Ventricular Assist Device (VAD)
EMS Presentation

Left Ventricular Assist Device Coordinator
Iowa Heart- Des Moines, Iowa
Updated 2018
Mechanical Support

• ‘Assists’ the function of the ventricle in circulating oxygen-rich blood throughout the body.
• Patient still carries the diagnosis of heart failure.
• ‘Durable’ wear, ambulatory devices.
Indications for Use

- **Bridge to Transplant (BTT)**
  - Non-reversible left heart failure
  - Imminent risk of death
  - Candidate for cardiac transplantation

- **Destination Therapy (DT)**
  - NYHA Class IIIIB or IV heart failure
  - Optimal medical therapy 45 of last 60 days
  - Not candidate for cardiac transplantation

- **For in-patient and out-patient use**
  - May be transported via ground ambulance, fixed wing aircraft or helicopter
Advanced Heart Failure

• Targeted patients may be eligible for VAD if:
  – LVEF <35%
  – NYHA class III or IV
  – Frequent admission >1 in last 6 months for heart failure
  – Intolerance to ACEI/ARB/Beta blocker
  – On maximal medical therapy 45 of the last 60 days
  – CRT non-responders (pace maker)
  – Worsening renal function with diuresis.
  – Inotrope dependent (ex. Continuous Milrinone, Dobutamine)
Heart Mate II® VAD

LVAD pumps blood into the aorta (to the body)

Blood from the left ventricle enters the LVAD

LVAD
Cable connecting to control unit

Heart is shown in cross-section
Left Ventricular Assist Device (LVAD)

Heart Mate II

Heart Mate 3

Heart Ware
Patient Management
Blood Pressure

• May not have a palpable pulse

• Continuous flow may over ride the pulsatility therefore it may be difficult to palpate a pulse or obtain a blood pressure.
  – Doppler ultrasound and manual blood pressure cuff
  – Goal is a mean pressure between 70-85 mmHg
  – SpO2 reading may be inaccurate because of a weak or absent pulse.

• Strong palpable pulse means a systolic/diastolic pressure may be more accurate.
Patient Management
Circulation

• Listen to see if the pump is running. Should hear a whirling or hum.
• The pump is dependent on preload, need volume in the left ventricle
  – Administer fluids or vasopressors as appropriate
• The pump is afterload sensitive. Hypertension can cause decrease blood flow with similar symptoms of hypotension
• Evaluate mental status and skin
Emergencies

• In the occurrence that the patient becomes unresponsive, **DO NOT** perform chest compressions as this may dislodge the device.

• All other measures to resuscitate the patient (medications and airway) should be performed (check code status).

• Most patients have a pacer/ICD. If shock advised and current ICD is not shocking the patient, external defibrillation can be performed **without** disconnecting the VAD.
Alarms/troubleshooting

• If the device has alarms that an VAD trained person can not troubleshoot, call the VAD coordinator.
• Check back up equipment bag for 24/7 emergency VAD phone number and alarm guide.
• Each implanting center will have a VAD Coordinator on call 24/7.
Advisory & Hazard Alarms

**Visual**
- **Red** – Stop, Fix it right now
- **Yellow** – slow down, has to be fixed but not emergent
- **Green** – Good, GO

**Audible**
- **Constant** – Stop, Fix it right now
- **Intermittent** – Slow Down, has to be fixed but not emergent
- **Quiet** – Good, GO
Transportation

• Patient should be transported to their implanting center (typically found on their emergency equipment bag)
• If patient is unstable, they should be transported to nearest VAD implanting center.
Patient Equipment

- Patient must have **back up** equipment with them at all times!
- The VAD patient and a primary caregiver, are trained to troubleshoot the equipment.

* Typical carry case holding extra equipment.*
Common Complications

- Bleeding
- Stroke
- Infection
- RV failure
- Suction events/arrhythmia
Bleeding (syncope)

• Nasal and GI bleeding is common
  – Continuous flow pump.
  – Arteriovenous malformations may develop

• Pump is pre load dependent
  – Need volume in the LV to work adequately
  – Common to give fluid bolus while in the field
Stroke

- Suspected stroke patients can only have a CT. **NO MRI**.
- Coumadin and Aspirin
- Heparin ok.
- INR goal 2.5-3.5
- TPA is typically not administered due to risk of clotting the pump.
Infection Risk

• Drive line wire exits the right (most likely) or left side of the abdomen.
• Sterile dressing change done by caregiver.
• Be aware of line when cutting clothes.
• Keep from pulling, bending or kinking.
RV Failure

