Left Ventricular Assist Device (LVAD) Complications
Nick Stadlberger, MD
M Anderson et. al. J Heart Lung Transplant, 2009 PMID 19560703

Tips
- These patients MAY NOT HAVE A PULSE
  - May need ABG since pulse ox may be inaccurate without pulse
- Contact your hospital’s or network’s LVAD Coordinator immediately to help with management and troubleshooting.
- Patients are usually on diuretics, and may intravascularly depleted or have electrolyte abnormalities

LVAD Patient in Extremis: Step-Wise Diagnostic Approach

1st
- Address airway, breathing, circulation; Obtain IV, O2, monitor
- Measure blood pressure: May need manual cuff with Doppler to obtain mean arterial pressure (MAP), or use arterial line (MAP goal 70-80 mmHg)
- Assign someone to call LVAD Coordinator

2nd
- Auscultate precordium. Is there a hum?
  - Yes → LVAD is working. No → LVAD is not working.
- Battery – Make sure it is plugged in.
- Controller – Check for alarms.
- Driveline – Check device type, evidence of infection/damage
- Echocardiogram

3rd
- Obtain VAD variables: Flow, Power, Speed, Pulsatility Index

4th
- Obtain ECG
- Obtain labs (CBC, electrolytes, coagulation studies, LDH, type and screen given GI bleed risk, ± blood cultures for infection concern, ± ABG)

Echocardiogram Findings | Potential Causes | Management (with LVAD team)
--- | --- | ---
Big RV + Big LV | Pump failure, Pump thrombosis Valve disorders | Heparin, antiplatelet agents, thrombolytics
Big RV + Small LV | Right heart failure, ST-elevation MI Pulmonary hypertension Note: If LV to outflow cannula size ratio is 1:1, then high risk for suction event | IV fluids, ECG, consider inotropes
Small RV + Small LV | Hypovolemia Sepsis GI bleed | IV fluids, consider blood transfusion, antibiotics
<table>
<thead>
<tr>
<th>LVAD Complication</th>
<th>Comment</th>
<th>Management (with LVAD team)</th>
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</thead>
<tbody>
<tr>
<td>Arrhythmia</td>
<td>Up to 50% with sustained VT/VF in first 4 weeks after LVAD placement</td>
<td>Depending on the cause:</td>
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<td>Difficult to determine primary vs. secondary cause:</td>
<td>• IV fluid challenge is reasonable</td>
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<td>• <strong>Primary</strong>: compromised myocardium + scar tissue</td>
<td>• Reduce pump speed</td>
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<td></td>
<td><strong>Secondary</strong>: electrolyte abnormalities, hypotension, suction events</td>
<td>• Correct electrolytes</td>
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<td>• Electrical or pharmacologic (amiodarone) cardioversion</td>
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<td>Infection</td>
<td>Up to 42% experience sepsis within 1 year (REMATCH Study). Most infections are in first 3 months. 9% are fungal.</td>
<td>Broad spectrum antibiotics + antifungal</td>
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<td>Thrombus</td>
<td>High risk despite anticoagulation. Pump thrombus suggested by warm device and increased power output. Elevated LDH</td>
<td>Heparin, thrombolitics, antiplatelet agents</td>
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<td>(pump thrombus, PE, stroke/TIA)</td>
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<td>Bleeding</td>
<td>Patients may have an acquired Von Willebrand Disease coagulopathy</td>
<td>If life-threatening, reverse anticoagulation and transfuse as needed.</td>
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<td>Suction Event (An underfilled LV causing suction of myocardium into LVAD)</td>
<td>Can be caused by right heart failure, hypovolemia, sepsis, restrictive cardiomyopathy, arrhythmias</td>
<td>IV fluids to increase LV filling</td>
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<td>RV Failure</td>
<td>Due to AMI or previous RV failure</td>
<td>IV fluids and consider inotropes. Aspirin and heparin if AMI</td>
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<td>Cannula Malposition</td>
<td>Consider in setting of new VT, suction event, chest compressions, or trauma</td>
<td>Requires surgical exploration</td>
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<td>Device Malfunction, Pump Failure</td>
<td>Suggested if no hum and MAP &lt;40 mmHg</td>
<td>Treat cardiogenic shock: IV fluids, vasopressors, ACLS protocols, consider heparin for thrombosis</td>
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<td>Cardiac Arrest</td>
<td>Multiple potential causes including all those listed above</td>
<td>ACLS algorithms except:</td>
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<td>• Chest compressions are controversial as they could dislodge the device.</td>
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<td>• Do NOT place defibrillation pads directly over device.</td>
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<td>• Assign one person to assess device placement during and after code.</td>
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</tbody>
</table>

AMI: acute myocardial infarction; GI: gastrointestinal; LV: left ventricle; MAP: mean arterial pressure; PE: pulmonary embolism; ROSC: return of spontaneous circulation; RV: right ventricle; TIA: transient ischemic attack; VT: ventricular tachycardia; VF: ventricular fibrillation
Altered LVAD Patient

No Perfusion
- Shock the arrhythmia
- Fluid bolus
- Epinephrine
- Heparin, possible lytics for thrombosis
- Check potassium
- Correct acidosis

LVAD Working
- (Check perfusion, cap refill, manual BP)

LVAD Not Working
- Replace Batteries
  - (Connect to wall unit or emergency power pack; check connections)

Shock
- Cardiac catheterization
- Heparin, pump replacement, possible lytics for thrombosis or PE
- Fluid for hypovolemic/suction event
- Check potassium
- Start vasopressors – consider dobutamine or milrinone for cardiogenic shock

Normal Perfusion
- Altered mental status workup

Auscultate the chest

LVAD Working: Check MAP and use "LVAD Working" algorithm above

LVAD still not working: Run like ACLS

Adapted from algorithm by Dr. Zach Shinar at EMCit.org

Updated 11/21/16