LVAD PATIENT RECEIVING DIALYSIS IN THE OUTPATIENT SETTING

ANNA MEETING
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LEFT VENTRICULAR ASSIST DEVICE (LVAD)

- An established therapy for advanced heart failure
- Shortage of cardiac donors; “fixed” # of heart transplants ~2400/yr in US
  - By contrast, kidney transplants approaching 20,000!
- Initially used as a “bridge” therapy to heart transplant
- Now shown to improve mortality as a “destination” therapy
- Kidney dysfunction NOT a contraindication to LVAD placement; kidney function USUALLY improves after LVAD placement

LVAD DEVICES

- Continuous Flow
  - Current standard
  - Placed within the pericardium
  - Makes PD possible
  - Smaller size, fewer infections, improved survival
- Pulsatile Flow
  - 1st generation of LVADs
  - Implanted in peritoneal cavity/abdominal wall
  - PD contraindicated

LVAD THERAPY INDICATIONS

- Advanced heart failure (class III/IV)
- Advancing cardiac dysfunction despite optimal medical therapy
- Cardiac index less than 2
- SBP below 80
- Signs/symptoms of left ventricular dysfunction

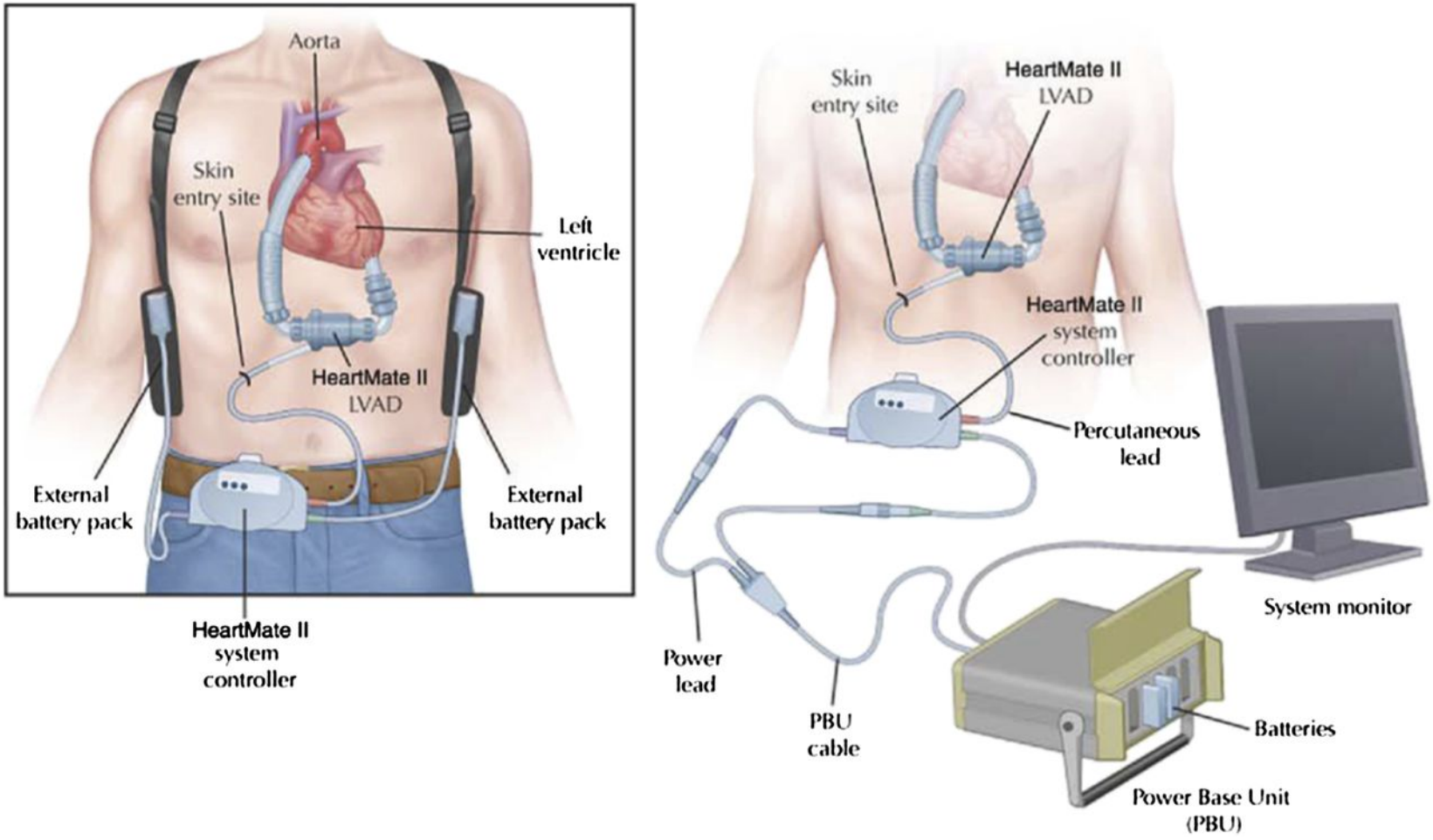
CHRONIC DIALYSIS POST LVAD

- ~3-5% chance of long term ESRD
- Associated w HIGH mortality
- Cautious approach
- Ultrafiltration related complications
- Lack of pulsatile flow = unreliable BP readings with conventional instrumentation
- Extended hospital stays due to lack of comfort level in outpatient dialysis settings

LVAD: HEART MATE II

- Current most commonly used system
- Continuous Flow
- Blood pump, percutaneous lead, external power source, & system driver
  - Percutaneous lead = “drive” line **infection risk
- Blood pump 124 mL
- Inflow: Left Ventricle
- Outflow: Ascending Aorta

HeartMate II Apparatus.



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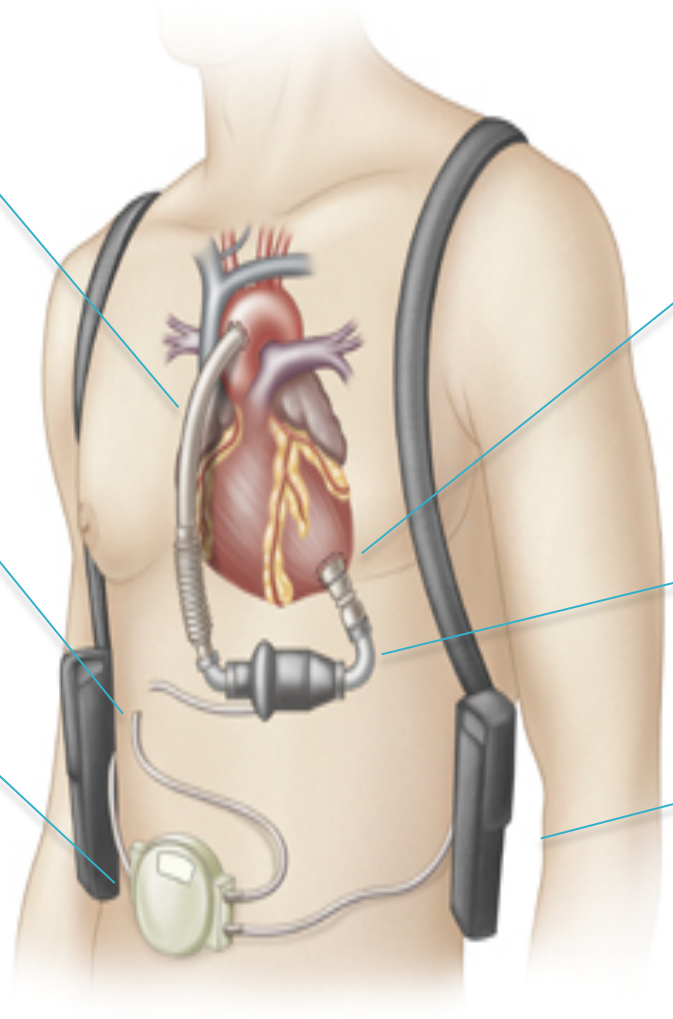
Potential Device Complications



Outflow graft (kink , leak)

