Mechanical Circulatory Support Program:
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Mechanical Circulatory Support Senior Consultant
First A Few Questions
Have you ever meet a person with Ventricular Assist Device (VAD)?

- A: Yes
- B: No
Have you ever looked after a VAD Patient?

- A: Yes, directly (eg: bedside nurse)
- B: Yes, indirectly (eg: X-ray tech, pharmacist, etc)
- C: No
What is a Ventricular Assist Device?

A **Ventricular Assist Device (VAD)** is a *mechanical circulatory device* that is used:

- **A**: Partially replace the function of a failing heart (Left Side Support Only)
- **B**: Partially replace the function of a failing heart (Right Side Support Only)
- **C**: Completely replace the function of a failing heart (Right and Left Side Support)
- **D**: All of the above
A Ventricular Assist Device (VAD) is a mechanical circulatory device that is used:

- A: Partially replace the function of a failing heart (Left Side Support Only)
- B: Partially replace the function of a failing heart (Right Side Support Only)
- C: Completely replace the function of a failing heart (Right and Left Side Support)
- D: All of the above

VAD is one form of treatment options for the management of Heart Failure.
Heart Failure

- Heart Failure is a progressive condition where the heart weakens and results in decreased blood flow (cardiac output) for adequate delivery of oxygen and nutrients to the body.

- Heart Failure can result from any **structural** or **functional** cardiac disorder that impairs the ability of the ventricle to fill with (diastolic dysfunction) or eject blood (systolic dysfunction).

- Acute versus Chronic
Number of VAD Consults
Adult & Pediatric Patients
Fiscal Year: 2010 – March 9, 2017
Out-Patients Living with Long-term VAD Therapy
Fiscal Year: 2005 – March 9, 2017
Devices: BH, Thoratec PVAD, HM, HVAD

![Number of Out-Patients](chart.png)
Home Communities of Our Patients
Let's Begin!
Assignment

You have shown interest in shadowing the Ventricular Assist Device Team. You have spoken to your manager and she has made arrangements for you to shadow the team.

Your learning objectives are:

- MCS TEAM
- Follow a VAD patient’s journey
- VAD Classification and Indication
- Name One Short Term Device
- Name on Long Term Device
- Complications of VAD Therapy
- Understand Discharge Process

Off you go to the VAD office
WHO ARE THESE PEOPLE?
MCS Team

MCS Occupational Therapist: Whitney
MCS Therapy Assistant: Kim

Perfusionist: Meyy

VAD Coordinator: Nicole
ECMO Coordinator: Brittany
MCS Social Worker: Laura
MCS Manager: Osiris
Transplant/MCS Fellow: Dr. Wang

Patient Care Managers: Cate, Sherry, Stacy, Janette, Cindy
OR Manager: Michele

Administrative Assistant: Lanna

MCS Dietician: Sabrina
MCS Physio Therapist: Natalie
Page to CCU
Patient: Mr. X

- A 49 year old male who presented to a local Emergency last evening. He had a 12 hour history of chest pain and was diagnosed with an anterior wall STEMI (late presentation).
- He was taken emergently to the Cath lab and required stenting of both the proximal LAD and circumflex coronary artery.
- He was then transferred to the Mazankowski CCU.
- Is has been about 8 hours since admitted to CCU and he is deteriorating quickly. He currently is intubated and on maximal inotropic support and in Cardiogenic Shock. Neurological status is unknown.
Upon admission his initial bloodwork was the following:

- ALT 73, AST 205, Bili 15, Crt 129, GFR 55, CK 3233, Glucose 7, Lactate 1.5

Current Blood Work is the following:

