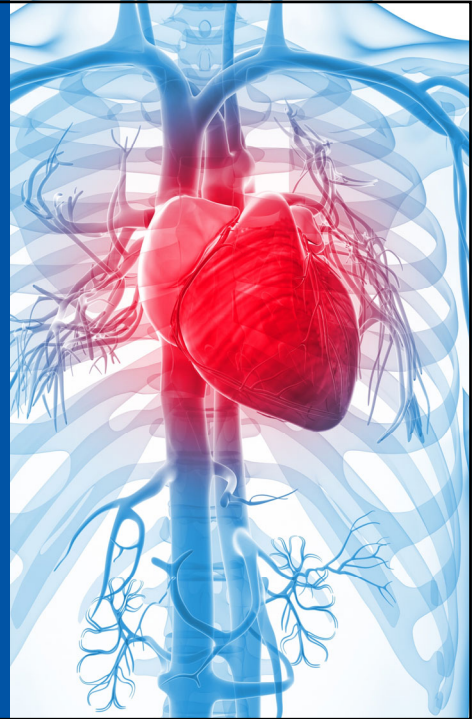




LVAD Management for Shared Care

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Faculty Disclosure

- None



Educational Need/Practice Gap

Clinicians in many medical settings are wholly unaware of advanced mechanical circulatory therapies to treat low cardiac output. New ventricular assist devices (VADS) have increased portability, function, and efficiency. Providers need to be aware of how to refer for VAD implant, understand new technological trends, and better co-manage patient care with implanting centers.



Objectives

Upon completion of this educational activity, you will be able to:

1. Describe the indications and contraindications for VAD.
2. Discuss clinical trends in VAD technology and new patient management strategies.
3. Utilize ACLS methodology based on presentation of relevant case studies.



Expected Outcome

- This presentation aims to educate providers on best-practices leading up to referral for VAD implant.
- Desired results include a better understanding VAD circuitry, controllers, drive lines, and overall technology.

Who is the patient?

- Cardiomyopathy
- Dilated left ventricle
- Ejection fraction <25%
- Pediatric to 80+ years
- Home bound to completely active and independent
- Bridge to transplantation vs. destination therapy

LVAD Coordinators

- All patients have one
- The patients should know how to reach them



LVAD Vital Signs

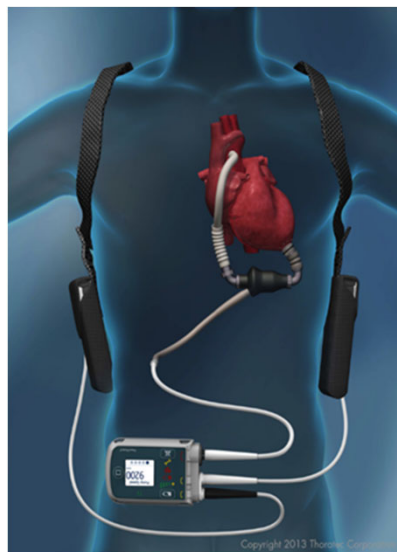
- Heart rate
 - Arrhythmias
- Blood pressure
 - MAP 65-85mmHg
 - SBP less than 110mmHg
- Respiratory rate
- Oxygen saturation
- Temperature

What's Different?

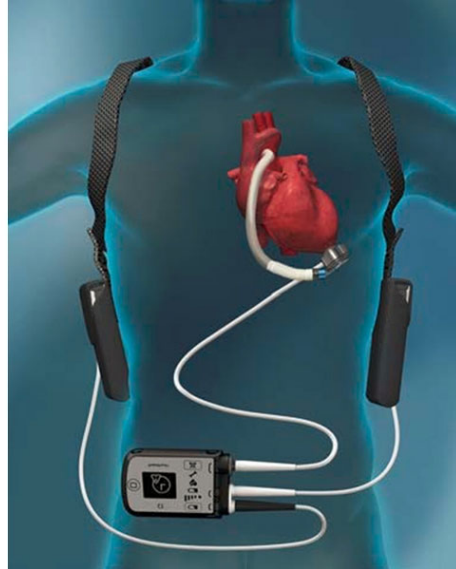
- **NO PULSE!** (or a little pulse)
- Automatic BP may not work
- SpO₂ is not reliable
- Almost all are anticoagulated
- Require equipment and power to live

