left ventricle squeezes, blood is pumped through the aortic valve and into the aorta. The aorta is the largest artery in the body and delivers blood to all of the body's organs.

The Heart's Own Blood Supply

Just like any other muscle in the body, the heart needs a continuous supply of oxygen and nutrients in order to function. However, the heart does not receive any oxygen or nutrients from the blood flowing through its chambers. Oxygen-rich blood is delivered to the heart tissue through the right and left coronary arteries, which arise from the base of the aorta and are embedded in the wall of the heart.

How the Heart Beats

Each heartbeat is the result of an electrical signal that passes through the heart. The electrical activity of the heart is called the heart's rhythm, and can be measured by an electrocardiogram (ECG).

The heart has its own natural pacemaker, called the sinus node. When the sinus node fires, an electrical signal passes through the atria (top chambers) of the heart, causing them to squeeze. When the atria contract, they "top off" the ventricles with blood. The electrical signal travels to the atrioventricular (AV) node, where it is held for a split second. This allows time for the ventricles to fill completely with blood. The electrical signal then continues into the ventricles, causes them to contract.

Normally, every heartbeat originates from the sinus node ("normal sinus rhythm"). A disturbance in the heart's electrical activity is called an arrhythmia. Arrhythmias may cause the heart to not pump blood as well as it should. Depending on the arrhythmia, it may be treated with medication, a pacemaker, or in some cases just left alone.

HEART DISEASE AND VADS

Certain diseases of the heart can decrease its pumping strength. When the heart does not pump blood as well as it should, fluid can accumulate in the lungs and other parts of the body. This is a situation known as congestive heart failure, because the lungs and body become "congested" with excess fluid.

The symptoms of heart failure generally result from the heart's inability to provide adequate blood flow to the body's vital organs. These include, exercise intolerance, shortness of breath, and gastrointestinal symptoms (nausea, vomiting, diarrhea).

Medications and dietary changes can decrease the workload of the heart and improve its function. In some cases, heart surgery, such as a valve replacement or coronary artery bypass, can also help alleviate symptoms and improve heart function. When medications can no longer help, and other surgical options have been exhausted, a physician may recommend a Ventricular Assist Device, or VAD.

A VAD is a blood pump. It is called a ventricular assist device because it can assist the ventricles (pumping chambers) of the heart in pumping blood.

There are several different types of VADs. However, all VADs have the following parts:

- A tube that removes blood from the heart and brings it to the pump.
- A pump that pumps the blood
- Another tube that exits the pump and carries blood back to an artery leaving the heart.
- A power source for the pump
- A controller for the pump

All VADs have some components on the outside of the body. This includes a power source and a controller which is used to monitor the pump and make adjustments as necessary. However, depending on the type of VAD implanted, the actual blood pump(s) may be inside or outside of the body. Your physician will explain why he or she has selected a particular VAD for you. The selection of a particular VAD depends on your heart disease, body size, and your overall medical condition. Your physician and/or VAD coordinator will provide you with additional educational materials with details of the particular VAD which is being recommended for you.

Aside from differing equipment, different kinds of VADs require different methods of treatment after implantation. For example, most VADs require the patient to take blood thinners after surgery to prevent clots from forming in or around the device. The specific blood thinners you will take (if any) after implantation depend on the type of VAD. Make sure to discuss with your surgeon the type of VAD he or she recommends and whether it requires a blood thinner.

VADs can be used to support one or both of the heart's pumping chambers (ventricles):

- A left ventricular assist device (LVAD) assists the left ventricle of the heart. The pump takes blood from the left ventricle (or in some cases the left atrium) and pumps it to the aorta.



Figure 2: The Heartmate II (shown on the left) is a type of LVAD. The blood pump is implanted inside of the body. The pump is connected to a controller and batteries which are located outside of the body.

- A right ventricular assist device (RVAD) assists the right ventricle of the heart. The pump takes blood from the right atrium (or in some cases the right ventricle) and pumps blood to the pulmonary artery.

- A biventricular assist device (BiVAD) assists both the left and right ventricles of the heart, and essentially involves implanting both an LVAD and an RVAD as described above.

