Caring for patients with a left ventricular assist device

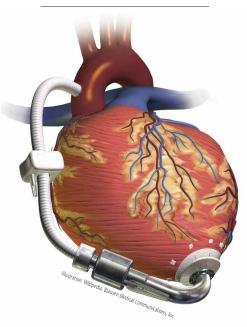
Thorough knowledge of left ventricular assist devices makes caring for these patients a rewarding challenge.

By Heather Martonik, MSN, RN

NEARLY 6 MILLION Americans suffer from heart failure (HF). The American Heart Association predicts that the number of individuals diagnosed with HF will increase 46% by 2030. HF can't be cured, but it can be managed with medications-until it reaches an advanced stage. At that point, a heart transplant or an implanted left ventricular assist device (LVAD) is the only long-term option for survival.

A continuous-flow pump, the LVAD directs blood from the left ventricle to the ascending aorta. (See *Understanding the LVAD*.) The Food and Drug Administration (FDA) first approved the LVAD for patients waiting for heart transplants; when used for this purpose, the device is considered a bridge to transplant. While a heart transplant is optimal, demand for donor hearts far exceeds supply. For that reason, LVADs have become increasingly popular as a destination therapy. The HeartMate II® by Thoratec is the only FDA-approved LVAD for destination therapy.

Since 2006, more than 20,000 patients have received LVADs as destination therapy, and this number is expected to increase. For this reason, nurses need to become more knowledgeable about-and confident incaring for patients with these devices. This article discusses nursing care of patients with LVADs for destination therapy, including device and medication management, potential complications, patient education, and psychosocial support for patients, home caregivers, and nurses.



Who benefits from an LVAD?

Although no stringent patient-selection guidelines exist, a provider usually refers a patient for an LVAD when advanced HF no longer re-



LEARNING OBJECTIVES

- 1. Describe the assessment of patients with a left ventricular assist device (LVAD).
- 2. Discuss nursing management of patients with an LVAD.
- 3. State possible complications from an LVAD.

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sponds to inotropic drugs or surgical interventions, such as valve repair. Patient evaluation for an LVAD includes nutritional status, end-organ function, right ventricular function, and signs or symptoms of infection. Patients also should be screened for depression and other psychological problems.

The selection process includes determining if a home caregiver is willing and able to care for the patient around the clock for at least 3 to 6 months after surgery. Home caregivers must learn how to care for the device and assist patients. Caregiver responsibilities include helping patients manage their LVAD, monitoring for infection, changing driveline dressings, managing medications, assisting with activities of daily living, and providing transportation to and from medical appointments. Depending on the patient's needs and whether complications occur, caregiving may be needed for the rest of the patient's life.

Approval for an LVAD typically occurs over several meetings between the patient and family and a team consisting of a cardiologist, a cardiothoracic surgeon, an LVAD (or VAD) coordinator, a social worker, and a palliative care provider. Many VAD coordinators are RNs who have special training in these devices. Based on the team's recommendation, the cardiothoracic surgeon will ultimately decide if the patient is a candidate for an LVAD.

Proper assessment

Caring for the hospitalized patient

with an LVAD begins with a thorough assessment of both the patient and LVAD.

Monitor blood pressure and mean arterial pressure (MAP); the goal is 60 mm Hg to 90 mm Hg. Elevated MAP decreases flow and perfusion. If MAP is too high, the patient may require antihypertensive drugs, such as metoprolol, hydralazine, and isosorbide dinitrate. These drugs may need to be adjusted until the goal MAP is reached. Always check with the provider before holding any medications due to a low MAP.

Check the LVAD each time you assess the patient's vital signs. You will hear the continuous humming sound of the pump when auscultating the heart. Make sure the battery-charging station is plugged into the wall and at least two spare batteries are in the charge station; a green light indicates a full charge. Additional safety checks include assessing the driveline to ensure it's securely in place and confirming there's a backup system controller in the room.

The LVAD may be connected to the power module, which is plugged into the wall; or, to allow more mobility, the patient may wear the batteries in a holster. When the device is plugged into the module, several numbers on the system monitor indicate pump flow, pump speed, pulse index, and power. (See *The 4 Ps of the LVAD*.) If the patient is wearing a battery holster, the numbers must be read from the controller.

