LVAD in a Community Hospital
Are You Prepared?

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Objectives

- Describe the principles of destination LVAD in advanced heart failure
- Discuss emergency management of LVAD patient
- Outline a plan of care for hospitalized patient on LVAD
- Case studies will also be presented

What’s an LVAD?”

“What do I do with it?”

LVAD ~ Left Ventricular Assist Device

- A mechanical circulatory support (MCS) pump
  - Supports the damaged heart
  - Reestablished normal hemodynamics
  - Restores blood flow to vital organs
  - Used in decompensating advanced heart failure patients who fail to improve or stabilize with optimal medical therapy.

LVAD ~ Left Ventricular Assist Device

- The basic parts of a LVAD
  - Cannula in left ventricle and cannula in aorta
  - Drive line to pump (controller)
  - Power source - batteries or console

Indications for Use

- Bridge to Transplant (BTT)
  - Non-reversible left heart failure
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- Destination Therapy (DT)
  - NYHA Class III or IV heart failure
  - Optimal medical therapy 45 of last 60 days
  - Not candidate for heart transplantation
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**Assist Device History**

- 1953: Era of Cardiac Surgery begins. 1st CBP
- 1963: First Report of artificial ventricle by Liddle
- 1966: DeBakey 1st successful LVAD post cardiomyopathy shock wean and BTR
- 1969: Cooley 1st TAH as BTT post cardiomyopathy shock
- 1982: Jarvik 7 TAH for permanent support
- 1984: 1st successful LVAD for chronic heart failure
- 1992–1998: FDA approves several devices for bridge to transplant
- 2003: FDA approves Thoratec HeartMate XVE (pulsatile flow) for Destination therapy
- 2006: Interagency Registry of Mechanically Assisted Circulatory Support (INTERMACS) established
- 2010: FDA approves HeartMate II (continuous flow)
- 2010: HeartWare (continuous flow) preliminary results BTT

**Innovative Pump Designs**

- Improved clinical outcomes
- Altered the profile of mechanical circulation support
- Changed the structure of advanced heart failure programs
- With these new advances, new challenges and opportunities

**HF Epidemiology**

- Estimated 5.1 million Americans > 20 y/o have HF
- Projected to ↑ 46% by 2030 or > 8 million
- 825,000 new cases annually
- After 65 y/o: 10 cases per 1000
- 75% of HF cases have hypertension
- At 40 y/o lifetime risk for HF overall is 1 in 5

**HF Mortality**

- 1 in 9 death certificates have HF mentioned
- 50% of people diagnosed with HF will die within 5 years
- With receiving and adhering to high level GDMT can decrease to 35% 5 year death rate
Normal Heart Injury → Class I Stage A → Normal Heart

Class II Stage B

Neurohormones Change

Class II Stage C

EF 35-40% / QRS < 120 msec /

Treatment: BB, ACEI, ARB, Aldactone, Give drugs and devices to prevent early exit (death is usually from arrhythmias)

Class III Stage C

Heart is football shape, EF 30 - 35%, QRS < 130 msec, Treatment: Add ICD

Class IV Stage D

Heart is basketball shape, EF < 30%, QRS > 130 msec, Treatment: CRT + ICD, Death is usually electrical mechanical failure

Exit VAD Transplant

Advanced Heart Failure Epidemic in USA

• Estimate to include 100,000 – 250,000 patients with refractory New York Heart Association (NYHA) class III or IV symptoms

• Less than 2,300 hearts are available

• Hearts reserved for younger patients with fewer morbidities

• Average weight time for Status I patient for a heart is > 6 months

• Exposed to risks of infections, blood clots, pressure ulcers and exhaustion family members

HOUSTON WE HAVE A PROBLEM

• Age is the most common reason for ineligibility for Heart transplant

  • 75% of HF patients are over 65 y/o

  • Average age of hospitalized HF patients with low EF is 75 y/o

  • Thus, elderly are an evolving population for DT-LVAD (DT = Destination Therapy)

