



# Alive with No Pulse: Artificial Hearts

**Mike McEvoy, PhD, NRP, RN, CCRN**

**EMS Coordinator, Saratoga County, NY**

**EMS Director - NYS Association of Fire Chiefs**

**Professor Emeritus – Critical Care Medicine, Albany Medical College**

**EMS Editor – Fire Engineering magazine**

# Ventricular Assist Devices

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



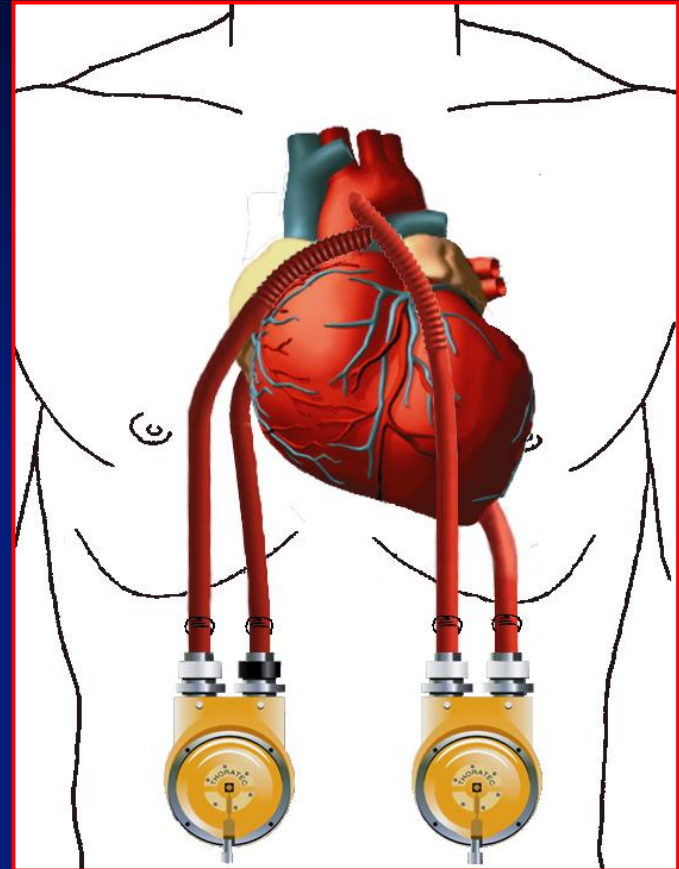
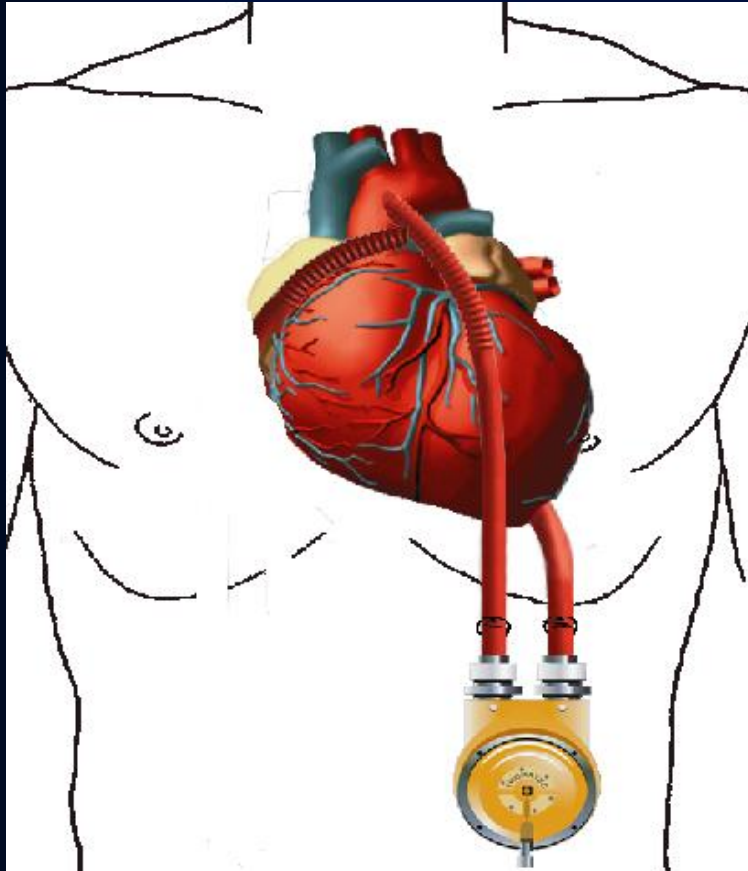
# Ventricular Assist Systems

- **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



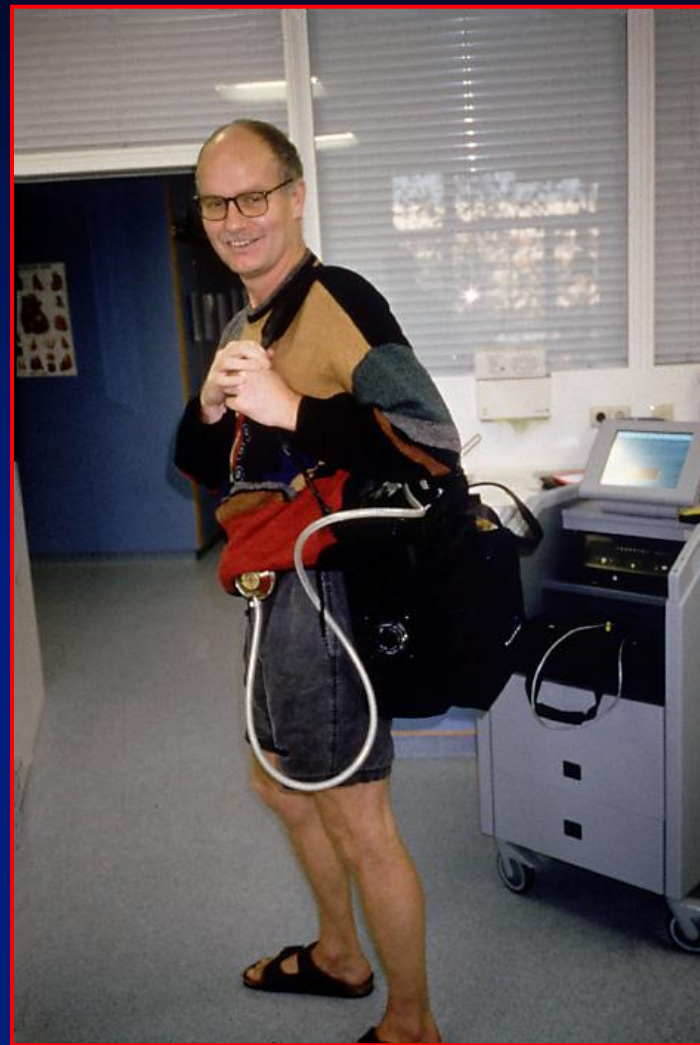
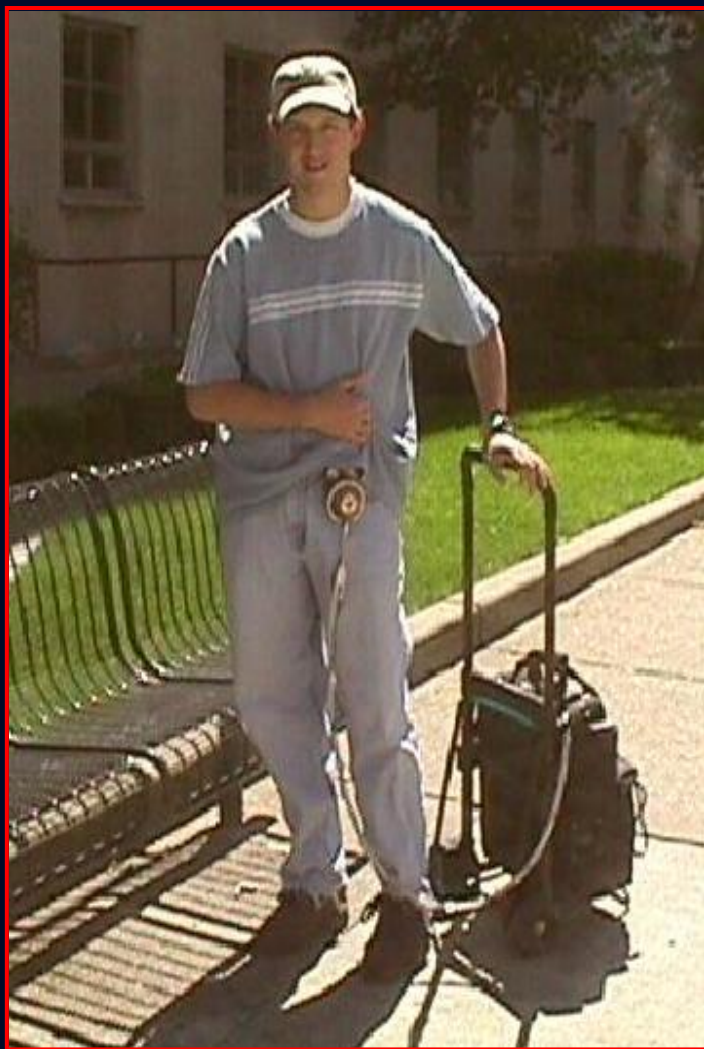
# Patients Recovered



