

# Left Ventricular Assist Device (LVAD)

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## EMT/ ADVANCED EMT / PARAMEDIC STANDING ORDERS

### PURPOSE

To provide an overview of how a Left Ventricular Assist Device (LVAD) works and how EMS provider assessment and treatment differs for a patient with a LVAD.

### Highlights of Assessing and Treating and LVAD Patient

- Recognize that you have a patient with a LVAD.
- Consult family/caregiver and telephone LVAD coordinator for guidance.
- Determine if your patient has a LVAD problem, or an unrelated illness or injury.
- A completely stable patient may have no palpable pulse or measurable blood pressure.
- Mental status and skin color must be used to determine patient stability.
- CPR should almost never be performed on a LVAD patient.
- Patients with a LVAD should almost never be pronounced dead at the scene.

### Overview of a LVAD

The LVAD, or Left Ventricular Assist Device, is a mechanical device that takes over some or all of the pumping function of the heart's left ventricle. This device is used for patients of any age or gender with advanced heart failure who would not otherwise survive without this device. Heart failure can result from chronic/long-term hypertension and heart disease, congenital heart defects, mechanical damage to the heart, infection, postpartum complications and many other reasons.

Some LVAD patients will have a LVAD while they are waiting for a heart transplant (called Bridge-to-Transplant). Other LVAD patients, who are not eligible for a heart transplant for some reason, will live with the device for the rest of their lives (called Destination Therapy, or Lifetime use).

### How the Heart Works versus How LVADs Work

The normal pumping function of the heart is achieved by the contraction of the left ventricular muscle, which pushes a bolus of blood forward in the cardiovascular system with each contraction. This contraction is what we feel when checking a pulse, and what we hear when taking a blood pressure. If the heart is not contracting, blood is not moving forward in the system, and we don't feel or hear a pulse. The LVAD, in contrast, flows constantly and therefore creates no "pulse" to feel or hear.

The LVAD is a tube that is about ½ -1 inch in diameter with a pump in the middle. One end of the tube (inflow) is surgically inserted into the left ventricle, and the other end (outflow) is sewn into the aorta, just above where it exits the heart.

The pump on the LVAD spins constantly. The right side of the heart still pushes blood through the lungs and back to the left ventricle, but then the LVAD pump pulls the blood out of the left ventricle and pumps it out to the body, taking over most or all of the failed pumping action of the left ventricle.

The drive unit for the pump, which includes the power source and programming controls, is outside of the body and connects to the LVAD by a cord that exits the body through the abdomen, usually in the right upper quadrant.

**NOTE:** The important part to us as EMS providers is that the pump is a constant flow pump. There is no rhythmic pumping as there is with the ventricle, and therefore there is little to no pulse. This means you can have a perfectly stable and healthy looking person who has no palpable pulse and whom you may or may not be able to take a blood pressure!

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### Assessing the LVAD Patient

#### 1. Recognize you have a LVAD patient!

- The LVAD patient has a control unit attached to their waist, or in a shoulder bag. The control unit is attached to a power cord exiting from the patients' abdomen.
- The control unit will be attached to batteries mounted to the belt, in shoulder holsters, or in a shoulder bag. At home, it could be attached to a long cord that connects to a large power unit.

**2. Decide if you have a patient with a LVAD problem,** or a patient with a medical problem who just happens to have a LVAD. Patients with LVADs will have all the same illnesses and injuries as any other patient you see. Their LVAD may have nothing to do with the reason you were called.

#### 3. Look:

- Alarms on the control unit will most likely indicate a LVAD problem. Follow resource guides with the patient to trouble shoot.
- Skin color and mental status are the most reliable indicators of patient stability for the LVAD patient.

#### 4. Listen:

- Listen over the LVAD pump location to make sure you can hear it running. This will be just to the left of the epigastrium, immediately below the base of the heart. You should hear a low hum with a stethoscope if the pump is running. Don't assume the pump is running just because the control unit looks OK.
- The patient and their family are experts on this device. Listen to what they have to say about any problems with the LVAD.

#### 5. Feel:

Feel the control unit. A hot control unit indicates the pump is working harder than it should and often indicates a pump problem such as a thrombosis (clot) in the pump. The use of pulse and blood pressure to assess stability can be unreliable in a LVAD patient, even if they are very stable.