LVAD considerations

• Allow patients to return home to improved quality of life while waiting for transplant

• Waiting for end-organ failure or more subtle signs of debilitation is no longer acceptable

• Should be considered an elective procedure in a medically stable patient not a “bailout” for the patient in refractory low cardiac output heart failure

UNOS (United Network Organ System) Status Classification Waiting List

• Status 1A or urgent need: Requires intensive care hospitalization, life-support measures, certain cardiac supporting intravenous medications with a Swan-Ganz catheter, or mechanical-assist device(s)

• Status 1B: Dependent on intravenous medications or a mechanical-assist device – in the hospital or at home.

• Status 2: Stable on oral medications and able to wait at home.

• Status 7 or inactive list: Inactive due to a change in condition – patients do not lose time they have already accrued

Reference: Mebra, etc. Listing criteria for heart transplantation. J Heart Lung Transplant, 2006;25:1024-1042


Status 1A or urgent need: Requires intensive care hospitalization, life-support measures, certain cardiac supporting intravenous medications with a Swan-Ganz catheter, or mechanical-assist device(s)
Survival with LVAD

- Survival with HF listed as status II is similar to 2nd generation LVAD continuous flow pumps
- In 2009, only 14% of transplants occurred in status II patients
- LVAD may improve functional capacity and quality of life compared to optimal medical therapy


Continuous Flow versus pulsatile

- 2011: INTERMACS Registry
  - 1 year survival 87% continuous flow vs 67% pulsatile
  - 2 year survival 72% continuous flow vs 45% pulsatile

Back to Case Study #1

Admission Diagnosis

- Left thigh infected seroma with cellulitis at previous vein harvest site and previous hematoma site

Infection – I can handle that!

What’s an LVAD?”

“What do I do with it?”

LVAD Care in a Nutshell

- Is the patient talking to you?
  - This is GOOD!
- Did their caregiver come with them?
  - Use as a resource
- Call the LVAD center 800 number for advice
- Patient usually brings patient education manual with them – use it!
Caregivers and Patient

- Intensive Education
- Must master
  - Battery Changes
  - Driveline care
  - Device alarm troubleshooting

Caregiver

- The patient and caregiver will know more than we do as they live with this every day.
- It’s okay for them to continue the care of the LVAD
- They take a “rescue bag” with them everywhere
  - Use this to get the implant center and MDs phone numbers

Patient Assessment

- LVAD technology is advanced
- However, assessment techniques require a return to low-technology methods
- Assessments require basic nursing skills

Electrical System of the Heart

- Normally produces a mechanical response from the myocytes which causes contraction
- With LVAD electrical system less significant
  - Forward flow is maintained by pump not by mechanical response related to electrical activity
  - Pump operates irrespective of the electrical impulses
  - Arrhythmias that are typically lethal, may cause few or no symptoms in LVAD patient

Mechanical System

- Normally mechanical function of the heart produces forward flow of blood
  - This is measured as blood pressure and felt as a pulse
- When a patient has a dysfunctional ventricle, cardiac output is low and unable to sustain metabolic functions
- LVAD to failing heart restores forward flow
- LVAD either augments or takes over the function of the failing LV
Pulseless?

- LVAD is a continuous flow pump
- Blood moves in a constant flow pattern
- Constant flow does not produce a pulse
- Partial support may produce a diminished pulse
- Monitoring blood pressure and SpO2 is difficult

Assessment

“Back to the Basics”

- Good peripheral circulation
  - Warm and pink legs and fingers
- Brisk capillary refill (< 5 seconds)
- Appropriate mentation
  - Follows commands
  - Able to talk to you and carry on normal conversation
  - Does not fall asleep
- Adequate urine output


Blood Pressure

- LVAD produces blood flow during all phases of cardiac cycle
- No Systolic or Diastolic BP – it is a MAP
- Use doppler to get BP
- Target BP 70 – 90 mmHg