# Portable TLC-II Driver



# TLC-II® Portable VAD Driver





# Heartmate XVE – implanted LVAD

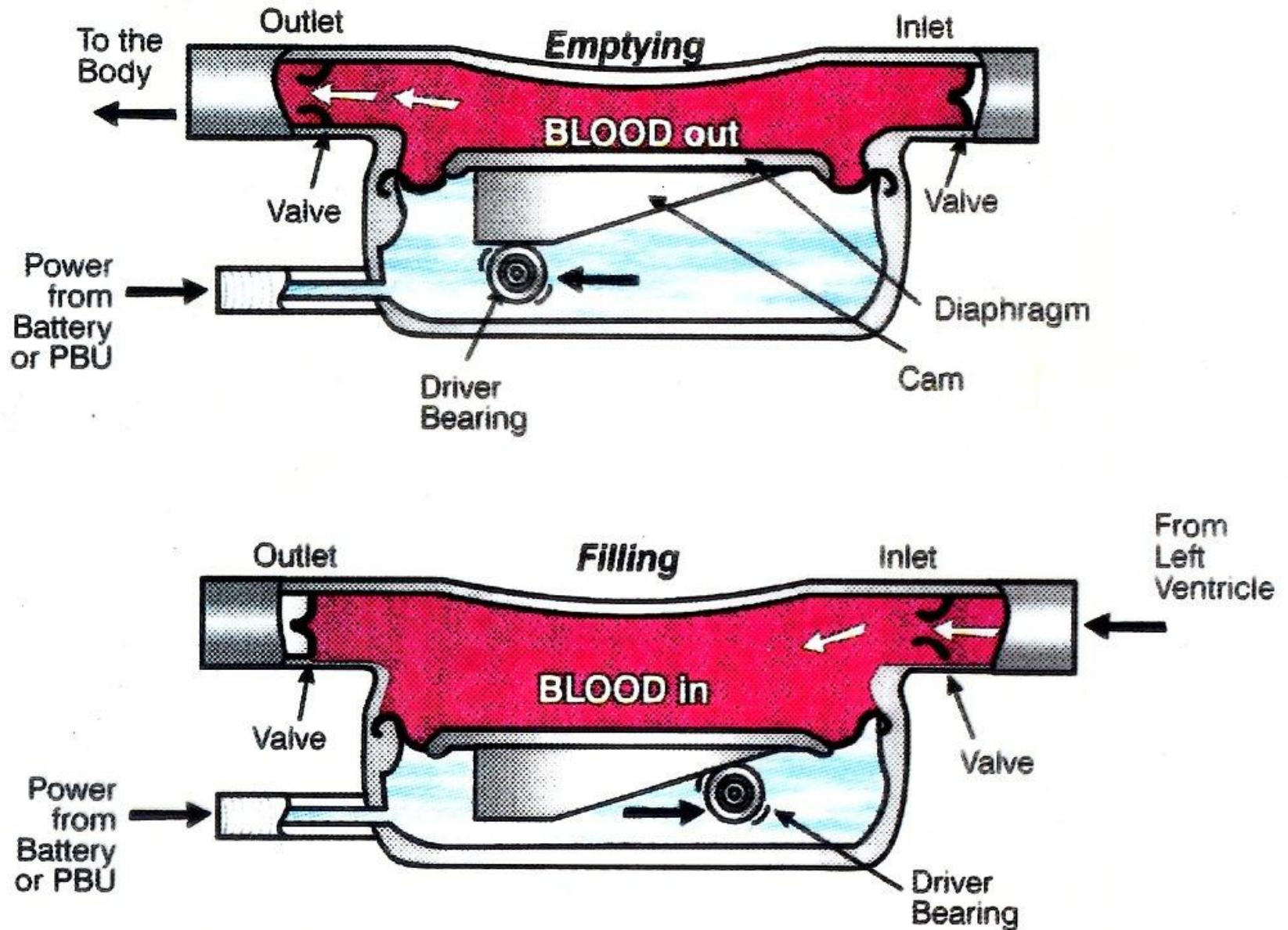


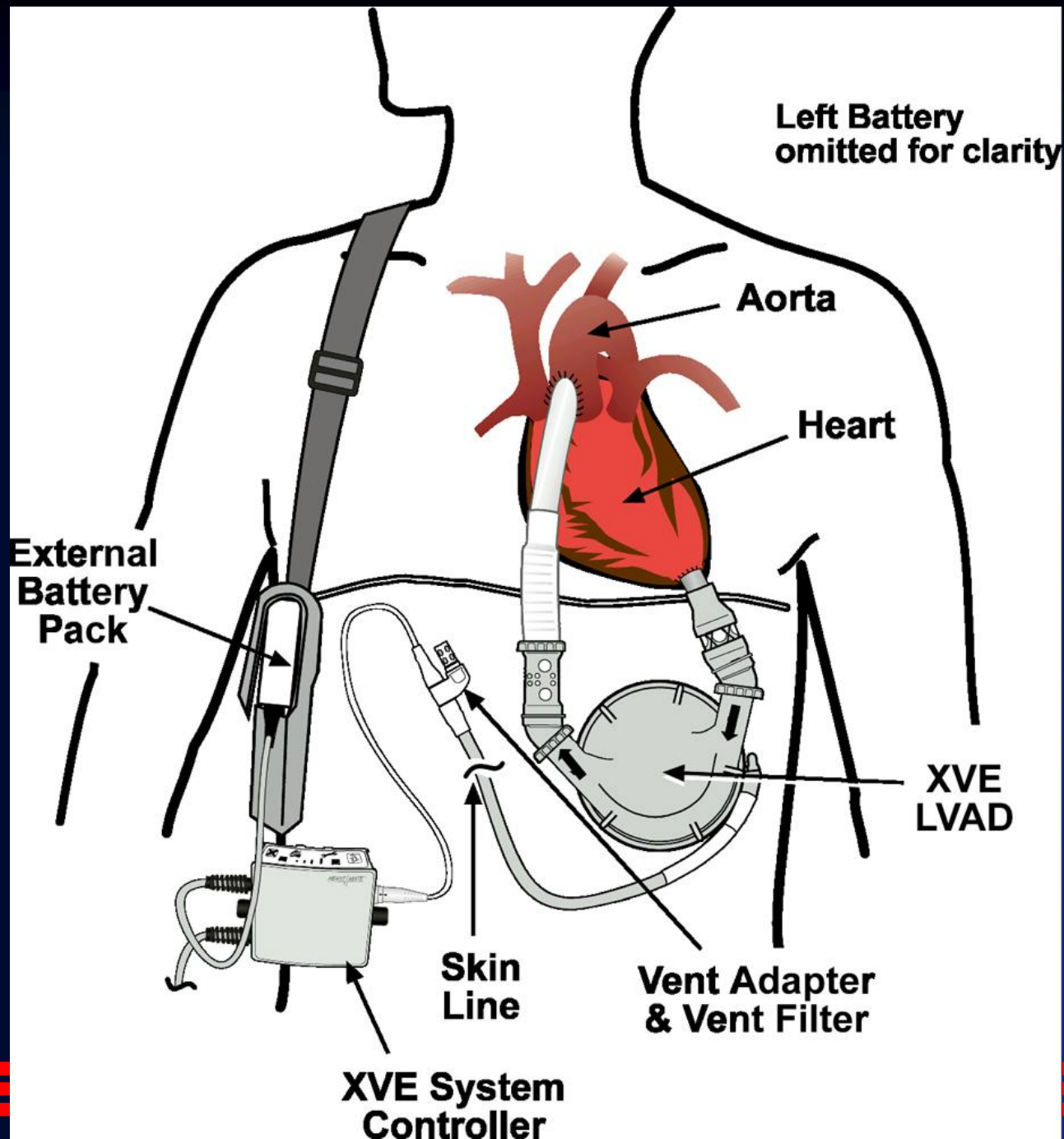
- Weight: 3.74 lbs
- Stroke volume: 83 ml
- Rate: Up to 120
- Flow: Up to 10 L/min
- Titanium
- Motor with 2 bearings
- Vent port
- Two tissue valves:
  - Inflow & Outflow