Technical care of the LVAD

The LVAD requires regular care and system checks, including power-source changes, daily self-tests, and driveline dressing changes. Performing these tasks in the hospital provides teaching opportunities for patients and caregivers. (See *Essential education for patients and caregivers.*)

Switching power sources

Patients and caregivers can learn

Understanding the LVAD

A left ventricular assist device (LVAD) is a continuous-flow pump that connects the left ventricle to the ascending aorta via an internal cannula. The illustration below shows the elements of the pump.

To power the LVAD, a percutaneous lead (driveline) exits the abdominal wall and connects to a system controller and a power module that remains plugged into a wall outlet. Patients also can connect their LVAD to two lithium-ion batteries. They may wear the batteries on a belt or a vest for increased mobility. Batteries last approximately 12 to 14 hours. The system controller has approximately 15 minutes of battery life, but never rely on it for battery power.

Patients have a set of two backup batteries, a charging station, and a shower bag to keep the controller dry while showering. Caution them not to swim or soak in a bath or hot tub.

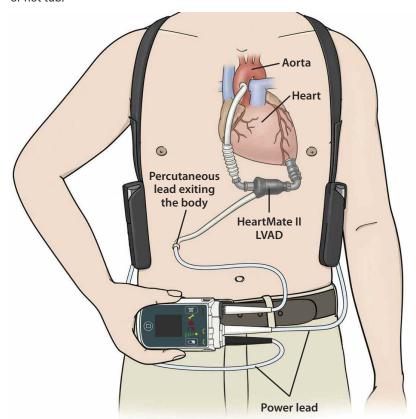


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how to change between batteries and the power module by watching you do it, so try to do it the same way every time. For example, always change out the white power cables first and then the black.

To change from one power source to the other, push the connectors of the white cables together and turn counterclockwise to disconnect. To reconnect, align the half moons on the connectors, push them together, and turn clockwise

until they're flush. Repeat the same steps with the black cables. Think "power, patient, power" to remind yourself to disconnect and reconnect one power source at a time.

Never disconnect both sets of cables at the same time; this essentially leaves the patient without a power source. The system controller provides power for a limited time, but never rely on it. Tell the patient the device will sound an alarm when changing between power sources.

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Performing a daily self-test

Teach the patient to perform a daily self-test to ensure the LVAD is working properly. When the patient presses and holds the battery button on the system controller, the screen displays "Self Test." If the panel is working properly, the audio alarm will sound and control panel alarms will light up. These alarms include power and battery alarms, a red heart (hazard) alarm, and a wrench (advisory) alarm.

Changing the driveline dressing

Assess the driveline site during each patient assessment, or more frequently if you're concerned about dislodgment. Except under special circumstances, the driveline dressings must be changed daily or every other day, depending on the provider's order and how long the patient has had the LVAD. (See How to change a driveline dressing.)

Ultimately, you're responsible for ensuring the dressing change is completed; however, if you or the VAD coordinator have trained and observed the patient and caregiver changing the dressing, you can let them do it.

Medication management

Patients with LVADs are typically prescribed several medications, including anticoagulants, antiplatelet agents, antihypertensives, antiarrhythmics, fluids, and electrolytes.

Anticoagulants and antiplatelets

Anticoagulants and antiplatelets (for example, heparin, warfarin, and aspirin) help prevent pump thrombosis. However, these drugs increase hemorrhage risk.

Antihypertensives

Adequate blood pressure (typically, a MAP between 60 mm Hg and 90 mm Hg) helps maintain sufficient pump flow. Commonly prescribed antihypertensive drugs include:

· vasodilators, such as hydralazine and isosorbide dinitrate

The 4 Ps of the LVAD

Monitor these key parameters on your patient's left ventricular assist device (LVAD).

- **Pump flow** is an estimate of cardiac output based on pump speed and power. It typically ranges from 4 to 6 L/minute. Pump flow is influenced by mean arterial pressure (MAP); a higher MAP increases pump flow, and a lower MAP de-
- Pump speed indicates the speed at which the LVAD rotors are spinning. The usual range is 8,600 to 9,800 rpm.
- Pulse index (PI) is a measurement of flow through the pump and is determined by pump speed and the patient's native heart function. PI typically ranges from 3 to 7. Lower values reflect less native heart function and greater reliance on the pump, while higher values reflect more native heart function and less support by the pump.
- Power is the amount of wattage (W) the device needs to maintain speed and flow. The normal range is 4 to 7 W.
- beta blockers, such as metoprolol and carvedilol
- angiotensin-converting enzyme (ACE) inhibitors, such as lisinopril.