- Doppler BP
 - MAP = consistent “swoosh”
 - SBP = pulsatile flow

HeartMate II



HeartMate 3



HeartMate Controller

HeartMate 3 System Controller User Interface

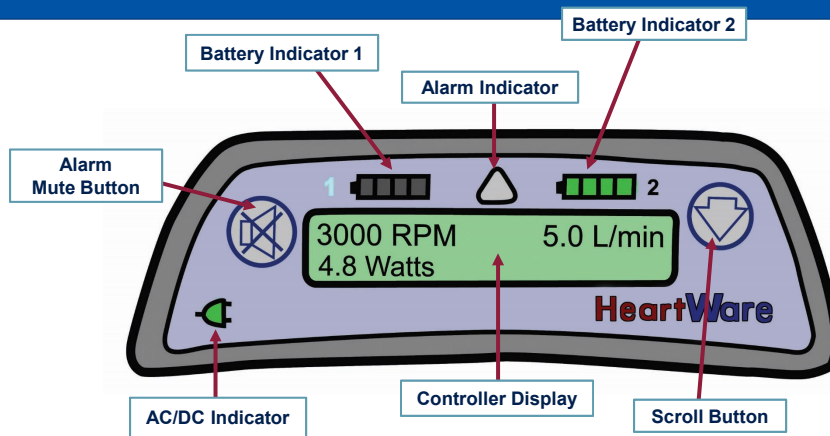


- Small computer that ensures the pump is working properly
- Sets pump speed (rpms) and regulates power use
- Connects to driveline and power source (via power cables)
- 15 minutes back up battery power
- Alarm review – hold down menu and silence alarm buttons





HVAD



HVAD Controller





HeartMate II and 3 - Advisory Alarms

- An intermittent sound is a cautionary sound
- Yellow light illuminated   
- Ensure running symbol is illuminated 
- Occurs most frequently when:
 - Changing power sources
 - Low batteries

HeartMate Advisory



HeartMate II and 3 – Hazard Alarms

- A ***continuous sound*** is an **EMERGENCY!**
- **Red** light illuminated  
- The display screen will display what kind of hazard alarm is occurring
- Will occur when:
 - All power is disconnected from the pump
 - Less than 5 minutes of battery power left
 - The pump has stopped or the flow is less than 2.5L/min
 - Driveline is disconnected

HeartMate Hazard (Power)



HeartMate Hazard (driveline)



HeartMate II and 3 – Driveline connection

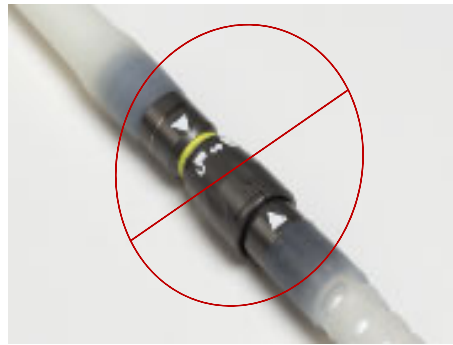
Never disconnect the driveline unless it is necessary to switch to the back up controller.



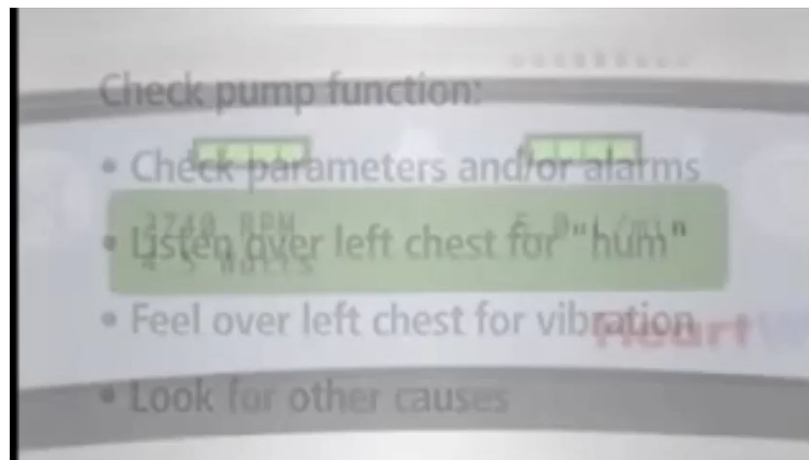
Line up the black arrow or line on the driveline with the black arrow on the connector port and firmly insert the driveline until it snaps into place.

HeartMate 3 modular driveline

- If a yellow line is visualized on the Heartmate III driveline connection, it is loose and must be tightened.



