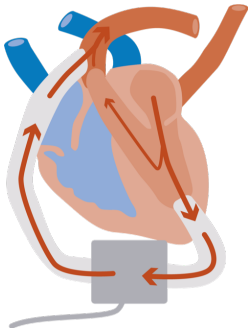
Special situations

RESUSCITATING THE PATIENT WITH A VENTRICULAR ASSIST DEVICE

Most currently available left ventricular assist devices (LVADs) use either an axial or centrifugal pump to provide **continuous** blood flow between the left ventricle and aorta to augment cardiac output.



Any patient with an implanted LVAD should have a **provider available,** to help guide management, who should generally be contacted immediately.

These patients normally have very little or **no palpable pulse**—even in a stable situation—so assessing perfusion is particularly challenging.

A Doppler signal may be helpful to determine a systolic pressure, which may be used to approximate mean arterial pressure.

The recommendations about whether to provide **chest compressions** for a patient whose LVAD has failed will vary by institution. In general, the LVAD will be much more effective than external chest compressions, so attention should be focused on salvaging the function of the device when possible.

Pump malfunction is often a concern for an unfamiliar provider, but fortunately it is very rare. Surgical replacement is really the only treatment for an actual mechanical failure, and it is usually fatal.

Device alarms

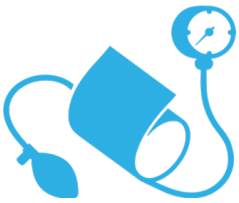
Device alarms can help guide providers' management decisions. If the **battery** is low or dead, it should be plugged in to a power source immediately. **Low flow** alarms may result from a variety of conditions, but generally either too much downstream pressure (e.g., high blood pressure), or not enough upstream pressure (i.e., low left ventricular filling pressure). Flow is not measured directly, but is calculated from the following equation:

$$\text{Device flow} = \frac{\text{rotor speed}}{P_{\text{inflow}} - P_{\text{outflow}}}$$

When left ventricular volume is significantly decreased, the inflow cannula of the device may become obstructed, causing suction alarms. This may result from

Dehydration

Hemorrhage



Hypotension

Thrombosis and hemorrhage

Thrombosis and hemorrhage are common concerns for patients with LVADs. If pump thrombosis is the cause of device failure, there is unfortunately very little that can be offered in the immediate scenario, and surgical device replacement is usually required. Fortunately, pump thrombosis is most often a gradual development. Patients should be anticoagulated, and thrombolysis may be considered on a case-by-case basis, but is generally not effective if blood flow is diverted around the device.

LVAD patients are at particular risk for bleeding, because they are anticoagulated, generally with an antiplatelet agent as well, and non-pulsatile flow increases the risk for arteriovenous malformations. In this case, the patient should generally be treated like any other hemorrhaging patient, but reversal of anticoagulation should be coordinated with the LVAD provider, as complete reversal may precipitate thrombosis.

Shock

Obstructive

Tamponade or any other obstructive physiology may cause a decrease in preload and cause the device to suction. Again, treating the obstruction should be the focus in order to restore LVAD function.

Distributive

Distributive shock may result from sepsis, and LVAD patients are particularly at risk because of their percutaneous indwelling driveline. This vasodilation may cause decreased ventricular filling and prompt suction events, which should be treated with IV fluids and vasopressors.

Cardiogenic

Cardiogenic shock may occur even with a functioning LVAD, because the device does not entirely replace cardiac output, and does not provide right ventricular support. Although patients may tolerate rhythms like ventricular tachycardia, it will generally compromise their cardiac output, and should be treated accordingly (e.g., cardioversion).