# Inside surface of pump housing

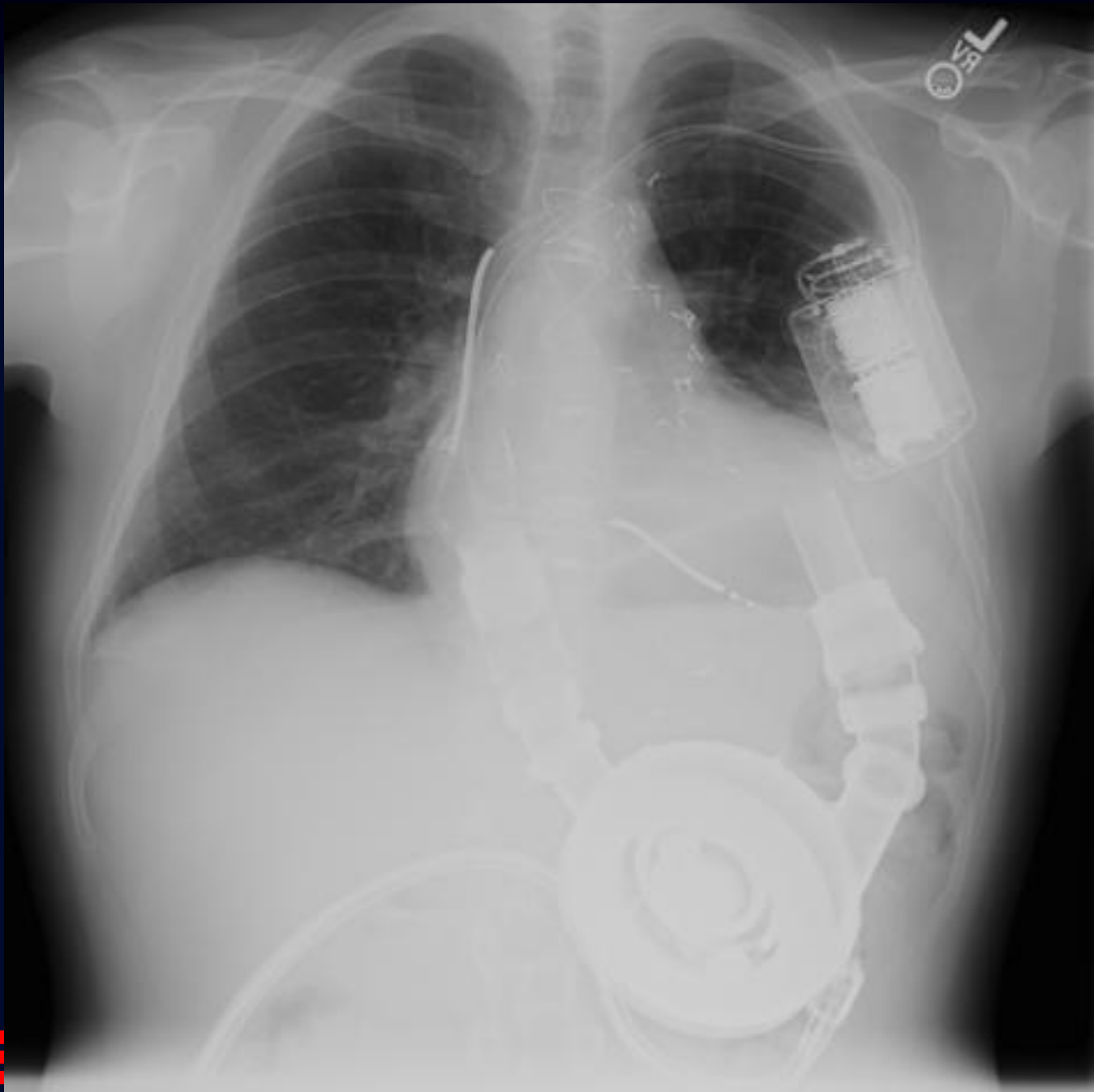


# Cross Section of Pump

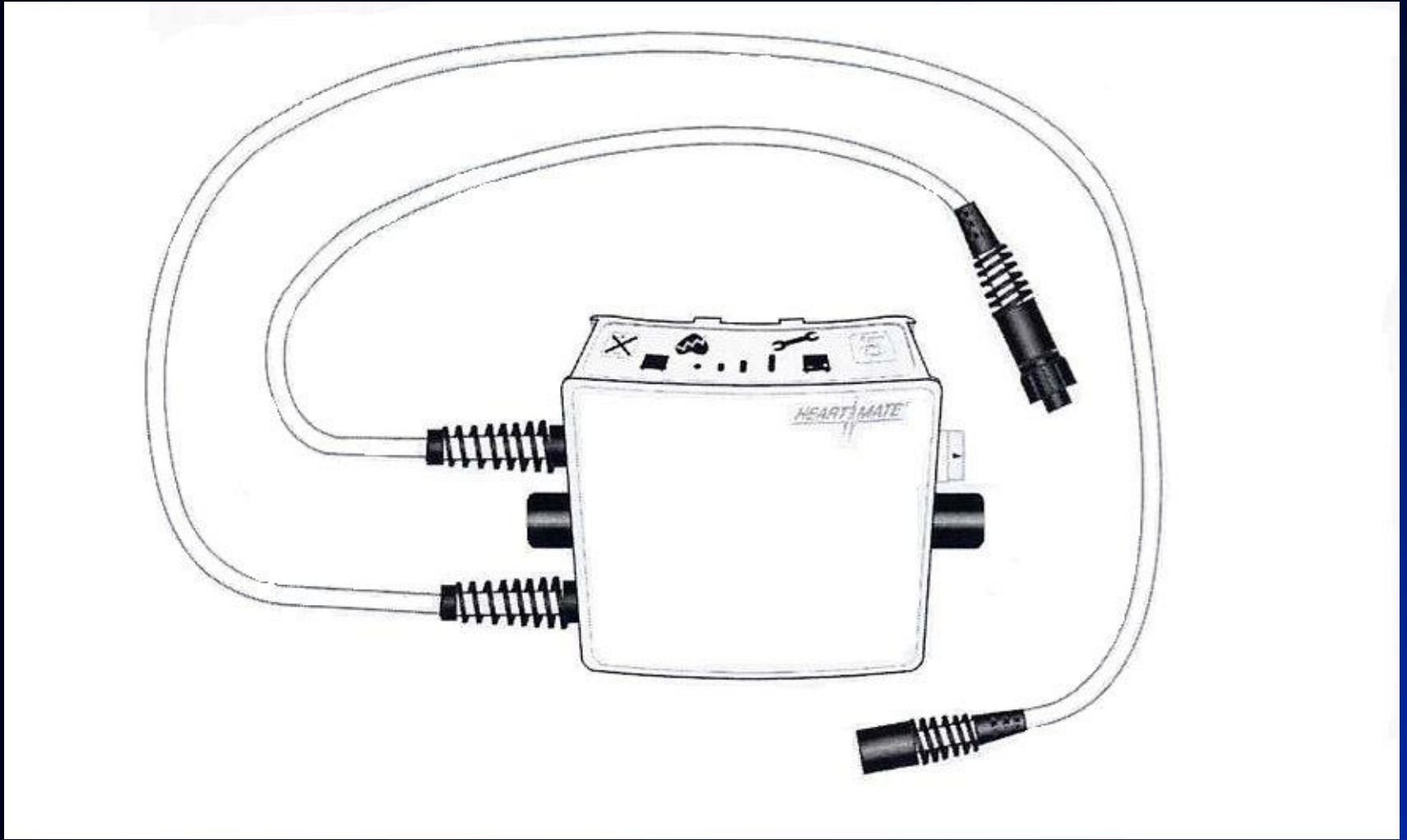




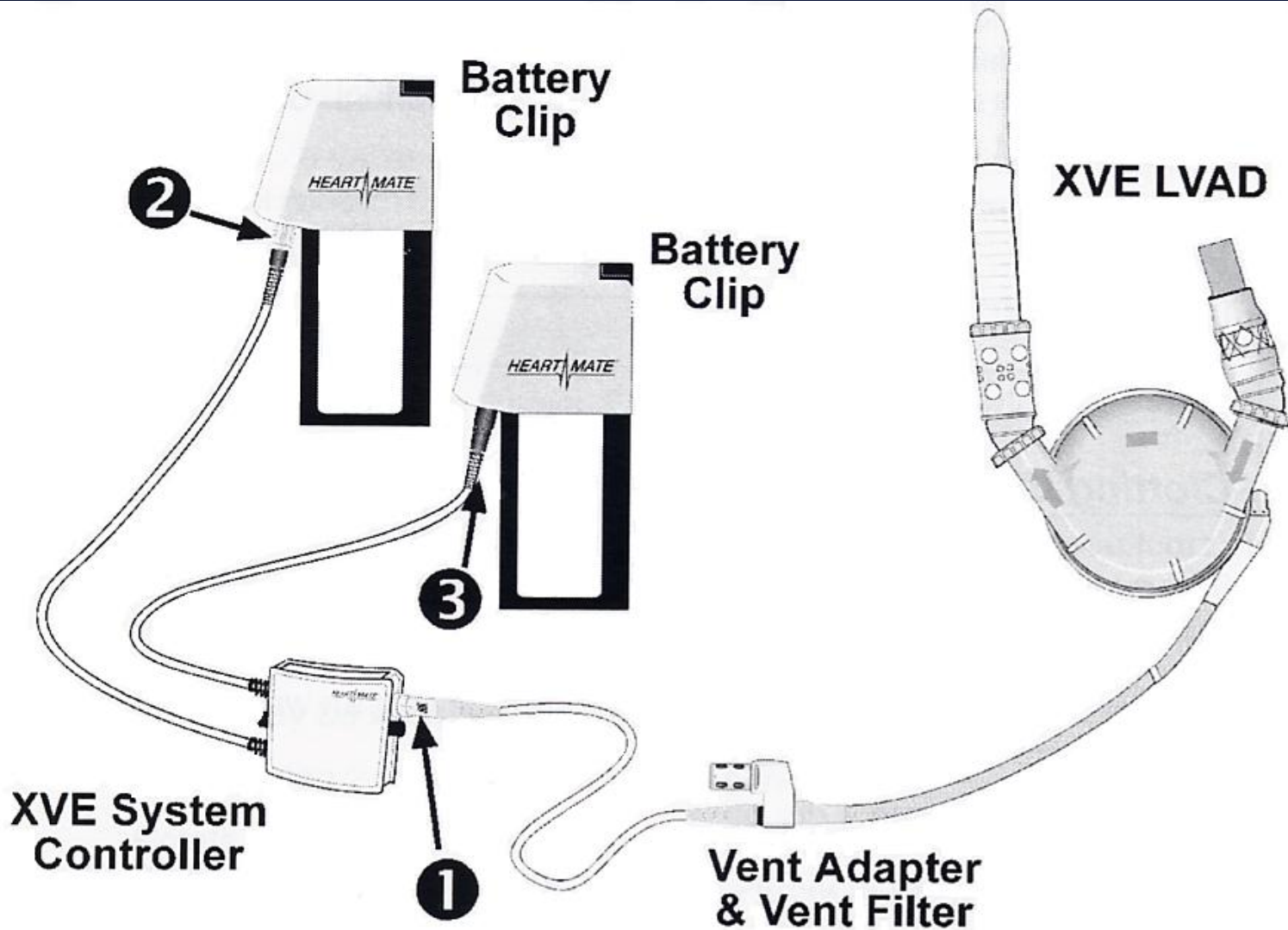




# System Controller & Cables



# Total