Artificial Heart Program

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Provider Review: General VAD Overview

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Indications for VAD

- Bridge to transplant (BTT)
  - historically most common (~80%)
  - allow rehab from severe CHF while awaiting donor
- Bridge to recovery (BTR)
  - unload heart, allow "reverse remodeling"
  - can be short- or long-term
  - typically for acute/reversible HF (postpartum, myocarditis)
- "Destination" therapy (DT)
  - permanent device, instead of transplant
  - increasingly prevalent due to better survival, chronic HTx shortage
- Bridge to candidacy (BTC)/ Bridge to decision (BTD)
  - when eligibility unclear at implant
  - not true "indication" but true for many pts

Which Pump for Which Patient?

Device	Ventricles	Indications	Duration	Trial?	Pulsatile?	Discharge?
Centrimag	L, R, B	BTR	Short	Y (PC)	N	N
Impella	L	BTR	Short	N	N	N
Thoratec	L, R, B	BTR , BTT	Medium	N	Y	Y
Syncardia	B (TAH)	BTT	Medium	N	Y	Y
HeartMate II	L	BTT, DT	Long	N	N	Y
Jarvik	L	BTT	Long	Y	N	Y
Heartware	L	(BTT), DT	Long	Y	N	Y

Ventricles: Ventricle(s): L: left/LVAD; R: right/RVAD; B: both/BiVAD
Duration: Approx. max. pump life; Short: < 1 month; Medium: < 1-2 yrs; Long: > 2 years
Indications: BTR: Bridge to recovery; BTT: Bridge to HTx; DT: Destination Rx
Trial?: In clinical trial? (PC: postcardiotomy)
Discharge?: Home discharge?

LVAD vs. BiVAD/TAH

- Risk factors for RV Dysfunction/Failure
  - smaller BSA
  - female
  - nonischemic etiology
  - elevated LFTs, INR, BUN, Cr
  - high CVP/PCW ratio
  - low RV stroke work index $\frac{(PAM - CVP) \times 1000 \times CI}{HR}$
  - requiring pressors, vent, acute VAD/ECMO
  - heavy intraop bleeding, long CPB times

LVAD vs. BiVAD/TAH

- Long-term implantable LVAD w/acute RVAD (Levitronix) backup
  - Preferable if patient not clearly bridge to transplant
  - Pros:
    - ease of implant
    - low thrombosis/hemolysis risk
  - Cons:
    - limited mobility
    - risk of cannula dislodgment
    - shorter duration support
    - surgical explant required

LVAD vs. BiVAD/TAH

- Consider planned long-term BiVAD or TAH if:
  - severe, long-standing RV dysfunction
  - refractory VT/VF
  - more clearly bridge to transplant
  - Prefer BiVAD if:
    - small BSA/peds
    - ”standard” anatomy
    - inadequate intrathoracic dimensions for TAH
  - Prefer TAH if:
    - large BSA
    - adequate intrathoracic dimesions
    - valvular pathologies (AI, AS, mechanical valve(s))
    - LV/RV thrombus;
    - Hypertrophic or restrictive cardiomyopathy
    - H/O LV reduction or prior HTx

General Principles

- ALL VADs are:
  - Preload-dependent
  - EKG-independent
  - Afterload-sensitive
  - Anticoagulated

- Key differences in management strategy depend on pulsatile vs. non-pulsatile device

Problems/Complications
(Common to All VADs)

- Major Complications:
  - Bleeding (~50% incidence)
  - Thrombosis (5-40% incidence, device-dependent)
  - Infection (20-40% incidence, device-dependent)
    - sepsis is leading cause of death in long-term VAD support

Problems/Complications
(Common to All VADs)

- Major Complications:
  - RV dysfunction/failure (~10-20% incidence)
  - Device failure/malfunction (variable)
  - Hemolysis (~10-20% incidence)

Problems/Complications

- Other Common Issues
  - Arrhythmias
    - more important for nonpulsatile LVAD
    - most deleterious in isolated RVAD (pulmonary edema)
    - less/not important in TAH/BiVAD
  - HLA sensitization
    - only important in BTT/BTC patients
  - Malnutrition/failure to thrive
  - Flow/preload issues (hyper/hypo-tension/-volemia)
  - Depression/adjustment disorders

Approach to Common Complications

- Infection
  - meticulous driveline care: sterile VAD dressing changes, driveline immobilization
  - prophylactic abx/antifungal
    - vanco, pip/tazo for 7d post-op (longer if open chest)
    - antifungal for 14d postop (longer if open chest)
  - optimal nutrition, hemodynamics, line care
  - early extubation & mobilization
  - persistent bacteremia typically requires VAD exchange
  - fungemia in VAD ~90% mortality

Approach to Common Complications

- RV Dysfunction/Failure
  - careful SGC-guided volume management
    - keep CVP ~10-15 w/CI >2.0
    - avoid unnecessary transfusions
    - early, aggressive volume removal (SCUF, Aquadex)
  - echo-guided titration of flow/speed
    - avoid R→L shift of ventricular septum
  - judicious dosing of inotropes, pulmonary vasodilators
  - return to OR early for RVAD if persistent high CVP with low PAP/CI

Approach to Common Complications

- Bleeding & Thrombosis
  - careful control of anticoagulation imperative
    - early
      - operative bleed
    - late
      - CVA
      - device thrombosis
      - acquired von Willebrand disease (GI bleeds, epistaxis)
    - treat both coagulation cascade & platelets
    - follow UMMC VAD protocol

Code/CPR Guidelines

- Follow VAD Code Protocol
- Cardioversion OK w/o disconnecting controller (be careful if on A/C power)
- If in doubt about whether VAD is pumping, auscultate
  - device failure rare in current devices (exc with thrombosis); pump stoppage often related to accidental driveline/power disconnect
  - if not running or in doubt, switch to b/u equipment or actuate manually if possible
- Volume always helps, but be gentle, esp. if isolated RVAD
- CPR: generally only as last resort
  - may be necessary if patient in non-perfusing rhythm w/evidence of global hypoperfusion (e.g. cyanosis, LOC, MAP <40s)
  - MAP alone may not be good guide/ may not be obtainable w/o a-line in nonpulsatile
  - high risk of cannula dislodgement

Resources

- UMMC Intranet:

  http://intra.umm.edu/ummc/cardiology/vad.htm

  – VAD Protocols (A/C, code mgmt, general mgmt)

  – Quick guides, overview slides for devices in use
- General principles of continuous-flow VAD management:

  J Heart Lung Transplant 2010;29:S1–S39

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