HVAD Alarms



HVAD Connections



VAD Drivelines

- Drivelines should have a clean, dry, and intact dressing on at all times.
- Ensure the driveline is not tugged, pulled, kinked, or pinched.
- Keep controller and batteries secured in patient's consolidated bag to decrease chance of traumatizing the driveline.



HeartWare Bag



HeartMate II and 3 Bag



Foley anchor not visualized

What can go wrong?

- GI bleeding
- Thrombosis of the LVAD
- Stroke
- Infection
- Arrhythmia
- Volume overload
- Over diuresis
- LVAD failure

Patient Management

- **Treat the Patient not the Equipment**
But...be aware of the equipment

Patient management

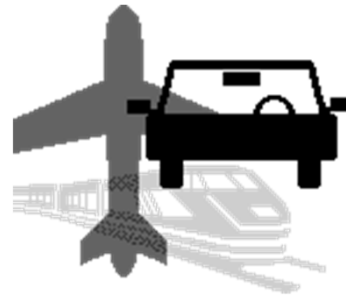
- Initial head to toe assessment as for ANY other patient
- Start with the patient and work your way back to the VAD –equipment emergencies are rare
- VAD sounds- “humming sound”
- Avoid sudden movements of drive lines
- The VAD patient has a driveline dressing (right or left upper quadrant) which is managed by them or a caregiver.

Blood pressure in the VAD patient...Where? How?



OKs for VADs

- Showers WITH shower bags
- Back to work
- Any non contact physical activity
- Travel- Air and ground
- Hunting-fishing
- Living LIFE!!



Not OK for VADs

- MRI
- Going through scanner at airport
- Swimming





ACLS for LVADs

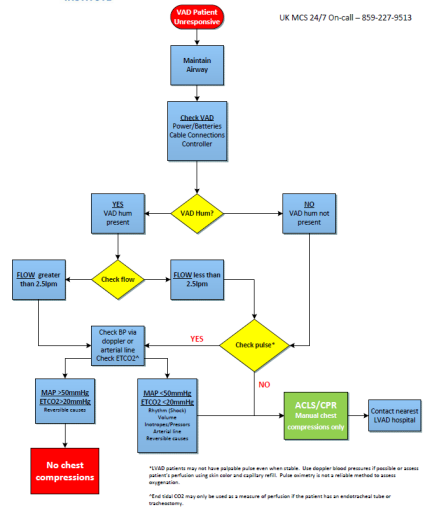
ACLS

- Chest Compressions - **YES**
 - You can perform chest compressions
 - Our center prefers no mechanical compressions
- Cardioversion/Defibrillation – **YES**
 - Do not stop the LVAD
- Fluid Bolus – **YES**
 - Be aware of volume overload
- Drugs - **YES**

LVAD ACLS



LVAD ACLS Algorithm for Respiratory and/or Cardiac Arrest
UK MCS 24/7 On-call – 859-227-9513



Case Studies

Case Study #1 H.C.

- 67 yr old male
- History: ICM, NSVT, OSA, DM2, CKD Stage III, morbid obesity
- Received Medtronic HVAD July 1, 2017
- Complications post implant: driveline infection, orthostatic hypotension, chronic deconditioned status
- Lived alone with daughter as caregiver



H.C. Sequence of Events at Home

- Being bridged with Lovenox d/t subtherapeutic INR in addition to warfarin
- Daughter called LVAD Coordinator in early evening reporting progressive decrease in mental status
- Patient speaking at the time and reported a fall earlier in the day, denying having hit his head
- Normal blood glucose per home meter
- Daughter instructed to call 911
- Patient sitting up at table and snoring could be heard over the phone
- Patient taken to nearest hospital



H.C. Sequence of Events in Hospital

- Per OSH ED RN, patient intubated upon arrival
 - CT scan obtained and significant hemorrhagic CVA seen
- Patient transferred to UKMC as Trauma Alert Red; no reversal given at OSH
- LVAD parameters stable, BP 104/70 (82)
- CT scan at UKMC revealed “devastating left-sided subdural hematoma”
- Care withdrawn within in hours per family request



Take Aways

- Assessment and treatment is the same as all other patients
- Reversal of INR is okay
- Low threshold for CT scan
- Severity can vary, but easily becomes fatal



Case Study #2

T.M.

- 36 yr old male
- History: NICM, Afib, DVT, OSA, morbid obesity
- Received Medtronic HVAD June 26, 2017
- Complications post implant: none; however, INR management had been difficult initially
- Lives with wife and children



T.M.