- Most VAD’s support the LV only. Over time the RV can fail in some patients.
- Heart Ware device can support either side or both if listed for a heart transplant.
Suction Events/Arrhythmia

- Suction events occurs when inflow cannula contacts ventricular wall causing ectopic beats.
- Evaluate for dehydration, volume loss or arrhythmia.
- Most patients will have an implanted cardiac defibrillator (ICD).
- If external defibrillation needed, place pads anterior/posterior.
- Provide ACLS per algorithm without chest compressions.
Heart Mate II® VAD
Heart Mate II® VAD

- Heart Pump (inside body)
- Battery
- Power Cord
- Pocket Controller
- Driveline, exits the body here
- Battery
- Power Cord

Thoratec®
There are many similarities between HeartMate II and HeartMate 3

Both Systems:

- Surgically implanted, rotary continuous-flow system that works in parallel with the native left ventricle
- HM 3 provides pulsatility to assist in preventing stasis in the pump.
- HM 3 has a modular driveline connection

CAUTION – Investigational device. Limited by US Federal law to investigational ClinicalTrials.gov Identifier: NCT02224755
Pocket System Controller
Alarm Indicators

- Black Power Lead Symbol
- White Power Lead Symbol
- Battery Advisory Symbol
- Battery Hazard Symbol
- Red Heart Hazard Symbol
- Yellow Wrench Advisory Symbol
- Driveline Symbol
The system controller will alarm if it detects an issue in the operation of the pump, if the patient is experiencing alarms, contact the Implant Center for LVAS-specific emergency instructions.
HeartMate II Power Sources

The HeartMate II system includes two sources of power

Power Module or MPU

• AC power from the Power Module provides unlimited tethered power.

Batteries

• DC power from 14-volt lithium-ion rechargeable batteries.
• When fully charged, a pair of HeartMate 14 Volt batteries can power the system for 10–15 hours.
Universal Battery Charger

• Charges 4 Lithium Ion batteries in 4 hours or less

• Pocket lights indicate battery charge status
  – **Green** = 100% charged
  – **Yellow** = Charging
  – **Red** = Battery defective, improperly inserted

• Performs diagnostic testing
  – Most accurate percent of battery charge level
  – Monitors use cycles of each battery
  – Monitors need for calibration and calibrates individual HeartMate batteries
  – Yellow blinking pocket light
HeartWare® System
HeartWare® System

- Small pump attaches directly to heart
- Thin, flexible driveline cable exits skin
- Lightweight, portable controller & batteries (less than 3 lbs)
HeartWare® Controller Display Overview

The HeartWare Controller displays pump parameters, alarms, and recommended troubleshooting.
One power source indicator (labeled “1” or “2”) will light up based on which port is providing primary power (e.g. “1” in this case).

Two battery indicators:

<table>
<thead>
<tr>
<th>Battery Capacity</th>
<th>Battery Indicator</th>
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</thead>
<tbody>
<tr>
<td>75-100%</td>
<td>4 GREEN lights</td>
</tr>
<tr>
<td>50-74%</td>
<td>3 GREEN lights</td>
</tr>
<tr>
<td>25-49%</td>
<td>2 YELLOW lights</td>
</tr>
<tr>
<td>&lt;24%</td>
<td>1 RED light</td>
</tr>
</tbody>
</table>

AC/DC symbol turns green when connected to an AC or DC adapter.
The AC/DC adapter will always be the primary source of power if connected.
Each battery can provide 4 to 6 hours of support.
Understanding Alarms

- Alarms tell you about the pump, controller, connections, or the power supply
- Alarm conditions are classified as high, medium or low
- When an alarm occurs, two lines of words appear in the controller display

1\textsuperscript{st} line tells you what the alarm is
2\textsuperscript{nd} line tells you what to do
HeartWare® Battery

- Each battery can provide 4 to 6 hours of support
- Pressing the Test Button will light the Battery Capacity Display

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- When one battery is depleted to <25%, the controller will automatically switch to the other battery
Key Knowledge for VAD

- Risks (bleed, infection, stroke, RV failure, suction events/arrhythmia)
- Anticoagulated
- CPR/ACLS/Defibrillation
- BP monitoring (mean pressure)
- No MRI, CT ok
- Back up equipment/caregiver
- Emergency help- Contact patients implanting center
  - Ask for VAD Coordinator on call