System





# Battery Clips & Batteries



# Power Base Unit (PBU)

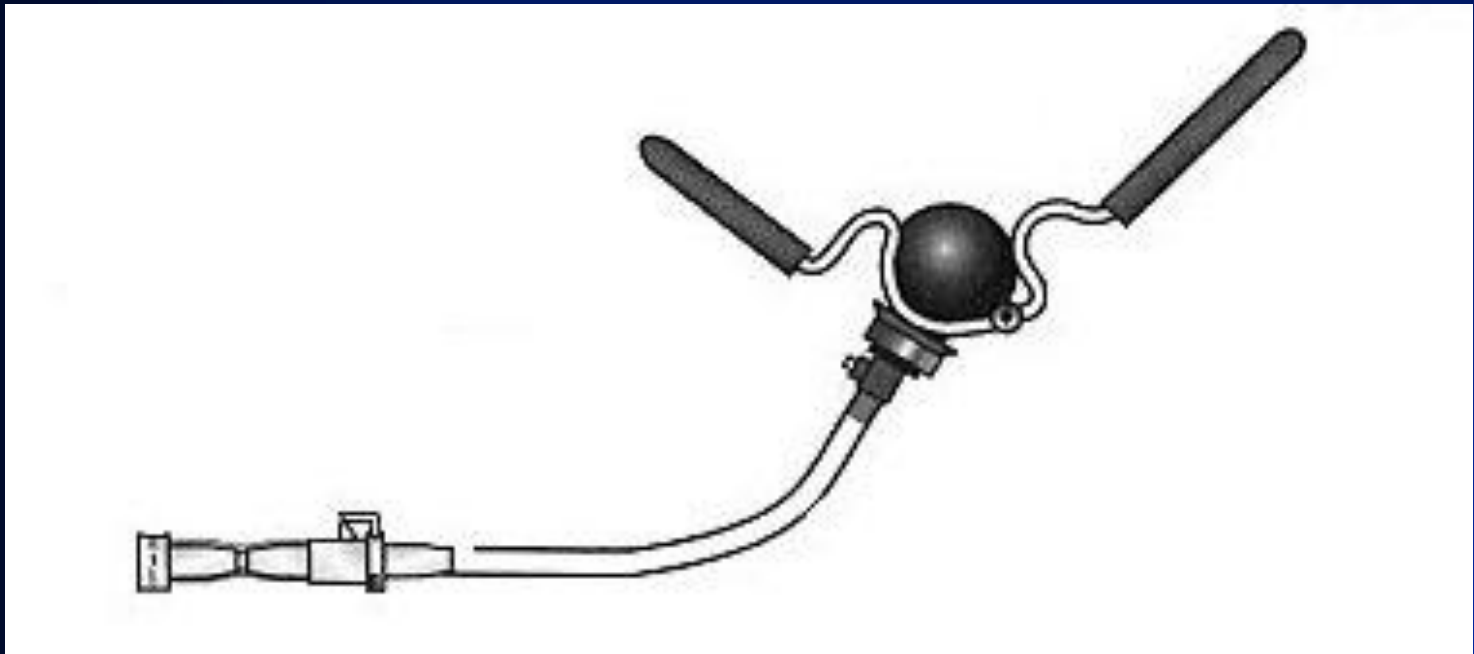


# Patient with LVAD (XVE)



# What if batteries die?

- Hand pump → vent port
- Always with patient



