emDocs

The EM Educator Series

The EM Educator Series: Man vs Machine – Basics & Beyond of VADs

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Cases:

#1: A 62-year-old male is brought in by EMS with feelings of lightheadedness. He has a history of severe heart failure requiring LVAD. On examination, you detect a hum but are unable to obtain a pulse. When he is placed on monitor, you see what appears to be ventricular tachycardia.

#2: A 53-year-old female with an LVAD is brought in with fever and chills. She has felt fatigued. Her MAP is 56 mm Hg, and she is febrile. The driveline site appears red.

Questions for Learners:

1) Why does the patient have the LVAD?
2) What is the basic anatomy and physiology of a VAD?
3) What should you evaluate on exam, and what labs are needed?
4) What complications do you need to consider?
5) Can you defibrillate these patients? How about chest compressions?
6) Who do you need to discuss these patients with?

Suggested Resources:

- ✓ Articles:
  - R.E.B.E.L. EM – LVAD
  - emDOCs.net – LVAD Patients: What You Need to Know
  - First 10 EM – LVADs
  - EMCritRACC – LVADs
  - Mechanical circulatory support.
  - The emergency management of ventricular assist devices.
  - Ventricular assist device in the emergency department: Evaluation and management considerations.

Answers for Learners:

1) Why does the patient have the LVAD?

- As a bridge to cardiac transplantation
- As a bridge to recovery (i.e. reversible myocardial pathology)
- As destination therapy = long-term treatment of patients who are not candidates for transplant

2) What is the basic anatomy and physiology of a VAD?

- Inflow Cannula (From Left Ventricle): Pulls blood from the LV into the pump
- The Pump: generates blood flow
- Outflow Conduit (Anastomosed to Ascending Aorta): Pushes blood into the aorta
- Driveline (Percutaneous Lead): Connection to external controller
- External System Components (Controller, Monitors, Power Source, and Battery): Monitors VAD performance, displays battery life, and typically two batteries

3) What should you evaluate on exam, and what labs are needed?

Approach to LVAD patients in the ED

- Manage ABCs (airway, access, monitoring).
- Obtain patient's blood pressure (either via doppler US or by placing arterial line) during initial assessment.
- Contact LVAD team coordinator (should be specific to your hospital, or patient should have phone number of coordinator).
- Auscultate for hum of LVAD and alarms. An alarm may indicate a battery problem. Check driveline and pump parameters. Perform bedside echo.
- Assess for the following LVAD emergencies

4) What complications do you need to consider?

a) Arrhythmias

Most LVAD patients have underlying ischemic heart disease or other types of cardiomyopathy, so they are at increased risk for atrial and ventricular dysrhythmias.

The incidence of sustained VT/VF is ~52% in LVAD patients. If this is not corrected, the patient can go into RV failure and decompensate.

Emergent cardioversion is indicated if the patient is unstable (ie by BP measurement or has AMS but if stable, can discuss cardioversion further with LVAD team before proceeding).

b) Acute decompensated heart failure

Recurrent or persistent heart failure is a very common cardiac emergency in LVAD patients presenting to the ED, occurring in at least 20% of patients.

This can occur due to RV or LV dysfunction or from general device failure.

Causes of RV Failure
Primary myocardial dysfunction
Cardiac tamponade
Tricuspid regurgitation
Ventricular arrhythmias
Pulmonary hypertension
Pulmonary embolism
LVAD pump speed too high
Suspect RV failure in patients with hypotension, peripheral edema, and JVD with echo findings of RV dilation, a D-shaped LV, and/or plethoric IVC.

Causes of LV Failure
Pump thrombosis
Cannula obstruction
Motor failure
Aortic insufficiency
Anemia due to GI bleed

c) Bleeding

LVADs can cause acquired von Willebrand Disease, thought to be from the action of rotary or axial flow pump of the LVAD which causes high shear stress that may increase lysis of large vWF multimers. Patients are at a higher risk of GI bleeds and intracranial bleeds.

d) Thrombosis

LVAD patients are also at risk for pump thrombosis and ischemic stroke, despite use of anticoagulation to minimize these complications.

The diagnosis of pump thrombosis can be suggested by hemolysis and changes in pump performance. Hemolysis may be suggested by hematuria, worsening renal function, and elevated LDH (> 1000). Patients with pump thrombosis may be asymptomatic or can present in severe heart failure.

e) Infection

Can occur in pump, pump pocket, and around driveline, but driveline infections are the most common. Drainage from the skin exit site is suggestive of a driveline infection.

Patients may present with only localized skin infections or may be septic.

The most common bacteria causing infections include S. aureus and coagulase-negative staph, followed by gram-negative bacilli (Klebsiella, Pseudomonas).

f) LVAD patient in extremis

What do you do if your LVAD patient isn't awake or breathing? Since pulses likely will not be palpable, along with securing the patient's airway, the next step is to listen over the heart for a whirring sound indicating that the pump is working. If there is no sound, look for a reason why the pump isn't working (power supply, battery, cables). If the pump is okay, perform doppler US to determine MAP and echo to assess for tamponade, findings suggestive of PE, etc. Chest compressions are controversial in LVAD patients as they can theoretically dislodge the device, but may be considered on a case-by-case basis as a last resort.

5) Can you defibrillate these patients? How about chest compressions?

With the assistance of your LVAD team you perform procedural sedation and defibrillate your patient with conversion to sinus rhythm.

Chest compressions are controversial in LVAD patients as they can theoretically dislodge the device, but may be considered on a case-by-case basis as a last resort.

CPR should be performed only if absolutely necessary, but remember this might lead to damage of the VAD itself. There was a small retrospective case series of 8 patients with VADs who received CPR during cardiac arrest, which showed no dislodgment or damage to the VADs, and 4 of the 8 patients surviving with neurologically good outcomes, but larger trials are needed before making this the standard practice.

6) Who do you need to discuss these patients with?

Always stabilize the patient first, but with the first opportunity you get, contact the local VAD-coordination team or center for assistance and/or to transfer the patient to a VAD center!!!