Drive line infection / fracture

Controller malfunction

Inflow cannula (poor position, obstruction)

Pump/rotor dysfunction (thrombus)

Battery dysfunction

LVAD: NEXT GENERATION

- Heartware VAD (HVAD)
- Continuous Flow
- Centrifugal as opposed to axial design
- Implanted directly into pericardial cavity
- Improved Pump flow at lower pump speeds due inherent improvements in design

COMPLICATIONS OF LVAD

- 3% rate of chronic RRT
- Thrombosis
  - Need for chronic anticoagulation
  - INR 1.5 – 2.5
- Bleeding
  - 30% of LVAD patients w GI bleed
- Hemolysis
  - Due to artificial pump
- Ventricular Arrhythmias
  - Most common in first 4 weeks after LVAD placement
  - AICD beneficial

Management Considerations

- Typically pulseless
  - Use a doppler or arterial line for BP assessment (Target MAP 60-80)
- Afterload sensitive
  - An increase against pump propulsion is reflected in decreased pump flow
- Preload sensitive
- Anticoagulation status
- Should not receive chest compressions during an arrest
- Patients still have heart failure

HEMODIALYSIS ACCESS

- Delayed maturation of AVF due to lack of pulsatile flow
- Increased infection risk
- AVOID TDCs
- AVG currently is recommended due to poor AVF maturation
- NO PULSE, NO THRILL, NO BRUIT
- USE DOPPLER

WHAT ABOUT THE BLOOD PRESSURE?

- Generally, standard automated cuffs are NOT feasible UNLESS patient has residual left ventricular function
- Automated cuffs LESS accurate in the setting of LVADs
- Use Doppler Ultrasound
- MAP 70-80 mm Hg, avoid over 90 mm Hg

CLINICAL PARAMETERS

- During HD, system driver connected to a display screen
- Pump Speed – set by LVAD team
  - Typically 8,000 – 10,000 rpm
  - Increasing pump speed enhances blood flow
  - Speeds too high can results in complications
- Pump Flow – derived from pump speed
  - Liters/min (approx 10 L/min)
  - Proportional to pump speed
  - Also dependent on Preload & Afterload – (can change with Ultrafiltration)
- Pulsatility Index (PI) – based on residual LV function AND preload – VERY USEFUL during dialysis
  - Maintain PI above 4 (usual range 1-10)