Pulse Oximetry

- May or may not be accurate due to little or no pulse
- Okay to monitor but in low saturation measurements, verify accuracy with ABGs

Vital Signs

- B/P: Take manually with doppler.
  - The pressure you hear is the MAP
  - MAP should be 70 - 80
  - MAP > 90, call
  - With automatic BP you may get a systolic & diastolic pressure with a very narrow pulse pressure
  - Pulse - - you may feel one radially, but it’s not accurate. Need to Dopple.
  - Telemetry – LVAD does not affect rhythm
  - Pulse ox – likely accurate

Arrhythmias

- Use urgency to evaluate the cause of the arrhythmia
- If hemodynamically stable
  - Assess and treat arrhythmia in less urgent manner
- If hemodynamically unstable
  - Assess and treat arrhythmia immediately
Patient Pump Assessment

- Auscultate left upper quadrant over pump pocket as part of every assessment:
  - It should sound like a boat motor
  - If it sounds like a soda can with gravel in it, it’s likely starting to clot.
  - What’s the PT/INR?

Insertion Site

- The insertion site needs to be kept dressed at all times.
- After healed, sterile dressing changes are generally every other day – do what patient has been instructed
- Most of the time, family member will want to do the dressing change. You can watch, but it’s fine for them to continue to do it.
- Assess site during dressing change. Notify MD if any concerns or signs of infection

Prevent infection

- Do everything you can to prevent infection!
- If the drive line gets infected, the patient will usually struggle with infection the rest of the time the LVAD is in.

Pump Assessment

Mechanics of LVAD

- LVAD is a machine
- Has no intuitive capabilities
- Programmed to run at certain speed
- Preload dependent
  - If inadequate blood is available for the pump to propel, the output of the pump decreases
  - When preload low (hypovolemia/dehydration), a negative pressure develops and lead to suction events in the ventricle

Power Source

Patient’s Lifeline

- 14 Volt Lithium Ion Batteries
- Use at Night
This is what the controls look like up close and personal:

Device Parameters
Monitor every shift
- Document on flowsheet in patient’s room:
  - Device parameters
    - Speed
      - The speed of the rotor
    - Power
    - Flow
      - Flow range 3 – 10 liters/minute
    - Pulsatility Index (PI)
      - Measurement of the flow pulse through the pump

Used for
HeartMate II.
HeartWare has different parameters

Device Assessment
- Pump function
  - Auscultate left upper quadrant over pump pocket as part of every assessment:
    - It should sound like a boat motor
- Pump Parameters
- System controller settings, alarm status
- Review system controller event recorder log file
- Driveline connection to system controller and locked in place
- Exit site status, immobilization of driveline
- Backup system controller available & programmed

System Controller Self Test
Perform Daily
- Pump operation is not affected
- Checks lamps and audio tones only
  - To Perform:
    - Press and hold Test Select button
    - After 3 seconds, verify all lamps illuminate and unbroken audio tone
    - Release the button. Tone and lamps will remain for at least 5 seconds

Advisory & Hazard Alarms
- Advisory Alarms
  - Power Cable Disconnected
  - SC Battery Module Low
  - Replace System Controller
  - Low Speed Operation
  - Low Voltage
- Hazard Alarms
  - Low Voltage
  - Percutaneous Lead Disconnected
  - Low Flow
  - Loss of Power
At Night

- Connect to power module
- Power module should be plugged into generator outlet in case electricity goes out
- There is 30 minute battery backup on power module and it will alarm loudly
- Power module cable is 20 feet long
- If bathroom not close enough, get commode

Other tips

- When changing from power module to batteries or vice versa, only disconnect one cable at a time. Disconnecting both at the same time, the LVAD will stop
- Never disconnect the DRIVE line from the pump
- Be careful with the DRIVE line and other cables that they don’t get tangled or catch on anything especially when ambulating
- Patients can only shower if okay with implant surgeon and then they have a special protective bag.