Always monitor heart rate and blood pressure when giving these medications.

Fluid and electrolyte replacement

Most patients with HF are restricted to 2 L of fluid per day. For patients with LVADs, who depend on adequate volume and pressure to maintain flow, you may need to push fluids to achieve the best filling pressures. For patients with long-term HF, provide education to ensure they don't become dehydrated after receiving the device.

The decision to push fluids depends on the patient's hemodynamic status. Signs of compromised fluid status include decreased pump flow and pulse index, as well as increased hemoglobin and hematocrit. Common indications of fluid overload, which can lead to right ventricular failure, include weight gain, edema, and shortness of breath, all of which indicate increased preload.

Keeping electrolytes, such as potassium, magnesium, sodium, and calcium, within normal ranges helps prevent arrhythmias. Check your patient's basic metabolic panel, comprehensive blood count, prothrombin time, and international normalized ratio (INR) daily.

Managing complications

Common LVAD complications include infection, pump thrombus, hemorrhage, arrhythmias, and suction events.

Infection

Several factors put patients with LVADs at high risk for infection—for example, malnutrition. Potential sources of infection include ventilators, central venous catheters, peripheral I.V. lines, and indwelling urinary catheters. Keep in mind that all hospital patients are at risk for methicillin-resistant Staphylococcus aureus infection and Clostridium difficile infection, as well as pressure injuries, which can become infected.

After surgery, driveline infections are common. To help prevent these infections, provide thorough patient and caregiver education on performing driveline dressing changes.

Pump thrombus

Signs and symptoms of pump thrombus include increased heart rate, shortness of breath, increased pulse pressure, and a steady increase in pump power over several days. If the pump is completely occluded by a clot, the pump flow rate decreases. Notify the provider immediately if the patient experiences any of these problems. Treatment of pump thrombus involves anticoagulant or antiplatelet therapy, direct infusion of a local thrombolytic into the LVAD, or

Essential education for patients and caregivers

Educating the patient, family, and home caregivers about proper care of the left ventricular assist device (LVAD) helps everyone feel more comfortable with the device and can reduce complications.

- Encourage patients and caregivers to handle the LVAD equipment soon after surgery so they become comfortable with it.
- Teach the patient and caregiver how to change the driveline dressing and have them perform a dressing change for you.
- Use the teach-back method when educating about signs and symptoms of infection and ways to reduce risks.
- Advise patients and caregivers to change the power source (see the photo below) the same way every time. For example, teach them to disconnect and connect the white cables first and then the black cables.
- Provide education about the purpose of medications, what to do if the patient misses a dose, and adverse reactions to report to the provider.
- Teach patients and caregivers to take the patient's vital signs and explain the normal ranges for heart rate and blood pressure.
- Ensure patients and caregivers know how to respond to LVAD alarms.
- Explain what to do if an emergency occurs.
- Emphasize the importance of notifying the local power company about the LVAD to ensure the home is a priority for power restoration if an outage occurs.



pump replacement. To avoid these problems, monitor lab values to help ensure the patient's INR is in the therapeutic range, typically 2 to 3.

Hemorrhage

Lifelong anticoagulant use puts patients at risk for hemorrhage, especially stroke or GI bleeding. Signs and symptoms of GI bleeding are frank red to black tarry stools, a significant drop in hematocrit, decreased oxygen saturation, pallor, and dizziness. Anticoagulant therapy may need to be adjusted, and the patient may require blood products.

Suction event

A suction event occurs when pressure inside the ventricles drops too

low, causing the internal cannula to adhere to the left ventricular septum. This typically results from hypovolemia. Other causes include high pump speed and poor internal cannula positioning. A suction event isn't life-threatening in itself but can lead to ventricular arrhythmias, such as ventricular tachycardia. Notify the provider immediately if you suspect a suction event.

Treatment may include pushing fluids to restore ventricular pressure, treating the cause of hypovolemia (such as over-diuresis or GI loss), or surgery to restore proper cannula positioning.