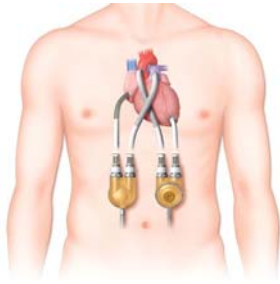


Figure 2: This image depicts a patient who has undergone implantation of a Thoratec® BiVAD, consisting on an LVAD (with tubes connecting the left ventricle of the heart to the aorta) and an RVAD (with tubes connecting the right atrium of the heart to the pulmonary artery. The blood pumps are on the outside of the body.

WHO CAN HAVE A VAD?

The following are general indications for VAD implantation:

- Bridge to transplant: A patient's medical condition can be stabilized while they wait for a donor heart
- Bridge to recovery: Patients who have had a heart attack or heart surgery and require the use of a pump while their heart recovers
- Destination Therapy: Patients who are not eligible to receive a heart transplant may be supported on a VAD indefinitely

A thorough medical evaluation is conducted to ensure that VAD implantation is the best option for the patient. This will include blood tests and other diagnostic studies to evaluate how well all of the organ systems in the body are functioning.

In addition to medical criteria, there are also psychosocial criteria that must be met. VAD therapy requires strict adherence to a medical regimen and careful monitoring. All patients must have adequate social support (i.e. friends or family) to ensure a successful outcome. Prior to undergoing VAD implantation, patients are required to identify caregivers who can commit to providing adequate support while the patient is being supported by the device. This includes attending teaching sessions with the VAD coordinators and being with the patient at all times for the first few weeks after hospital discharge and ensuring adequate transportation to medical appointments.

ALTERNATIVE TREATMENTS

Your doctor will initially attempt to treat your heart disease with medications and lifestyle changes before considering surgery or a VAD. Medications often used to treat heart failure include beta blockers and ACE inhibitors, which decrease the workload of the heart. Diuretics are often used to get rid of excess fluid which accumulates as a result of heart failure. Examples of good lifestyle changes that can make the heart healthier are:

- Regular exercise and weight loss
- Cholesterol and blood pressure management with the help of your doctor
- Smoking cessation
- Controlling diabetes (if applicable)

While a VAD is a good option for patients with end-stage heart failure, it is not always the best option. Your physician will only recommend a VAD if he/she believes it is the best option for you.

THE IMPLANTATION PROCEDURE

Surgery to implant a VAD is performed by a cardiothoracic surgeon under general anesthesia. The surgery to implant a VAD is considered “open-heart surgery,” and usually takes between 4 to 6 hours. The general procedure is outlined below:

Patients undergoing heart surgery require a number of different kinds of support tubes and lines. After you are asleep, the anesthesiologist will insert a breathing tube through your mouth into your windpipe. The breathing tube will be connected to a respirator which will breathe for you while you are asleep. IVs will be placed, as well as an arterial line, which is a small catheter inserted into an artery (usually in your forearm) to measure blood pressure. A urinary catheter (called a Foley catheter) will be inserted through your urethra into your bladder to drain urine. A small tube may be inserted through your nose or mouth into your stomach. Once all of the necessary tubes and lines are in place, the surgery can begin. The general surgical procedure is as follows:

1. The surgeon makes an incision down the front of the chest. The sternum (breastbone) is opened so the surgeon can access the heart.
2. Tubes are inserted to connect the patient to the heart-lung bypass machine. The bypass machine performs the function of the heart and lungs. By diverting blood away from the heart, the surgeon can operate on the heart much more safely.
3. The surgeon will then sew in the tubes which will connect to the blood pump(s) of the VAD. The locations of these tubes depend on the type of VAD being implanted. For an LVAD, the surgeon will core out a hole in the bottom of the left ventricle and insert the inflow cannula (tube) of the VAD. The cannula is secured with sutures. The outflow cannula for the LVAD is then sewn to the aorta. For an RVAD, cannulae are sewn into the right atrium and pulmonary artery.
4. Depending on the type of VAD being implanted, the blood pump may be on the inside or outside of the body. When the pump is on the inside of the body, the surgeon will create a “pocket” for the pump in the abdominal wall just below the heart. If the pump is on the

outside of the body, the tubes attached to the heart will be tunneled out of the body through incisions in the skin.

5. Next, the surgeon attaches the tubes to the VAD pump and turns on the pump. Blood begins to flow out of the heart into the VAD. Your surgeon will adjust the settings on the pump to ensure it is appropriately supporting your heart.
6. Finally, the breastbone and chest incision are closed.