#### 6. Vitals:

- Pulse: Generally, you will be unable to feel a pulse.
- Blood Pressure: Not Reliable: you may or may not be able to obtain one, standard readings often varying widely from attempt to attempt, and correlation to systemic pressures is unreliable, even with consistent readings in the "normal" range.
- Pulse-oximetry: Readings seem to be fairly accurate and consistent, according to TEMSIS data, despite the manufacturer stating that pulse oximetry often doesn't work.
- Quantitative Continuous Waveform Capnography: This should remain accurate, as it relies on respiration, not pulse. Normal (printed) waveform shape with a normal respiratory rate and low CO2 readings (<30) can indicate low perfusion = poor pump function.
- Temperature: infection and sepsis are common, check temperatures!

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7. LVAD patients can remain stable and experience a range of ECG rhythms that could be dangerous or fatal in another patient.

8. Remember blood sugar and stroke assessment, particularly for an altered mental status.

### Treating the LVAD Patient

Generally, treatments for a LVAD patient will follow the current NH EMS Protocols. However, there are a few special considerations to keep in mind:

1. Don't let the LVAD distract you from treating the patient!
2. The best medical resource available to you for LVAD related problems is the patient's VAD coordinator. The patient will have a contact sheet for the VAD coordinator with them at all times. Contact the VAD coordinator as soon as possible.
3. Pump has stopped: Battery problems are a common cause for a pump to stop (battery dead, not seated properly, or both taken out at once). This is unlikely to be immediately fatal unless a patient is in VF/VT when the pump stops. The patient is more likely to return to their baseline unstable CHF symptoms. Treat the symptoms and contact the VAD coordinator before restarting a pump that has been stopped longer than 1 – 2 minutes.
4. Sepsis and stroke are leading causes of death for LVAD patients. Keep this in mind when assessing and treating a patient with an altered mental status.
5. Treating ECG changes:
  - Use of ACLS medications, defibrillation and pacing is unchanged for LVAD patients. Follow standard AHA and protocol guidelines as appropriate.
  - An implanted defibrillator and/or a pacemaker may already be in place.
  - The continuous flow of the LVAD means potentially unstable or fatal ECG rhythms, may have minimal to no short-term effect on the cardiac output and stability. Treat ECG changes according to protocol.
6. Trauma: LVAD patients are always on anticoagulant medications. Keep this in mind when treating traumatic injuries. Even minor appearing chest or abdominal trauma, such as a seatbelt mark, could be hiding a very serious injury.
7. CPR: CPR should NOT be performed if there is ANY evidence the pump is still functioning. The decision whether to perform CPR should be made based upon best clinical judgment of the provider in consultation with the patient's family and the VAD coordinators (or medical control if VAD coordinator unavailable). In any event, CPR should be initiated only where:
  - a. You have confirmed the pump has stopped (by listening for pump sounds) **AND** all troubleshooting efforts to restart it (connect wires, batteries, new control unit, etc.) have failed, **AND**
  - b. The patient is unconscious, unresponsive, and has no detectable signs of life (no pulse, no blood pressure, no pulse ox readings, or waveform capnography reading, **AND**
  - c. The patient does not have a valid DNR in place.

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8. Patients should not be pronounced dead if LVAD continues to function, unless they have obvious factors of death such as decapitation, rigor mortis or dependent lividity.

### Transport of the LVAD Patient

1. Patients without a LVAD problem should be transported to the closest appropriate hospital for their condition.

2. Patients with a LVAD should be transported to their VAD resource hospital, if possible. The local VAD resource centers are Catholic Medical Center in Manchester and Tufts Medical Center and Brigham and Women's Hospital in Boston. Check with your patient to see which hospital is their resource center. When in doubt, transport to the closest hospital to access more transport resources and support.

3. Always bring the patient's resource bag with you. It should have spare batteries, possibly a spare control unit, contact sheets for the VAD coordinator and directions for equipment and system alarms.

4. Always bring spare batteries for the LVAD with the patient, even if it is not a LVAD problem (see # 3. above). Fresh batteries generally last 3-10 hours, depending on the battery style.

5. If you have a long transport or expect that the patient may be away from home for more than 4-5 hours, then try and bring the patient's power base unit.

- This is the big unit that can plug into the wall and power the patients control unit. It is often also the battery recharger.
- In some cases, you can ask the family to bring it to the hospital for you, but there may be times when you might need to bring this in the ambulance and plug it into the inverter and use it as the power source.

6. Use your patient and their family as a resource. They are experts about this device and can help you help them.

Recommended Unit Resource: Print EMS Guide for Mechanical Circulatory Support and place in all ambulances (20 pages). This guide has excellent information and trouble shooting guidance for the 5 LVAD devices that patients could have out in the public. Access the resource guide at: <http://www.mylvad.com/sites/mylvadrp/files/Field%20Guides%20Master%20Document.pdf>.

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