- ALT 131, AST 580, Bili 17, Crt 212, GFR 30, CK 6960, Glucose 11.8
<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
<th>Ref. Range (Units)</th>
<th>Abnormality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen Type</td>
<td>Arterial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FiO2</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH, Arterial</td>
<td>*7.25</td>
<td>7.35-7.45</td>
<td>Low</td>
</tr>
<tr>
<td>pCO2, Arterial</td>
<td>42</td>
<td>(mm Hg)</td>
<td></td>
</tr>
<tr>
<td>pO2, Arterial</td>
<td>54</td>
<td>(mm Hg)</td>
<td></td>
</tr>
<tr>
<td>O2 Saturation (meas.)</td>
<td>79.1</td>
<td>(%) (Measured)</td>
<td></td>
</tr>
<tr>
<td>Base Excess Negative</td>
<td>-8</td>
<td>(mmol/L)</td>
<td></td>
</tr>
<tr>
<td>HC03-(calc.)</td>
<td>17.7</td>
<td>(mmol/L)</td>
<td></td>
</tr>
<tr>
<td>HGB</td>
<td>140</td>
<td>136-175 (g/L)</td>
<td></td>
</tr>
<tr>
<td>Hematocrit (calc.)</td>
<td>0.43</td>
<td>0.41-0.52 (L/L)</td>
<td></td>
</tr>
<tr>
<td>Oxyhemoglobin</td>
<td>78.5</td>
<td>(%)</td>
<td></td>
</tr>
<tr>
<td>Carboxyhemoglobin</td>
<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methemoglobin</td>
<td>0.4</td>
<td>0-1.5 (%)</td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td>133</td>
<td>133-146 (mmol/L)</td>
<td>Low Critical</td>
</tr>
<tr>
<td>Potassium</td>
<td>*2.9</td>
<td>3.3-4.8 (mmol/L)</td>
<td>Low</td>
</tr>
<tr>
<td>Chloride</td>
<td>106</td>
<td>96-107 (mmol/L)</td>
<td></td>
</tr>
<tr>
<td>Ionized Calcium</td>
<td>1.07</td>
<td>(mmol/L)</td>
<td></td>
</tr>
<tr>
<td>Ionized Calcium (pH adjusted)</td>
<td>*0.99</td>
<td>1.09-1.25 (mmol/L)</td>
<td>Low</td>
</tr>
<tr>
<td>Anion Gap</td>
<td>10</td>
<td>4-16 (mmol/L)</td>
<td></td>
</tr>
<tr>
<td>Glucose, random</td>
<td>*12.5</td>
<td>3.3-11.0 (mmol/L)</td>
<td>High</td>
</tr>
<tr>
<td>Lactate</td>
<td>*3.3</td>
<td>0.5-2.2 (mmol/L)</td>
<td>High</td>
</tr>
</tbody>
</table>
Patient: Mr. X

ECHO

- Severe global hypokinesis of Left ventricle with apical and anterior wall akinesia
- LVEF 15%

Social History:

- Married and has a child. Works part time as a Nursing Attendant in a long term care facility. No known history of Alcohol or smoking.
What kind of Mechanical Circulatory Support Device does the patient need?
**VAD Classification/Indication**

- **Bridge to Decision** (short term support)
- **Bridge to Transplant/Candidacy** (mid-term to long term support)
- **Destination Therapy** (long-term support)
Indication For Use:

- Bridge to Decision (Short Term Support)
- A rescue device intended for short term use to support one or both sides of the heart to treat patients in acute cardiogenic shock (crashing & burning), as a bridge to decision when it is unclear whether the patient’s heart will recover or whether the patient will need (or be a candidate for) additional, alternative, longer-term therapies (ie - long term VAD or heart transplant).
Indication for Use

- **Bridge to Transplant/Candidacy (mid to long term support)**
  - Non-reversible left heart failure
  - Imminent risk of death
  - Candidate for cardiac transplantation

- **Destination Therapy (long term support)**
  - Currently not a candidate for cardiac transplantation, or
  - The patient has chosen to decline the option of transplantation and will continue with VAD therapy.
    - Patient will live with device until time of death.
What kind of Mechanical Circulatory Support Device does the patient need?

- A: Bridge to Decision
- B: Bridge to Transplant/Candidacy
- C: Destination Therapy
- D: Palliative
What kind of Mechanical Circulatory Support Device does the patient need?