AFTER SURGERY

After surgery you will be transferred to the Cardiothoracic Intensive Care Unit (CT-ICU), still asleep and on the respirator. You will gradually awaken as the effects of the anesthesia wear off. While on the respirator, you will be unable to speak. You will be kept comfortable with sedatives and pain medications. When you are fully awake and able to breathe on your own, the breathing tube will be removed.

You will probably have some pain following surgery. It is important to let the nurses know if you are having pain so they can give you pain medication. Your nose and throat may be sore from having the breathing and stomach tubes in. Lozenges and throat sprays can ease soreness. Your wrist may be bruised and sore from the arterial line that was used to monitor your blood pressure during surgery. This, too, will improve in a few days. The Foley catheter may make you feel like there is pressure on your bladder or that you have to urinate. The Foley is generally removed after 1-2 days. After the Foley is removed, you may feel a burning sensation the first few times you urinate.

When you are off the respirator and in stable condition, you will be transferred out of the ICU to a monitored hospital room to continue your recovery.

Activity is an important part of getting well after surgery. You can expect to be getting out of bed as soon as your doctor allows. At first you will sit in a chair several times a day, followed by short walks in the hallway. Nurses or physical therapists will help you.

Deep breathing exercises and coughing are also important to speed recovery. Coughing reduces the chance of infections developing in the lungs (pneumonia). Although it may be painful at times, coughing will not disturb the incision.

Your incision will be cleansed daily with mild soap and water. Your healthcare providers will perform regular dressing changes to your wounds to help prevent infection.

Nutrition also affects your recovery from surgery. The dietitian may visit you to ensure that you are eating well. It is important to maintain an appropriate weight and avoid smoking.

Your muscles will feel weak and sore for some time after surgery. Regular exercise, such as walking, is a good way to regain muscle strength. Physical therapists will be available to assist you.

RISKS AND COMPLICATIONS

There are numerous risks associated with VAD implantation. These include bleeding, stroke, kidney failure, liver dysfunction, and infection, any of which could lead to death. There is also the risk of device malfunction, which could result in death. There may also be risks that are currently unforeseeable. Your physician will thoroughly review the potential risks and complications of VAD implantation with you before you are asked to decide whether or not to undergo the procedure. You will be provided with an informed consent form which will provide additional details of the risks and potential complications associated with VAD implantation. Be sure to read the informed consent form thoroughly, and ask any questions you may have, before agreeing to undergo VAD implantation. If your present medical condition permits, you are encouraged to seek second opinions from other healthcare providers regarding the optimal treatment of your heart failure. If you ultimately decide to undergo VAD implantation, you will be asked to sign the informed consent form to signify your understanding.

ANTICOAGULATION

Depending on the type of VAD you have, your doctor may prescribe one or more blood thinners (anticoagulants) to prevent clots from forming in the device. Not all VADs require blood thinners. If you leave the hospital on blood thinners, such as Coumadin or aspirin, you will be asked to have frequent blood tests to monitor your level of anticoagulation. Your doctor will review the results of each blood test and may adjust your dosage of blood thinner as needed.

Blood thinners are used to prevent clots from forming in the VAD. However, the use of blood thinners also prevents blood from clotting elsewhere in the body. Thus, significant bleeding could occur with even a very minor injury. Should you injure yourself (i.e. fall), you may have to be checked by a doctor for signs of bleeding. When taking blood thinners, even minor falls can cause significant bleeding that could lead to death.

Your healthcare team will educate you on the use of blood thinners and how you can minimize the risks of complications associated with their use.

DISCHARGE FROM THE HOSPITAL

Depending on your medical condition and the type of VAD you have implanted, you may be able to be discharged from the hospital. Prior to discharge, you and your caregivers will undergo extensive teaching to ensure you are comfortable in caring for yourself and operating your VAD. Your nurses will teach you how to use “aseptic technique” to change dressings and care for the VAD exit site. Training involves at least 3 – 4 one hour sessions. Before being discharged home, you will be sent on an “excursion” outside of the hospital with your caregiver. During the excursion you will be asked to leave the hospital with a caregiver and perform daily activities (i.e. walking, shopping, dining, etc.) for 3-4 hours to ensure you are capable of operating the VAD independently.

