Alive with No Pulse: Artificial Hearts

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Ventricular Assist Devices

- Mechanical circulatory assist
  - “artificial heart”
  - Usually L ventricular assist device/system
- Currently about 6,000 outpatients in US.
Ventricular Assist Systems

- LVAS, RVAS or “artificial heart”
- Earlier devices were air driven
  - Pulsatile pumps
- Next gen devices are centrifugal
  - Magnetically levitated impeller propels blood
  - Non-pulsatile flow
Thoratec VAD (pVAD/iVAD)
RVAD, LVAD or BiVAD
Patients Recovered
Portable TLC-II Driver
Heartmate XVE – implanted LVAD

- Weight: 3.74 lbs
- Stroke volume: 83 ml
- Rate: Up to 120
- Flow: Up to 10 L/min
- Titatanium
- Motor with 2 bearings
- Vent port
- Two tissue valves:
  - Inflow & Outflow
Inside surface of pump housing
System Controller & Cables
Total System

1. XVE System Controller
2. Battery Clip
3. Battery Clip

XVE LVAD

Vent Adapter & Vent Filter
Battery Clips & Batteries
Power Base Unit (PBU)
Patient with LVAD (XVE)
What if batteries die?

- Hand pump $\rightarrow$ vent port
- Always with patient
Can’t we make ‘em smaller?

• Yup! – new devices centrifugal:

Jarvik 2000 LVAD
Non-pulsatile flow
Size Comparison
HeartMate II LVAD - simple

FDA: BTT 4/21/08, DT 1/20/10
About 5,000 implants to date
HM II

Cored into LV
Outflow to aorta
Percutaneous tube
System Controller
Batteries
Inside the HM II

is a rotor

↔↔ Blood Flow ↔↔
Controller + Back-up Controller
Batteries Required
BATTERY CHARGER
Smaller, cleaner profile:

Simple Design:

- Valveless
- One moving part (rotor)
The AbioCor System has four main parts that are implanted inside the body.
HeartWare® System Peripherals
In Puerto Rico following instructions to avoid swimming pools and oceans
Enjoying the streets: Madrid, Spain
Sightseeing: Seattle, Washington
Visiting: New Orleans
Out for a ride: anywhere
Holding Political Office
How can I identify a VAS?
Obvious:
How to ID a VAS Patient:

1. Sternotomy scar
2. Attached equipment
3. Caregivers
4. Medical alert identification
Sternotomy
Sternotomy
External Equipment
Next: HeartMate III…

- Magnetically Levitated Rotor (bearingless)
- Transcutaneous charging of implanted battery
- Flow: 2-12 l/min
- Potential extended longevity (>10 yrs)
ALL VADs are:

- Preload-dependent (consider fluid bolus)
- EKG-independent (but require a rhythm)
- Afterload-sensitive (caution with pressors)
- Anticoagulated (bleeding risk)
- Prone to:
  - infection
  - thrombosis/stroke
  - mechanical malfunction
- Key difference: pulsatile vs. non-pulsatile
CPR SHOULD NOT BE PERFORMED ON VAS PATIENTS UNLESS DIRECTED
VAD Resuscitation Measures

1. DO NOT unplug / remove equipment
2. Assess vitals (C-A-B)
   - Non-pulsatile flow requires doppler
   - MAP 70-80, keep < 90 mmHg
   - Pulse oximetry, NIBP likely inaccurate
3. NO CPR
4. Obtain immediate trained assistance
   - Family / caregivers are highly trained
   - Immediately contact VAD center
   - OLMC unlikely to be helpful, wastes time
Doppler measured BP
Artificial Hearts

- Need for artificial hearts growing
- Currently 6,000 in communities
- Travel extensively
- Require special assessment skills
- Consultation with implant center

Thanks! mikemcevoy.com