Basics of HM II

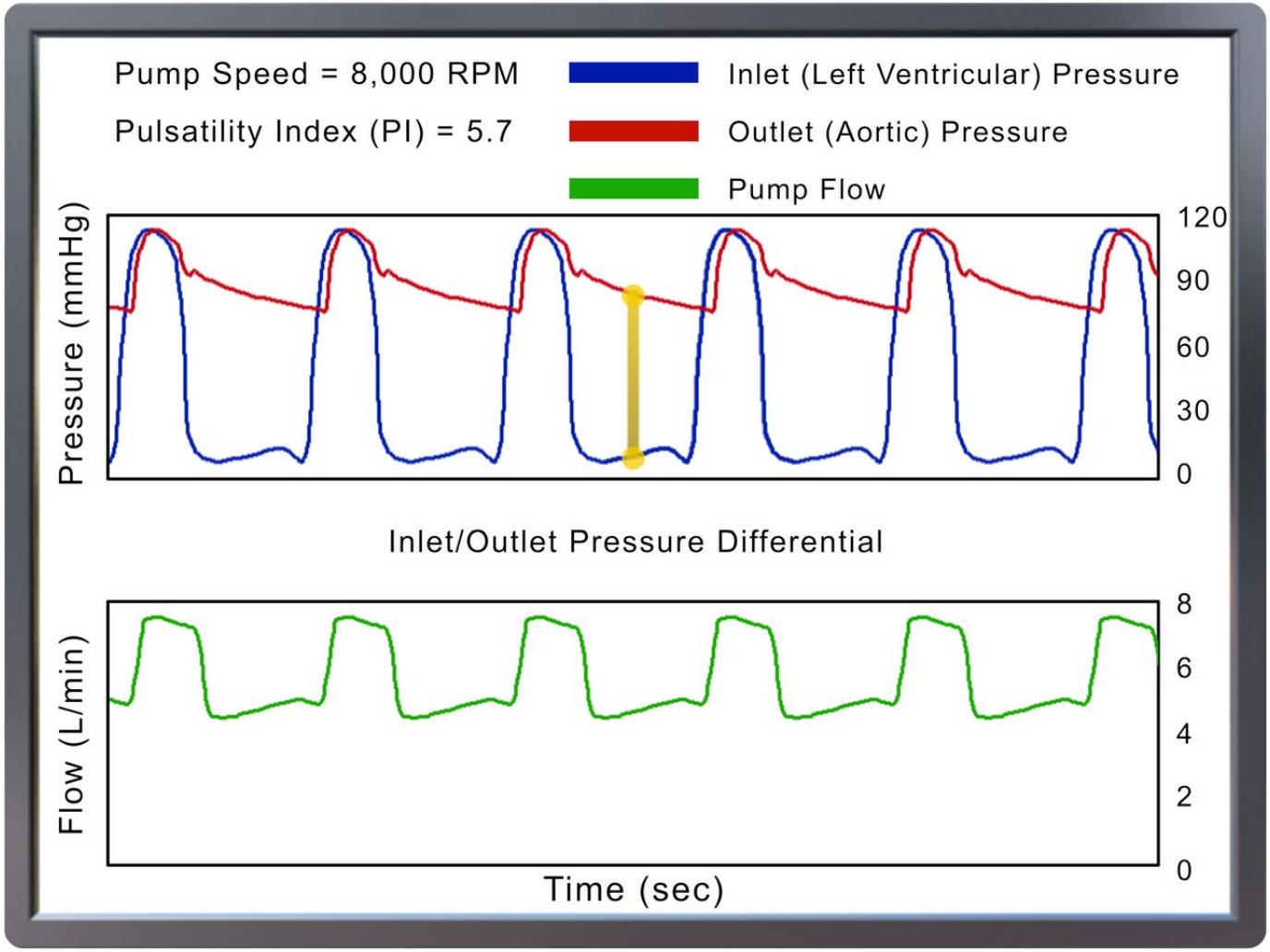
Pump Speed (RPM) – How quickly the pump rotates

Pump Power (Watts) – Measure of motor voltage and current

Pump Flow (L/min) – Estimated value of the volume running through the pump

Pulsitility Index – The measure of the left ventricular pressure

Relationship between LVAD flow and pressure.



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"AUDIBLES"

- Possible changes in LVAD parameters during hemodialysis
- Uncontrolled hypertension:↑ Afterload ➔ ↓ PI and ↓pump flow
- Excessive volume removal:↓ Preload ➔ ↓ PI and ↓ pump flow
- Trendelenburg position or saline infusion:↑ Preload ➔ ↑ PI and ↑ pump flow

HEMODIALYSIS – Safety analysis of intermittent hemodialysis in patients with continuous flow left ventricular assist devices.

(Quader, et al, Hemodial Int, 2014)

- June 2009 – Oct 2012: 139 patients w LVAD
- 10 patients (~7%) required intermittent HD postop
- Mean age: 53 +/- 14; 90% men
- 281 dialysis sessions, 1025 hours (3.6 hrs/ session)
- BP by Doppler: mean SBP 97 +/- 18 mm Hg
- Mean UF per session: 2.6 L
- 15 sessions interrupted/terminated (5.3%)

PERITONEAL DIALYSIS

- Not possible with first generations LVADs due to location
- Case reports of successful PD with Heart Mate II device
- Theoretical benefit of less hemodynamic flux and daily ultrafiltration
- NO studies comparing HD w PD in the LVAD population

SUMMARY

- Heart failure prevalence increasing
- Renal dysfunction common in this population
- Limited cardiac donors
- LVADs now being used for “final” therapy (as opposed to “bridge”
- Small but significant chance of requiring long term dialysis post LVAD placement
- Unique challenges in the outpatient dialysis setting
- Minimal literature to define “best” practices