# Can't we make 'em smaller?

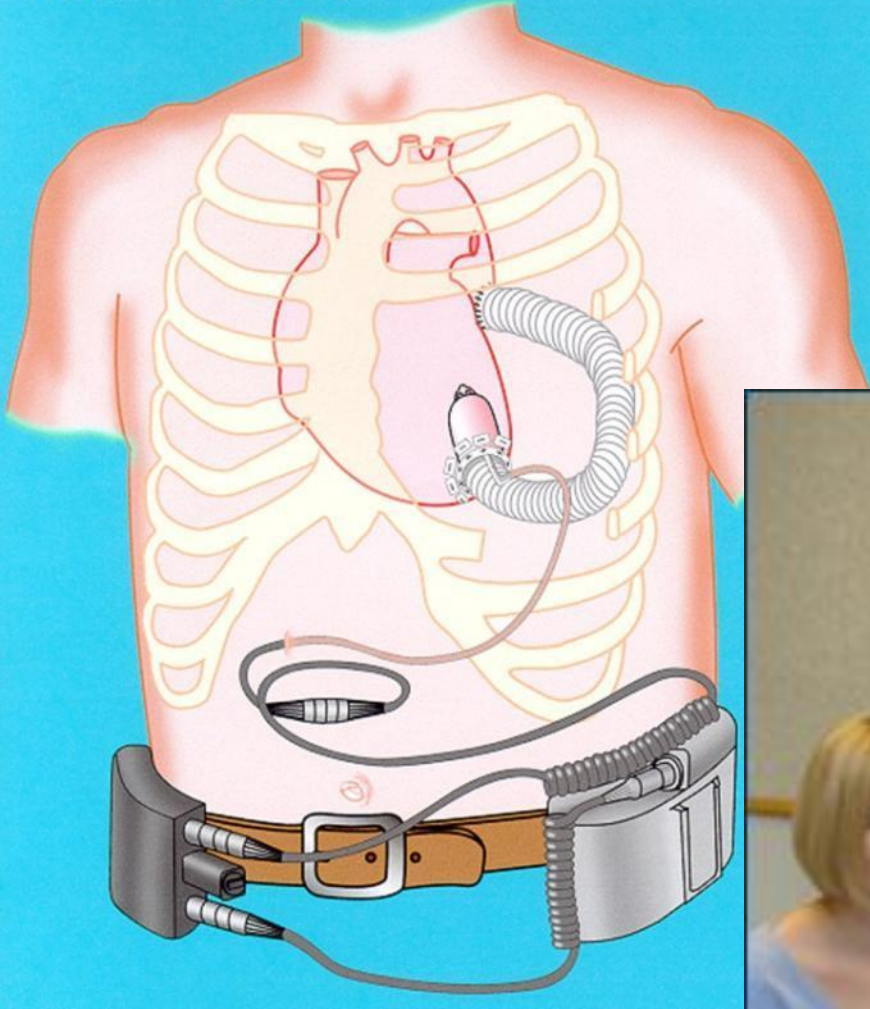
- Yup! – new devices centrifugal:



Jarvik 2000 LVAD

# Non-pulsatile flow

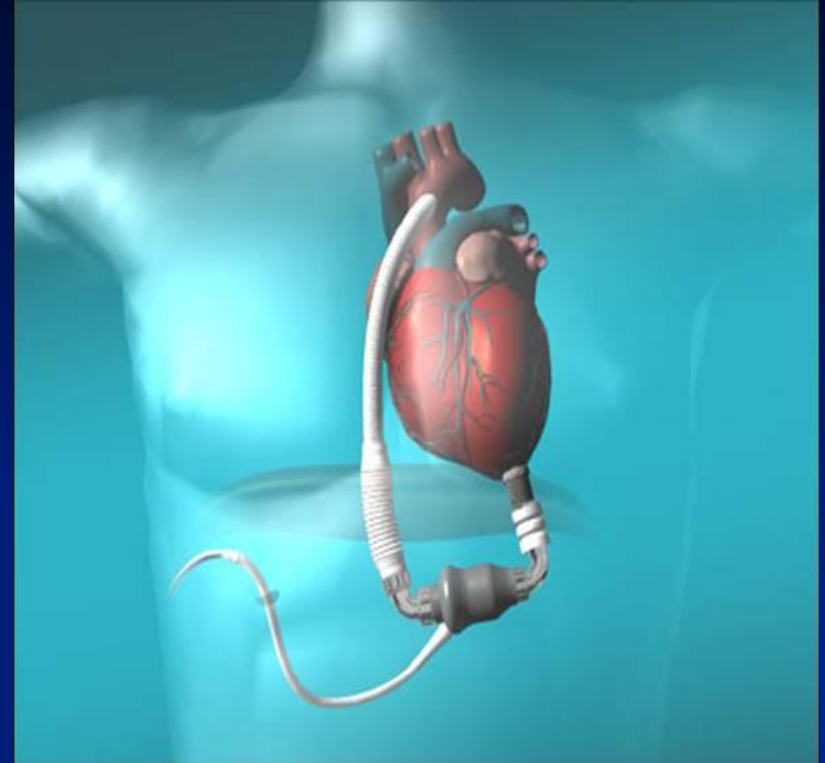
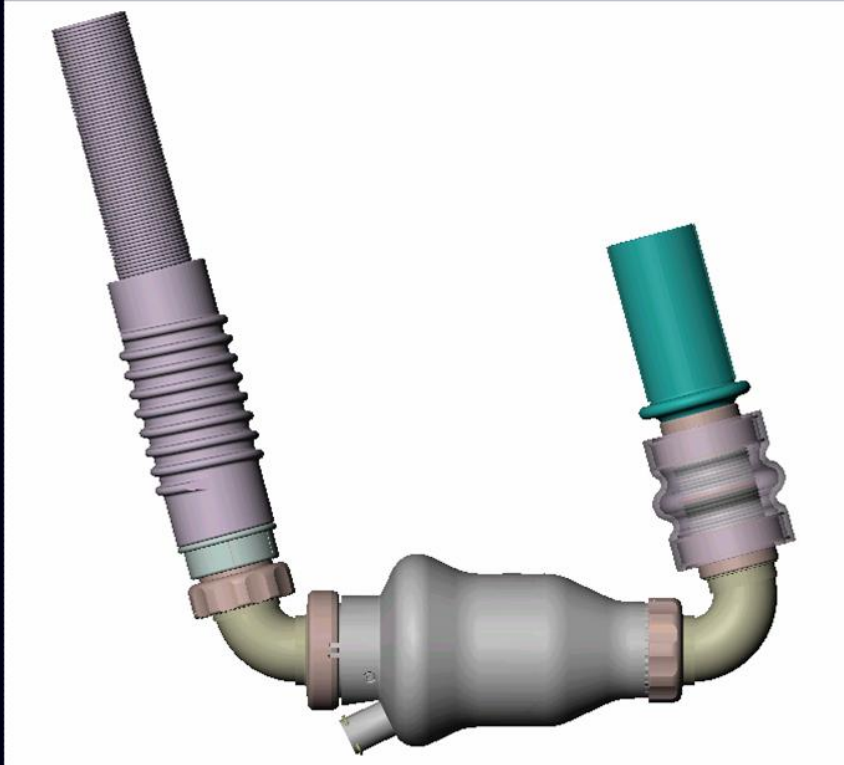
©2000 Texas Heart® Institute