Arrhythmias

Arrhythmias, such as ventricular

tachycardia and atrial fibrillation, are common in LVAD patients. Many of these patients had a pacemaker placed before surgery to treat atrial fibrillation. After LVAD placement, arrhythmias are medically managed with antiarrhythmic agents, such as amiodarone and digoxin. For a newonset arrhythmia, assess the patient to see if he or she is stable or symptomatic, check electrolyte levels, and notify the provider.

Contact the provider and VAD coordinator immediately if the patient experiences symptomatic or sustained ventricular tachycardia (longer than 30 seconds) or ventricular fibrillation. If the patient becomes unresponsive, call a code blue. Avoid chest compressions except as a last resort because they can dislodge the LVAD and cause irreparable damage. Give medications per advanced cardiac life support protocol. You can leave the pump running during defibrillation.

Psychosocial support

Patients with LVADs experience many physical and emotional changes. Although there are many physiological benefits (increased energy, reduced shortness of breath), patients may become depressed or even suicidal. Many patients feel socially isolated and express frustration over loss of control and dependency on family and caregivers. Others may be afraid of their device.

Assess patients for depression on admission and throughout their hospital stay. Ask how they're managing daily life using open-ended questions, such as:

- How has your life changed since receiving an LVAD?
- What are your greatest concerns after leaving the hospital?
- How will you cope with these concerns?
- What are some benefits and challenges you've experienced since receiving your LVAD?

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Teach coping skills, such as journaling, meditation, art therapy, prayer, and the importance of reaching out to others. Patients with LVADs can offer significant support to one another, so provide information about support groups.

Caring for the home caregiver

Caregiving can be burdensome. Many caregivers express fear of the LVAD, regret taking on the role, or experience depression and anxiety. They need support, even if the patient has had an LVAD for a long time. Provide caregivers with resources for support groups where they can receive encouragement and respite care.

Self-care for the nurse

Many nurses who are new to caring for patients with LVADs express anxiety over caring for this patient population. Make sure you're up-to-date with your employer's standard education on LVADs. Refamiliarize yourself with the equipment and ask to shadow a nurse who's caring for a patient with an LVAD. Ask for help from someone who's more experienced. VAD coordinators are excellent sources of support, so find out who's on call and how to reach him or her.

In many cases, nurses who care for patients with LVADs get to know them and their families well and may experience grief if a patient becomes seriously ill or dies. If you feel you're experiencing grief or burnout, reach out to a trusted coworker, manager, or counselor. Spend days off doing something enjoyable, such as spending quality time with family, friends, or a pet. Treat yourself to a massage or a relaxing bath, go outside, take a yoga class, or meditate. Most important, never forget why you became a nurse.

Rewarding challenge

As the population of patients with

How to change a driveline dressing

- Remove the old dressing and assess the exit site for signs of infection. Ensure the exit site is clean and dry, with no redness or drainage.
- **2** Using a back-and-forth motion, clean the area surrounding the exit site with chlorhexidine, moving from the area immediately around the driveline exit site outward. Don't use a circular motion, as this increases infection risk.
- Clean the driveline with a new chlorhexidine swab, sweeping away from the exit site to prevent bacteria from traveling up the driveline.
- Fold a 2" x 2" gauze pad and tuck it underneath the driveline; cover it with another 2" x 2" gauze pad.
- 5 Use low-adherent tape to cover the gauze pads, tearing one side just enough to tuck under the driveling. to tuck under the driveline. Ensure a proper securement device is intact and placed several inches lateral from the driveline exit site. It should provide just enough slack to the driveline so it's not taut.

advanced HF increases, nurses in all healthcare settings need to become familiar with the care of patients with LVADs, including device assessment and management, potential complications, and patient and caregiver education and support. Caring for the patient with an LVAD can be challenging, but it's also immensely rewarding.

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Please mark the correct answer online.

- 1. George Davidson,* a 60-year-old man with severe heart failure, is on the heart transplant list. As a bridge, he receives a left ventricular assist device (LVAD). You are Mr. Davidson's nurse today. You know you need to monitor his mean arterial pressure, which should be kept at
 - a. 20 mm Hg to 40 mm Hg.
 - b. 30 mm Hg to 60 mm Hg.
 - c. 60 mm Hg to 90 mm Hg.
 - d. 90 mm Hg to 100 mm Hg.

