A 74 year old man is brought into the resus room at your community hospital. He has an altered level of consciousness, but is still rousable. EMS is quite concerned because he doesn't have a pulse. He does have a large machine sticking out of his chest that his wife tells you is an LVAD. You have never seen one of these doohickeys before. Your nurse had never even heard of an LVAD before. Everyone looks at you expectantly...

**MY APPROACH**

**Call for help.** You should try to get the team that is looking after this patient's LVAD on the phone ASAP. Check the pump, battery pack, or a wallet card for a phone number as well as information about what kind of device it is. Consider early transfer to the LVAD centre.

Begin your assessment as usual. Get IVs and monitors attached. Assess the airway and breathing. Cardiovascular assessment: assess mentation, urine output, skin, and JVP. Remember that pulses may or may not be palpable. Get an ECG.

If the patient or family can tell you, gather some information about the pump. Does it have a backup hand pump in case of failure? Are the backup batteries and power pack with the patient? Is the pump supposed to be a bridge to transplant or is it destination therapy?

**Start a bolus.** In general, LVADS love volume and you are unlikely to do harm by increasing preload. If there is an obviously shockable rhythm (and the patient is unstable), I would defibrillate/cardiovert now, ensuring the pads aren't over the pump mechanism.
Now check the pump:

1. Listen for a hum from the device (to tell you it’s working)
2. Check the MAP. (Check manually by listening or with doppler. The first sound you hear is the MAP in non-pulsatile flow.) In the critically ill, an art line is ideal.
3. Check the batteries. If the power pack is available, plug the LVAD in.
4. Systematically, check all the wires and ensure they are connected. Be thorough and check every single connection
5. Check the control pack for power, flow, and RPM information
6. Feel the LVAD: is it overheating?

At this point, you should have a general sense of the patient’s MAP, fluid status, and whether the pump is working or not.

If available, add bedside echocardiography to help focus the diagnosis:

- Small RV → inadequate preload
- Large RV and small LV → PE, RV STEMI, or pulmonary hypertension
- Large RV and large LV → Pump thrombosis or obstruction

**Patient appears dry, JVP is low, and RV is small**

DDx is hypovolemia, bleeding, and sepsis

- Bleeding → these patients are on anti-coagulation and develop acquired von-Willebrand disease. Resuscitate with blood products, but talk to LVAD centre before reversing anti-coagulation if possible
- Hypovolemia → fluid resuscitate, add pressors if required
- Sepsis → the pump can get infected, but initially manage like all other sepsis. Fluids, antibiotics, cultures, and pressors

**Patient appears fluid overloaded, JVP is high, and RV is larger than LV**

DDx is RV STEMI, acute pulmonary hypertension, and PE

- RV STEMI → get the patient to the cath lab
- Acute pulmonary hypertension → caused by hypoxemia and acidosis. Intubate and consider bicarb
- PE → manage PE

**Pump is hot, running high RPMs, and has an abnormal hum; patient has an enlarged RV and LV**

Pump thrombosis → Given a heparin bolus. If the patient is peri-arrest consider thrombolytics

**Pump is hot, running high RPMs, and has an abnormal hum; patient has a small LV**

Suction event (pump intake stuck against LV wall) → IV fluids and stat transfer to LVAD centre

Go through a thorough differential diagnosis. In an unconscious LVAD patient, the lack of pulse might be normal. As tempting as it is to rush to ACLS, but it would be embarrassing to miss hypoglycemia or an accidental overdose.

**Should you start CPR?**

First, ensure that you are not missing a reversible cause. If the LVAD has a hand pump, use that and don’t start CPR. CPR can cause disastrous outcomes (ripping the device out of the LV or aorta), but if the patients needs it, you don’t have much choice. If MAP is 0 and you don’t think the pump is working, start CPR and treat as if the LVAD was not there.

**NOTES**

LVADs can be used as a bridge to transplant, bridge to recovery from a temporary heart condition, or as destination therapy.

You cannot rely on a palpable pulse, they may not have one at baseline.
Also, remember that the pulse ox may not be reliable, because of the loss of a pulse pressure.

Aortic insufficiency - blood just flows in short circuit backwards into LV - needs surgery ASAP

Fig 5 in Birati at al Critical care clinics 2014;30(3):607-627

The title image is based on creative commons public domain art found at Wikimedia Commons by Madhero88 and Mimooh.

OTHER FOAMED RESOURCES

Left ventricular assist devices (LVADS) on EMCrit

Part man, part machine... on thebluntdissection

The LVAD Master document field guide for EMS from myLVAD.com

Ventricular assist device (VAD) from LITFL

LVAD overview lecture from myLVAD.com

Left Ventricular Assist Device on R.E.B.E.L.E.M

REFERENCES

