LVAD Patient Care At the Local Level
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Laura Blue is a consultant for Thoratec Corporation

Laura Blue is a consultant for HeartWare, Inc.
Objectives

- The learner will identify components of two VAD types
- The learner will describe the overall function of two VAD types
- The learner will identify two types of VAD alarms that can occur
- The learner will identify methods to troubleshoot alarms in the VAD patient
Mechanical Cardiac Support (MCS)

- Thoratec PVAD
- Heartmate II
- Impella 2.5
- CentriMag
- HeartWare

Source: Thoratec, Abiomed and Heartware
HeartMate II LVAD: A Continuous Flow Pump

Source: Thoratec
Heartmate II Pump Operation

- Operates in a fixed speed mode
- Preload dependent & afterload sensitive
- Automatic speed reduction is incorporated to prevent over emptying of the left ventricle
- Normal VAD Parameters:
  - Flow: 4-8LPM (calculated from flow and power)
  - Power: varies with speed, ~ 6.0-8.5 watts
  - Speed: 8,000-10,000 rpms
  - Pulsatility Index (PI): 2-6
Common HeartMate Peripherals

- Power Module
- Batteries & clips
- Battery charger
- Display Module
- System controller

Source: Thoratec
HVAD™ Pump

- Centrifugal pump
- One moving part
- Short integrated inflow cannula
- 10mm Outflow Graft
- Dual motor stators
- Thin, flexible driveline
- Sewing Ring

Source: Heartware
HeartWare® System Components

- HVAD™ Pump
- HeartWare™ Controller
- HeartWare™ Monitor
- HeartWare™ Batteries & Battery Charger
- HeartWare™ Controller AC Adapter
- HeartWare™ Controller DC Adapter

Source: Heartware
Pericardial Placement

Source: Heartware
HVAD® Pump Operating Guidelines

- Operates in a fixed speed mode
- Preload dependent & afterload sensitive
- Normal VAD Parameters:
  - Speed: 2400-3200 RPM
  - Flow: 4-8LPM
  - Flow Trough >2L/min
  - Flow Pulsatility 2 to 4 L/min
  - Power: 3-7 watts
- No automatic speed reduction is incorporated to prevent over emptying of the left ventricle. Suction detection triggered from flow trough requires manual speed reduction.
Why is the VAD alarming?

- Improper connections
- Low Flow
- High Power
How to treat alarms....

Assess patient!

STABLE-TRIAGE ALARM  |  UNSTABLE-ACLS

Check connections (SIMULTANEOUS TO ABOVE)

Percutaneous lead to controller  |  Controller to wall power or batteries

Attach to clinical screen for interrogation!

Low flow  |  High power (Centrifugal)
Alarm Conditions:

- Suction  CALL
- Low Flow  CALL
- High Watts  CALL

Pump or Patient?
What’s the Right Call?
## Troubleshooting Low Flow Alarms

<table>
<thead>
<tr>
<th>Patient Issues</th>
<th>Pump Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diuresis</td>
<td>Speed set too low or</td>
</tr>
<tr>
<td></td>
<td>too high</td>
</tr>
<tr>
<td>Bleeding</td>
<td>Obstruction</td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
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<tr>
<td>Arrhythmia</td>
<td></td>
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<tr>
<td>RV Failure</td>
<td></td>
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<tr>
<td>Wean of Inotropes</td>
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</tbody>
</table>
## Troubleshooting Suction Alarms

<table>
<thead>
<tr>
<th>Patient Issue</th>
<th>Pump Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced preload</td>
<td>Pump speed too high</td>
</tr>
<tr>
<td>Circadian rhythms</td>
<td>Pump inflow alignment</td>
</tr>
<tr>
<td></td>
<td>Sensitivity of calculation</td>
</tr>
<tr>
<td></td>
<td>when flow trough &lt; 2</td>
</tr>
<tr>
<td></td>
<td>Viscosity setting</td>
</tr>
</tbody>
</table>
**Troubleshooting High Watts Alarms**

<table>
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<th>Patient Issue</th>
<th>Pump Issue</th>
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<tr>
<td>Fluid overload</td>
<td>Alarm settings inappropriate</td>
</tr>
<tr>
<td>Aortic insufficiency</td>
<td>Electrical fault</td>
</tr>
<tr>
<td>Dehydration</td>
<td>Ingestion/Thrombus (clot or tissue)</td>
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</tbody>
</table>
YOUR LOCAL VAD TEAM: PRICELESS
WE’LL BE WAITING FOR YOUR CALL!