# Size Comparison



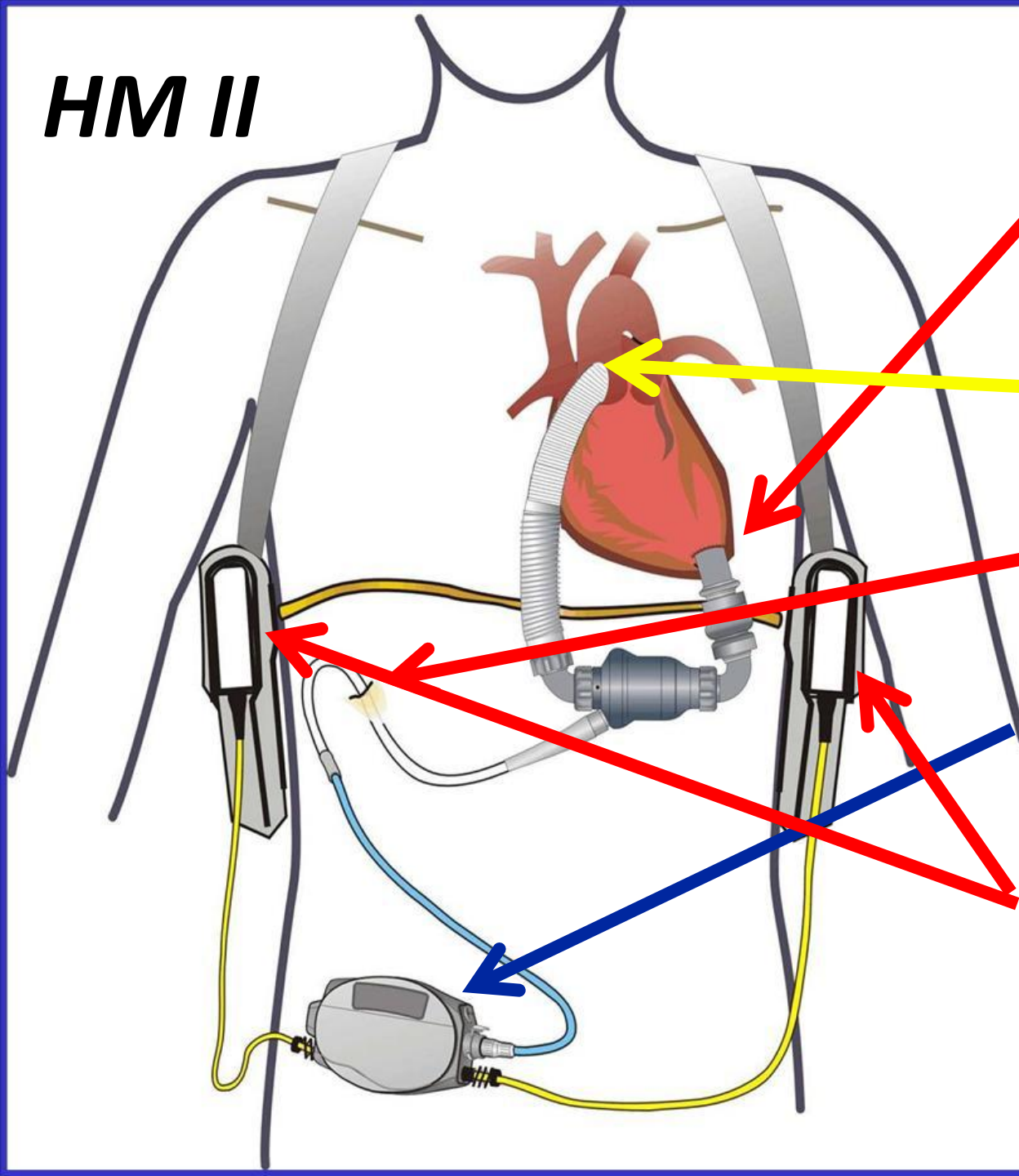
# HeartMate II LVAD - simple



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



# HM II



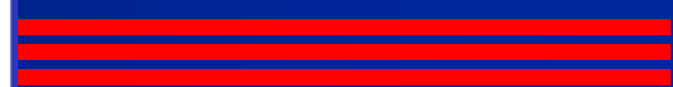
Cored into LV

Outflow to aorta

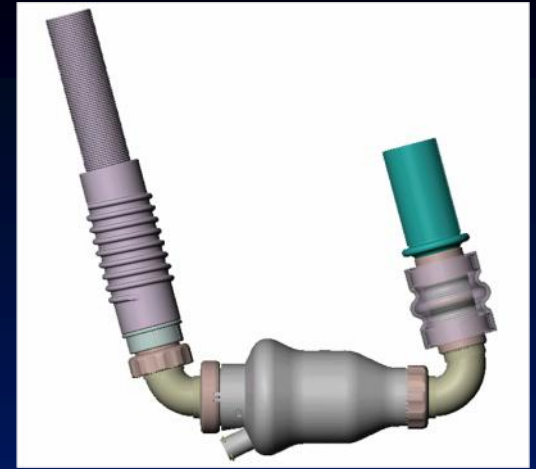
Percutaneous tube

System Controller

Batteries