Specific LVAD Patient Care

Complications

- Stroke
  - Embolic more common than hemorrhagic
  - Optimum level of antiplatelet and anticoagulation therapy is unknown
  - INR 1.5 – 2.0
- Infection
  - Percutaneous driveline
  - Pump pocket
- Bleeding
  - Acquired von Willebrand syndrome from high shear stress on blood
  - Chronic anticoagulation induced bleeding
  - GI bleeding
  - Hemorrhagic strokes
- Mechanical failure

Hypovolemia

- LVAD is preload (volume) dependent
- If patient becomes dehydrated it causes the cannulas to suck up the walls of the LV
- This can cause arrhythmias
- Thus, keep patient euovolumic

Suction events

- Caused by low preload (hypovolemia/dehydration)
- Negative pressure sucks part of the ventricular wall and covers cannula
- Can cause an arrhythmia
- Pump will alarm and automatically decrease the speed to release the suction
- Treatment = fluids!
Unresponsive?

- If LVAD running? If so, treat as any other unresponsive patient
  - Hypoglycemia
  - Stroke
  - Sepsis

Pump stops running

- Don’t panic!
- Call implant center immediately
- Most patients have some heart function (EF) without the LVAD

Emergency Management

- Have the implant center phone numbers readily available
  - Place at Bedside
  - Call them!
  - Hand off these numbers to next shift

Emergency Management

- Arrhythmias are major cause of emergencies
  - If LVAD is running, blood is still circulating
  - OK to defibrillate or cardiovert or external pace
    - Do not stop the pump!
    - Do not place pads over implanted pump
  - Do NOT do chest compressions.
    - Compressions will displace cannulas
    - Call implant center before doing compressions
    - If LVAD is running, blood is still circulating
  - Dehydration can cause lethal arrhythmias.
  - Need immediate bolus
Most Important!!

- No single parameter is a substitute for monitoring patient’s clinical status!!
- Note baseline values
- Trends
- Abrupt changes

LVAD in a Community Hospital Preparation

Peoria is three hours from Chicago – Our LVAD center

10 LVADs in Our Community

- Some patient will come to the ED because of other problems not LVAD problems
  - Abdominal pain
  - Gall stones
  - GI bleed
  - Pneumonia, etc
- Treat them like any other patient. The difference these patients have a LVAD supporting their Left ventricle
Resource Book
ED, CVICU, Progressive unit, Rehab & Nursing Office

- Alarm Flowcharts
- Emergency Management
- Emergency Contacts
- Patient LVAD pump resource manual

Placement of Patients

- CVICU if critically ill
- Cardiac Progressive if stable
- Rehabilitation Unit

Other Resources

- www.thoratec.com
- Hospital specific online LVAD learning module with quiz
- Also did education for EMS system

Destination Therapy
Left Ventricular Assist Device

LVAD
VVI pacer
**Worldwide Clinical Experience**

More than 15,000 patients worldwide have now been implanted with the HeartMate II® LVAS.

Over 6,000 patients on ongoing support
- Patients supported ≥ 1 year: 3,838
- Patients supported ≥ 2 years: 2,141
- Patients supported ≥ 5 years: 294
- 1 patient has even been supported for over 8 years

As of July 2013

*Based on clinical trial and device tracking data

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**Discussion Topics**

1. What to do if the LVAD fails and the patient requires an emergent operation
2. What to do if multiorgan failure develops and the LVAD does not seem to be helping a “futile” situation
3. What to do if the LVAD device becomes infected
4. What to do if the patient has a postop stroke
5. What to do if a patient has a traumatic injury or a terminal malignant tumor and the LVAD is functioning properly

Source: O’Neill, B. Destination to Nowhere. CCN 34:2,52

**In Summary.....**

- Many patients as recent as 10 years ago would have died without the support of LVADs and are living relatively normal lives
- More patients will come to the community hospitals because of other problems not LVAD problems
  - Abdominal pain
  - Gall stones
  - GI bleed
  - Pneumonia, etc