- A: Bridge to Decision
- B: Bridge to Transplant/Candidacy
- C: Destination Therapy
- D: Palliative
## Table 4: INTERMACS Profiles

<table>
<thead>
<tr>
<th>Profiles</th>
<th>Brief Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERMACS 1</td>
<td>Critical cardiogenic shock (Crash and burn)</td>
<td>Life-threatening hypotension despite rapidly escalating inotropic support.</td>
</tr>
<tr>
<td>INTERMACS 2</td>
<td>Progressive decline (Sliding fast on inotropes)</td>
<td>Declining function despite intravenous inotropic support.</td>
</tr>
<tr>
<td>INTERMACS 3</td>
<td>Stable but inotrope dependent (Dependent stability)</td>
<td>Stable on continuous intravenous inotropic support.</td>
</tr>
<tr>
<td>INTERMACS 4</td>
<td>Resting symptoms on oral therapy at home</td>
<td>Patient experiences daily symptoms of congestion at rest or during activities of daily living.</td>
</tr>
<tr>
<td>INTERMACS 5</td>
<td>Exertion intolerant</td>
<td>Patient is comfortable at rest and with activities of daily living but unable to engage in any other activity.</td>
</tr>
<tr>
<td>INTERMACS 6</td>
<td>Exertion limited (Walking wounded)</td>
<td>Patient has fatigue after the first few minutes of any meaningful activity.</td>
</tr>
<tr>
<td>INTERMACS 7</td>
<td>Advanced NYHA class III (Placeholder)</td>
<td>Patients living comfortably with meaningful activity limited to mild physical exertion.</td>
</tr>
</tbody>
</table>

**INTERMACS**: Interagency Registry for Mechanically Assisted Circulatory Support; NYHA – New York Heart Association. Adapted from: Stevenson LW, et al.\(^{26}\)
What INTERMACS Status is Mr. X?

- A: INTERMACS Status 1
- B: INTERMACS Status 2
- C: INTERMACS Status 3
What INTERMACS Status is Mr. X?

- A: INTERMACS Status 1
- B: INTERMACS Status 2
- C: INTERMACS Status 3
Current VAD Devices in Use:

- **Berlin Heart**
  - Start Date: 2006

- **Centrimag**
  - Start Date: 2009

- **HeartMate**
  - Start Date: 2009

- **HeartWare**
  - Start Date: 2011
Isolated LVAD
**CentriMag**

**Right Sided Support Inflow:** Right Atrium (RA)

**Right Sided Support Outflow:** Pulmonary Artery (PA)

**Left Sided Support Inflow:** Left Atrium (LA)

**Left Sided Support Outflow:** Aorta

**Right Side:** Blood moves from the RA to the CentriMag Blood Pump then back into the PA then to the lungs

**Left Side:** Blood moves from the LA or LV to the CentriMag Blood Pump then back into the Aorta then to the rest of the body

Left Sided Support Inflow can also be Left Ventricle (LV) (not pictured)
Ideal “Bridge to Decision” Device

- Easily implanted & transportable
- Provide complete circulatory support (LVAD, RVAD or BiVAD if necessary)
- Easily managed in CVICU
- Durable
- Cost efficient & readily available
Patient Taken to OR
Patient: Mr. X

- Pt came out of the OR-severe coagulopathy and bleeding.
- Had to be taken back to OR for a washout.
- Remained intubated as he failed extubation x 2, decision made to Trach Pt.
- Prisma
- GI Bleed-AVMs
- Sternal Infection-Surgical Debridment
- Neurologically-Improving-Intermittent Delirium/Confusion

Social Work Update:
Patient: Mr. X

- C.Diff
- Neurologically-Recovered
- Kidneys-Recovered
- Trached-Tolerating Plugged
- Heart-Unable to wean Centrimag

- Team Decision needs to be made
Cardiogenic shock
- Shock Team Activation: Cardiology, CV Surgery, CV Intensive Care specialists

Inotropes/vasopressors

Myocardial Infarction
- Reparfusion

Acute myocarditis
- Supportive therapy

Acute decompensated chronic HF
- Diuresis
- Afterload reduction

Refractory Cardiogenic Shock

Short-term MCS devices
- Bridge to recovery
- Bridge to decision

Short-term MCS devices
- Bridge to recovery
- Bridge to decision

Durable VADs
- Bridge to transplant
- Destination therapy
- Bridge to recovery

Unable to wean MCS

Multidisciplinary Team Meeting

Durable VADs
- Bridge to transplant
- Destination therapy
- Bridge to recovery

Palliative care
What kind of Mechanical Circulatory Support Device does the patient need?