Sequence of Events at Home

- Patient calls LVAD coordinator at evening on a Thursday reporting “bloody urine” and “high watts” alarms
- Patient sent to OSH ED
- INR within range at 2.5 (range 2.5-3.5)
- LVAD parameters:
 - flows >12
 - RPMs 3100
 - Peak 11, trough 5.9
 - watts 11
- Patient briefly evaluated, UFH initiated and transferred to UKMC



T.M. Sequence of Events in Hospital

- LDH upon arrival 3785
- UFH continued
- UA: red, large leukocytes, unable to provide further information d/t specimen color or the presence of interfering substance
- CTA chest: no thrombus visualized
- LDH begins trending down; CTS opts to continue medical management



T.M. Sequence of Events in Hospital

- Received 18 days of UFH
- LVAD parameters returned to baseline after approx. 24 hours of being on UFH
 - Flow ~5 LPM
 - RPMs 3100
 - Power ~7
- INR goal increased to 3-3.5 and discharged home
- LDH following discharge 189

2018-07-11 05:44:26	LDH	234
2018-07-10 02:41:30	LDH	270
2018-07-09 03:41:42	LDH	259
2018-07-08 06:42:19	LDH	274
2018-07-07 03:33:28	LDH	311
2018-07-06 03:43:06	LDH	402
2018-07-05 03:10:16	LDH	448
2018-07-04 10:45:03	LDH	618
2018-07-03 08:07:40	LDH	723
2018-07-02 03:43:40	LDH	818
2018-07-01 05:39:57	LDH	1226
2018-06-30 06:59:06	LDH	1191
2018-06-29 05:36:13	LDH	971
2018-06-28 06:12:22	LDH	1238
2018-06-27 06:43:29	LDH	1296
2018-06-26 02:14:57	LDH	1491
2018-06-25 05:25:48	LDH	1668
2018-06-24 07:20:24	LDH	2512
2018-06-23 07:29:03	LDH	3785*



Take Aways

- Importance of therapeutic INR
- Trend LDH and pump power
- Quick response to symptoms and treatment
- Pump exchange not always the end result



Case Study #2 Supratherapeutic INRs

- Patient checks INR on home meter
- Reports INR of 7.5 to LVAD Coordinator
- Patient denies taking extra dose of warfarin, changes in diet or medications
- Patient sent to local OSH ED for venipuncture confirmation and possible FFP infusion



Supratherapeutic INRs

- Venipuncture at OSH ED 6.9 on Monday
- Per protocol, ED MD instructed to give 2 units FFP
- 1 hour following infusion, INR 3.3
- Patient d/c'ed home
- X2 warfarin dose held
- Repeat INR on Wednesday via venipuncture 3.5
- Restarted warfarin with a 20% decrease in dose

Take Aways

- Vitamin K in setting of bleeding only
- Prefer use of FFP to lower INR
- Risk vs. benefit, patients at risk for devastating injury

Case Study #4 J.M.

- 62 yr old male
- History: ICM, VT storm s/p ablation, DM2, CKD Stage III, multiple PCIs
- Received Medtronic HVAD March 26, 2018
- Complications post implant: intermittent orthostatic hypotension



J.M. Sequence of Events at Home

- Patient seen in LVAD clinic on Friday; a drop in Hgb from 9 to 7.5 was found
- Patient denied any s/s of bleeding; decreased warfarin dose (range 2.5-3.5)
- Patient experiences significant amount of hematochezia on Monday, but dose not notify LVAD coordinators
- Second episode on Tuesday and wife notifies coordinator to come to UKMC ED for further evaluation/treatment



J.M. Sequence of Events in Hospital

- INR 3.6; warfarin stopped
- Hgb 6.3, 2 units FFP and 2 units PRBC given
- Repeat Hgb 4.8; received additional 4 units PRBCs
- Colonoscopy/EGD per GI on Thursday: blood in colon found and diverticuli noted; EGD unremarkable
- INR goal decreased to 1.8-2.2, ASA stopped, no change to PPI
- Discharged home with INR 2.1 and Hgb 9.6
 - Follow up Hgb 10.5 and 11.2

Take Aways

- 20-30% of patients have GI bleed
- Occurs within six months after implant, at risk for reoccurrence
- Severity varies, but can still effect volume status
- Maintain healthy bowel regimen
- May lower INR goal

Resources

- MyLVAD.com
- Heartmate.com
- Heartware.com
- UK MCS Team
- <https://www.youtube.com/watch?v=EmFNvjmAmh0>
- <https://www.youtube.com/watch?v=rjwMu9iXHau>



UKHC MCS
Office – 859-323-3517
Emergency 859-227- 9513