2. Which of the following would alert you to a possible safety issue with Mr. Davidson's LVAD?

- a. An additional system controller in the room
- b. Continuous humming sound on auscultation
- c. Two batteries in the charging station
- d. Yellow light on the battery charging station

3. When explaining the LVAD to Mr. Davidson, you tell him that it

- a. connects the right ventricle to the ascending aorta.
- b. connects the left ventricle to the ascending aorta.
- c. uses an external cannula for connecting the ventricle to the aorta.
- d. provides intermittant pump flow via three lithium-ion batteries.

4. Which statement about the pump flow reading on Mr. Davidson's LVAD display is correct?

- a. A higher MAP will reduce pump flow.
- b. It usually ranges from 2 to 4 L/minute.
- c. It's an estimate of cardiac output based on pump speed and power.
- d. It reflects the amount of wattage needed to maintain flow.

5. Mr. Davidson's pulse index is 4, which tells

- a. it is lower than the usual range of 6 to 8.
- b. it is unaffected by the pump speed.
- c. he has more native heart function, so he has less reliance on the LVAD.
- d. he has less native heart function, so he has greater reliance on the LVAD.
- 6. Mr. Davidson's wife Amelia will be his caregiver at home. When teaching her how to

change between batteries and the power module, you tell her to

- a. alternate the order in which the power cables are changed.
- b. change the white power cables first and then the black.
- c. turn the cable connectors clockwise to disconnect them.
- d. turn the cable connectors counterclockwise to reconnect.

7. When teaching Ms. Davidson how to change a driveline dressing, you instruct her to

- a. use chlorhexidine to clean the exit site area from outward towards the exit site.
- b. use a circular motion to clean the exit site area with chlorhexidine.
- c. clean the driveline using the same chlorhexidine swab, sweeping towards the exit site.
- d. clean the driveline with a new chlorhexidine swab, sweeping away from the exit site.

8. Which of the following statements about the driveline dressing change is correct?

- Use low-adherent tape to cover the gauze pad on the driveline, tearing one side just enough to tuck under the driveline.
- b. Use high-adhesive tape to cover the gauze pad on the driveline, tearing two sides just enough to tuck under the driveline.
- c. A securement device should be placed one inch from the driveline exit site.
- d. The securement device should be placed so that it keeps the driveline taut.

9. Which do you need to consider about Mr. Davidson's fluids?

- Symptoms of fluid overload are dangerous for patients with an LVAD because they can decrease preload.
- b. Common indicators of fluid overload include weight loss, pulmonary edema, and shortness of breath.
- He may need more fluids than typical patients with heart failure to achieve the best filling pressures.
- d. Signs of compromised fluid status include increased pump flow and pulse index.

10. Mr. Davidson says he is short of breath, and his heart rate and pulse pressure have increased. You note that there has been a steady

increase in pump power during the week. Based on these findings, you suspect

- a. suction event.
- b. pump thrombosis.
- c. hemorrhage.
- d. driveline infection.
- 11. You alert Mr. Davidson's physician to the potential problem, which is resolved. Later that day, you act as a preceptor to a nurse who has not yet cared for a patient with an LVAD. As you're discussing Mr. Davidson's needs, you note that his international normalized ratio should be kept in the therapeutic range, typically
 - a. 1 to 1.25
 - b. 1.5 to 2.
 - c. 2 to 3.
 - d. 4 to 5.

12. Mr. Davidson experiences a cardiac arrest. You know to

- a. leave the pump on during defibrillation.
- b. turn the pump off during defibrillation.
- c. begin chest compressions immediately and avoid interrupting them.
- d. avoid the use of advanced cardiac life support medications.

13. Which of the following could cause a suction event for Mr. Davidson?

- a. Hypovolemia
- b. Pump speed of 8,800 rpm
- c. Poor external cannula position
- d. Pump speed of 8,600 rpm

14. Which statement about the psychological needs for Mr. and Ms. Davidson is NOT correct?

- Patients with an LVAD, as well as their families, require minimal psychological support.
- Although LVADs provide many benefits, patients may become depressed or even suicidal.
- c. Patients should be assessed for depression on admission and throughout their hospital
- d. Families of patients with an LVAD may benefit from support groups and respite care

*Names used are fictitious.