- A: Bridge to Decision
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What kind of Mechanical Circulatory Support Device does the patient need?

- A: Bridge to Decision
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Two Long Term Devices

- HeartWare
- HeartMate II
HeartWare VAD Classification:

Type of Indication:
- Bridge to Transplant/Candidacy
- Destination Therapy

Support Type:
- LVAD, RVAD, or BiVAD

Pump Type:
- Continuous Flow (non-pulsatile flow)
  - Centrifugal Flow Pump
Risks of VAD Therapy

- Thromboembolic Events:
  - Stroke & Cerebral Bleeds
  - Ischemic Gut
  - Pump Thrombus

- Infection
  - Driveline infection
  - Pump Pocket infection

- Bleeding
  - GI bleeding
  - Epistaxis

- Aortic Regurgitation & Insufficiency

- Psychosocial & Body Image issues

- Right heart failure post LVAD Implant

- Syncope

- Device failure
  - Controller Failure
  - Driveline fracture
  - Pump Failure
Finally Made It to Discharge!

You start wondering........How many hours does it take to train a VAD Patient and their Family?

A: Greater than 30hrs
B: 10 hours
C: No Training is required
D: 15-20hrs
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A: Greater than 30hrs
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Patient Education

Learning Self-care After Left Ventricular Assist Device Implantation

Naoko Kato, Tiny Jaarsma, Tuvia Ben Gal
Clinical Follow-up

- Clinical Follow Up
  - Physical and Nutritional Follow Up
  - VAD Assessment
- Weekly Blood work
- Jim Pattison 2x week
- Chest Xray, Echos every 6 months
<table>
<thead>
<tr>
<th>Medication</th>
<th>Dosage</th>
<th>Directions</th>
<th>Medication Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warfarin (Coumadin) anticoagulant</td>
<td>Daily dosage</td>
<td>Take ONCE daily as directed by VAD team</td>
<td>AM 6:00</td>
</tr>
<tr>
<td>Carvedilol (Coreg) betablocker</td>
<td>25 mg</td>
<td>Take 25 mg TWICE daily</td>
<td>Noon 8:00</td>
</tr>
<tr>
<td>Spironolactone (Aldactone) diuretic, slows progression of heart failure</td>
<td>25 mg</td>
<td>Take 25 mg ONCE daily</td>
<td>PM 8:00</td>
</tr>
<tr>
<td>Magnesium glucoheptonate (Mag Rougier)</td>
<td>1500 mg (15 mL)</td>
<td>Take 1500 mg ONCE daily</td>
<td>Bed 6:00</td>
</tr>
<tr>
<td>Atorvastatin (Lipitor) lowers cholesterol</td>
<td>80 mg</td>
<td>Take 80 mg ONCE daily</td>
<td></td>
</tr>
<tr>
<td>Pantoprazole (Tecta) prevent ulcers</td>
<td>40 mg</td>
<td>Take 40 mg ONCE daily</td>
<td></td>
</tr>
<tr>
<td>levothyroxine (Synthroid) for thyroid</td>
<td>150 mcg</td>
<td>Take 150 mcg ONCE daily</td>
<td></td>
</tr>
<tr>
<td>vitamin D</td>
<td>1000 units</td>
<td>Take 1000 units ONCE daily</td>
<td></td>
</tr>
<tr>
<td>multivitamin</td>
<td>1 tab</td>
<td>Take 1 tablet ONCE daily</td>
<td></td>
</tr>
<tr>
<td>vitamin K to stabilize INR and warfarin dose.</td>
<td>100 mcg</td>
<td>Take 100 mcg ONCE daily</td>
<td></td>
</tr>
</tbody>
</table>
Good Bye to Mr. X
Thank-You for Joining our VAD Team

Question ?