If you do not live close to UCLA, you may be asked to stay near UCLA for the first week or two after discharge before returning home. Social workers can assist you in locating temporary housing close to UCLA.

Prior to going home, a VAD program nurse will visit your home to ensure that it will be a safe environment for you while being supported by a VAD. They will complete a safety checklist with your primary caregiver and provide tips on how to ensure your safety while you are home. This will include fall prevention, decreasing static electricity, and cleanliness. An important part of this inspection will be identifying where your VAD's power source will be located and which electrical socket it will be plugged into. An inspection by an electrician may be required to ensure you have an electrical outlet capable of powering your VAD. The outlet that your VAD will be plugged into can not be operated by a switch.

LIVING WITH A VAD

While being supported by a VAD, you will be able to do many of the normal activities you are used to. However, there are some restrictions which are important to ensuring your health and safety while you are on the VAD. Your healthcare team will educate you on lifestyle adjustments required for a successful course.

Your dietitian will help you develop "heart healthy" eating habits. Since the VAD is implanted near your stomach, you may feel full faster. Therefore, you may need to eat more frequent, smaller portions throughout the day. Certain foods may affect blood thinning medications. Your dietitian will give you a list of foods to avoid. Drink plenty of fluids, as your VAD depends on adequate blood volume to function properly. It is also very important that you work to lose any excess weight through healthy eating choices and regular exercise.

It is recommended that you avoid being active in very hot or very cold temperatures. While on a VAD you cannot swim or take a bath, as water can get inside of the pump and cause it to stop. Once the VAD exit site has healed, you may be allowed to shower. You must get permission from your doctor before doing so. Your healthcare team will educate you on how to use a specially designed shower kit to protect the external components of the system from water while showering.

Do not drive or operate heavy machinery unless your doctor gives you permission to do so. Do not engage in strenuous activity or play contact sports while implanted with the VAD. Ask your doctor about sexual activity and pregnancy while implanted with the VAD.

You **MUST** stop smoking if you have not already done so! All tobacco products cause serious cardiovascular problems, including constriction (tightening) of the arteries, which reduces blood flow to vital organs. This makes it harder for the VAD to pump effectively. Using tobacco products also reduces your ability to fight infection. Also avoid secondhand smoke, which can be just as dangerous to your health.

Alcohol can interfere with certain medications. Additionally, alcohol is a diuretic, which means it causes you to lose fluid. Since your VAD depends on having enough blood volume to function

optimally, it is important that you abstain from drinking alcohol. Furthermore, alcohol consumption may impair your ability to understand and respond to system alarms.

Be sure to tell your dentist and other doctors that you have a VAD. If you require any medical or dental procedures, ask your doctor if you will need to take antibiotics prior to the procedure to prevent potential infections.

Do not have magnetic resonance imaging (MRI). MRI uses powerful magnets that could cause serious injury and may cause the pump to stop. Additionally, static electricity may damage the electrical components of the pump. Ask your healthcare provider about touching electronic equipment, such as TVs and computer monitors.

After discharge, your doctor may allow you to travel if your condition has remained stable. You must speak with your doctor and VAD coordinator about any travel plans ahead of time so that we may provide you with contact information for a medical facility with a VAD program near to where you are traveling.

SUMMARY

A Ventricular Assist Device, or VAD, is a mechanical pump that helps weakened hearts pump blood. A VAD can provide improved blood flow and better organ function in patients with end-stage heart failure.

For heart transplant candidates, a VAD can stabilize a patient's condition, thereby allowing a longer period of time to await a donor heart. For patients who are not eligible for a heart transplant, a VAD can provide long-term support for an enhanced quality of life.

Surgery to insert a VAD involves significant risks. It is important that you review all potential risks, as well as potential alternatives, with your physician before proceeding with VAD implantation.

By signing below, you acknowledge that you have read (or someone has read to you) the information provided above. The UCLA VAD Program will retain this page as documentation that you have been provided with this educational brochure.

I have been given an opportunity to ask questions and all of my questions have been answered to my satisfaction. I have been provided with a copy of this brochure to keep as a reference.

Patient Name: _____

Signature: _____

Date: _____

Witness Name: _____

Signature: _____

Date: _____