# Inside the HM II

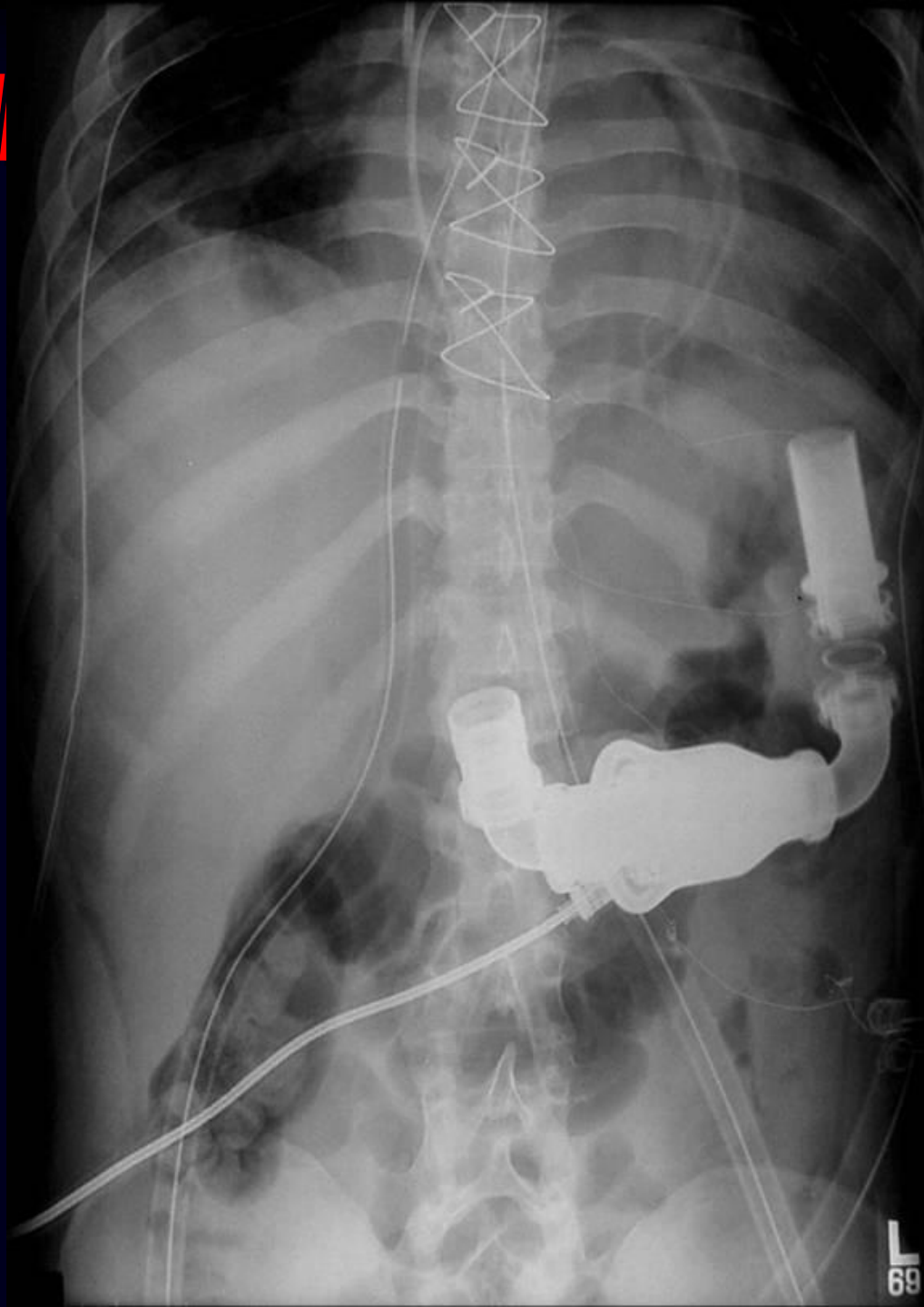


is a rotor



←← Blood Flow ←←





# Anatomic Placement



# SYSTEM CONTROLLER



- Controller + Back-up Controller

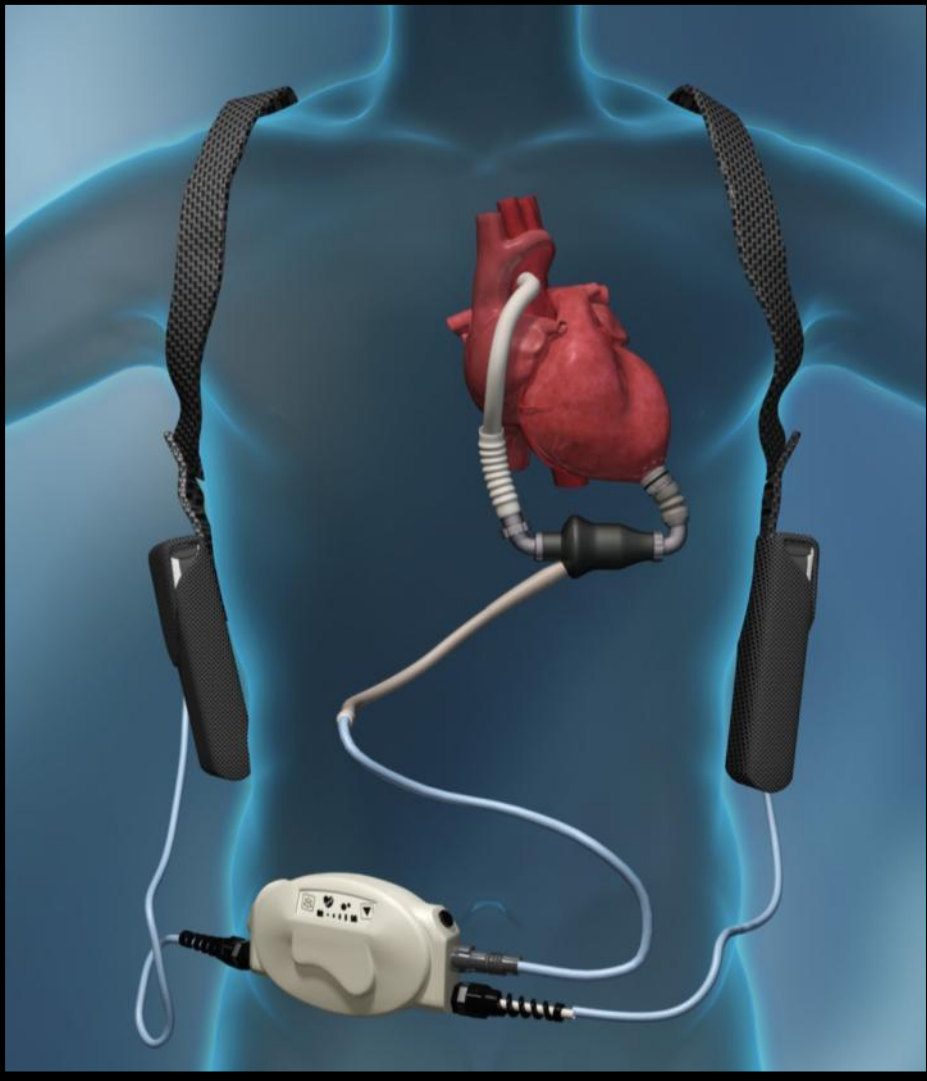
# Batteries Required



# BATTERY CHARGER



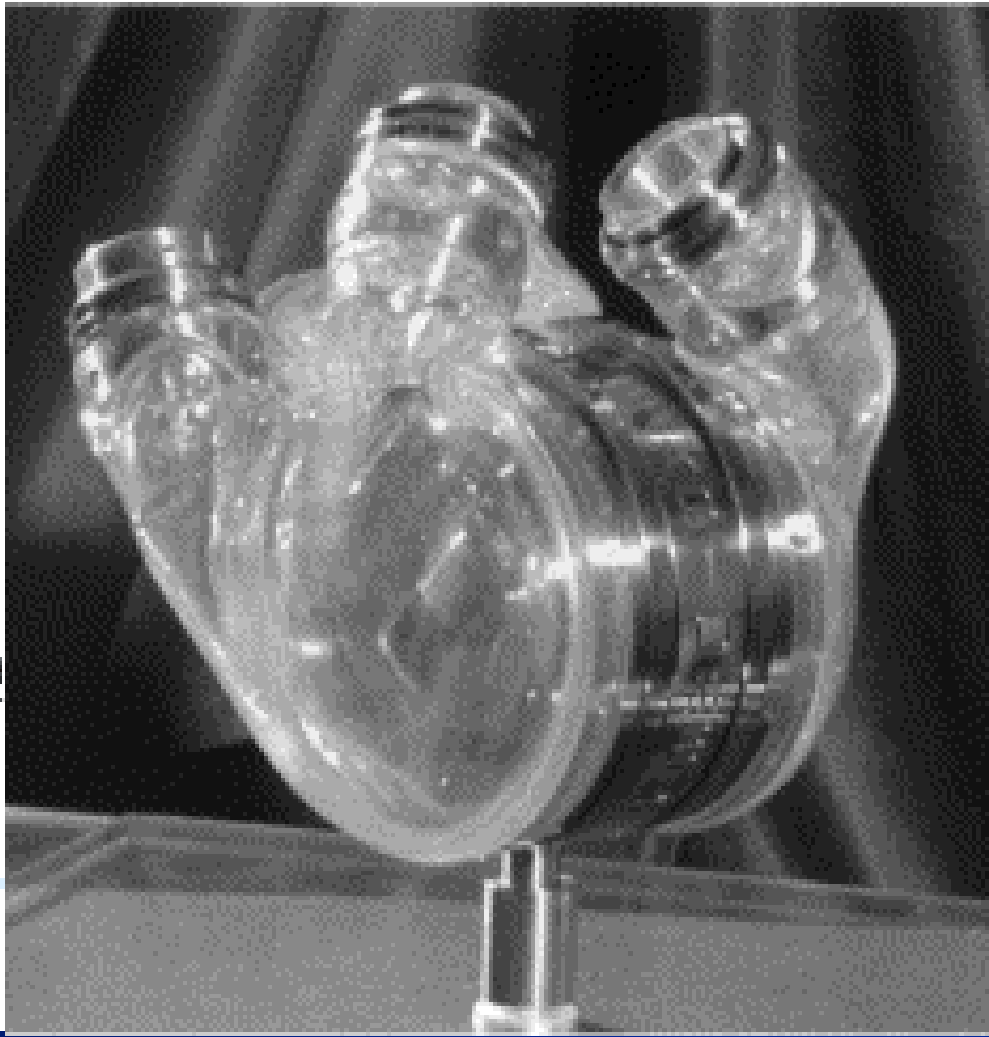
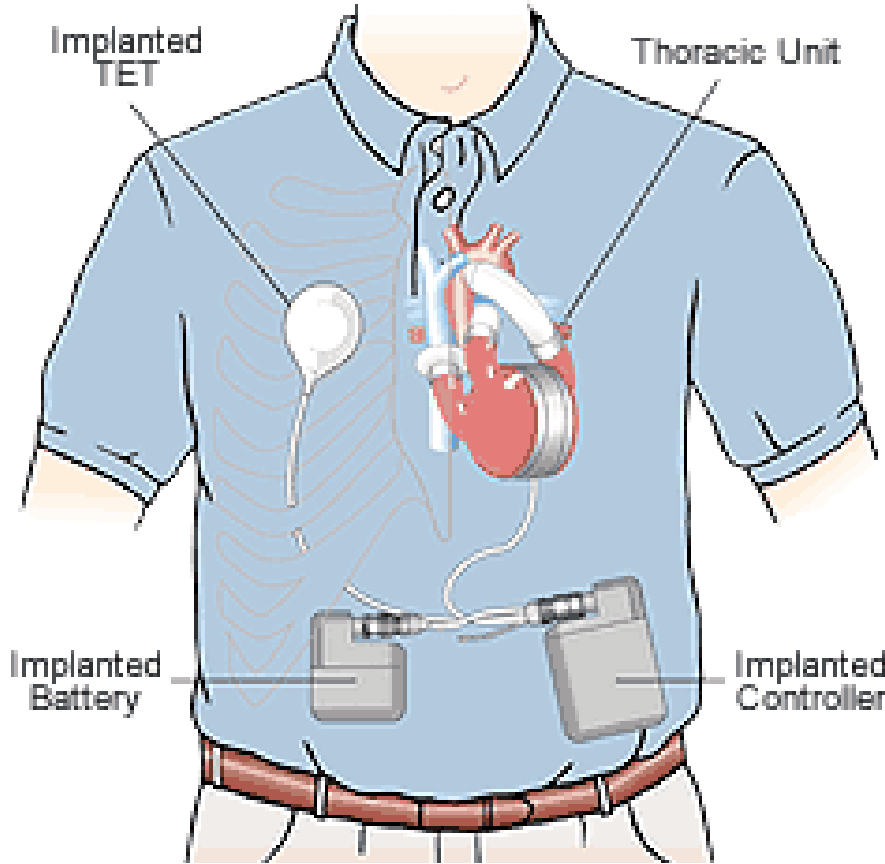
# Smaller, cleaner profile:



## Simple Design:

- Valveless
- One moving part (rotor)

# AbioCor TAH



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



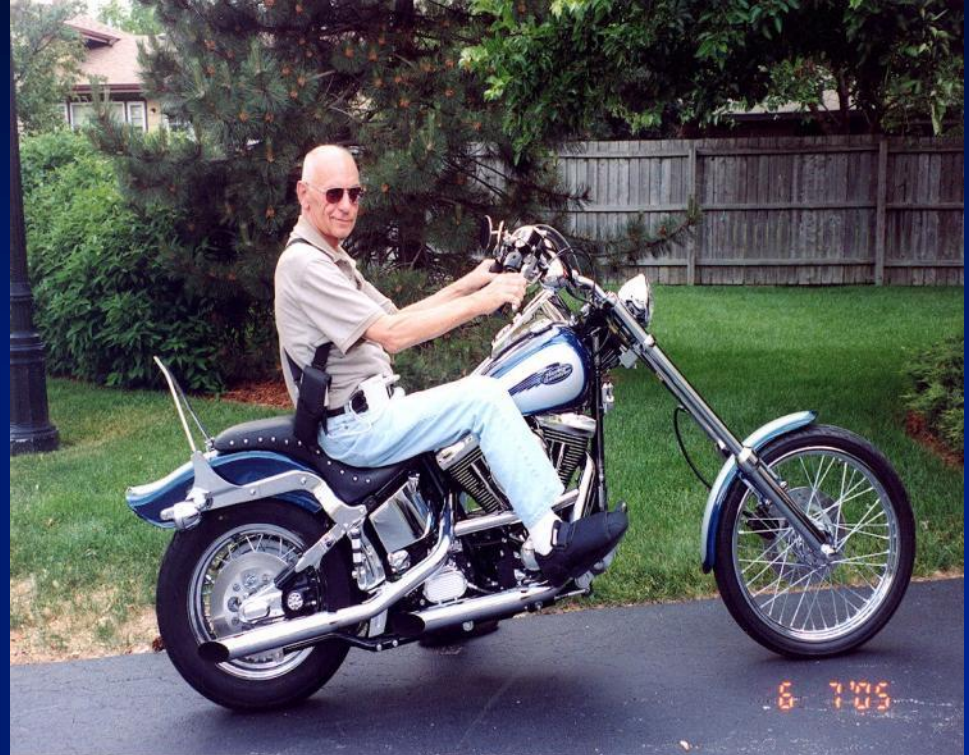
# Sightseeing: Seattle, Washington



# Visiting: New Orleans



# Out for a ride: anywhere

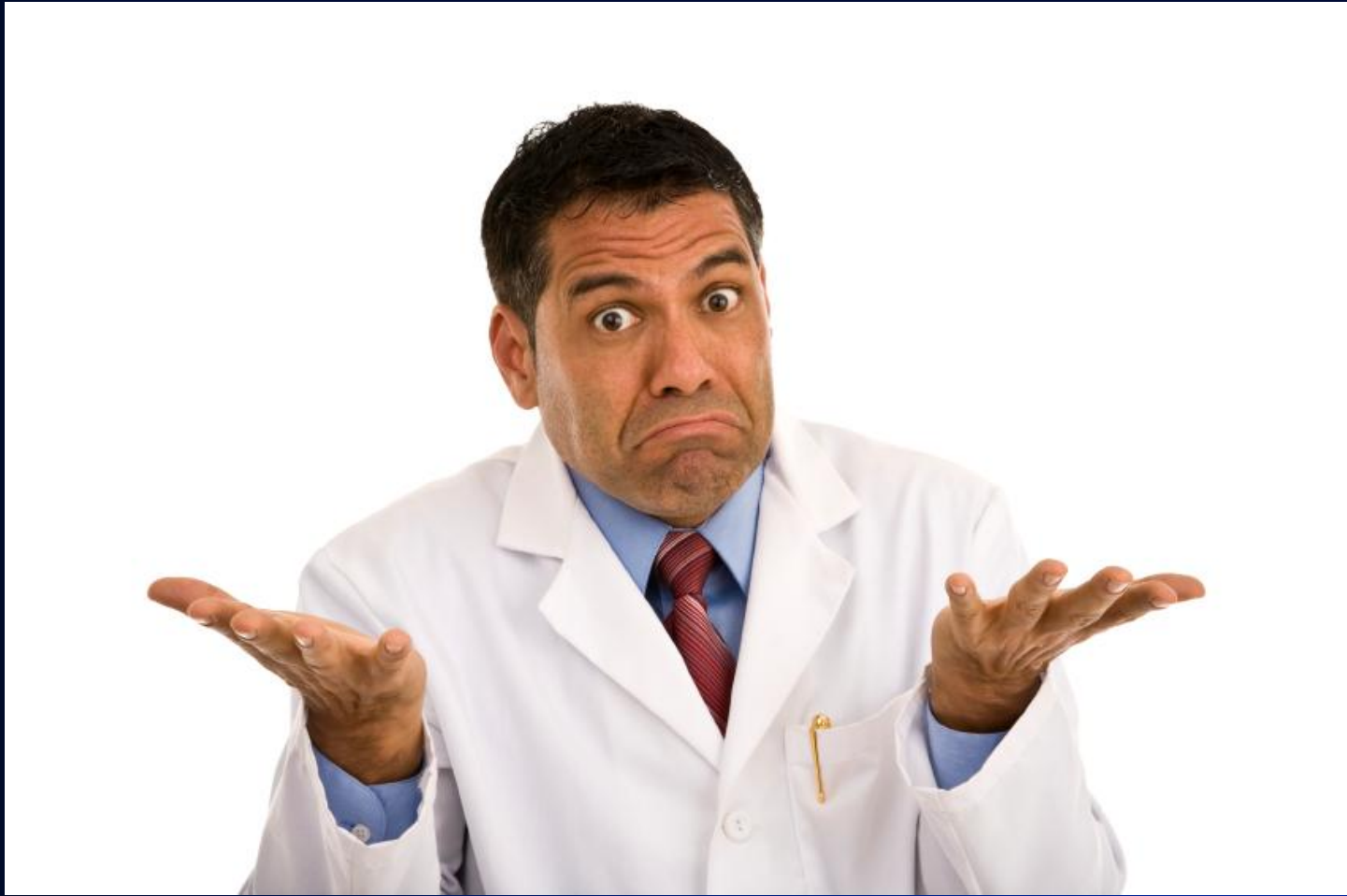


# /// Holding Political Office





# 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



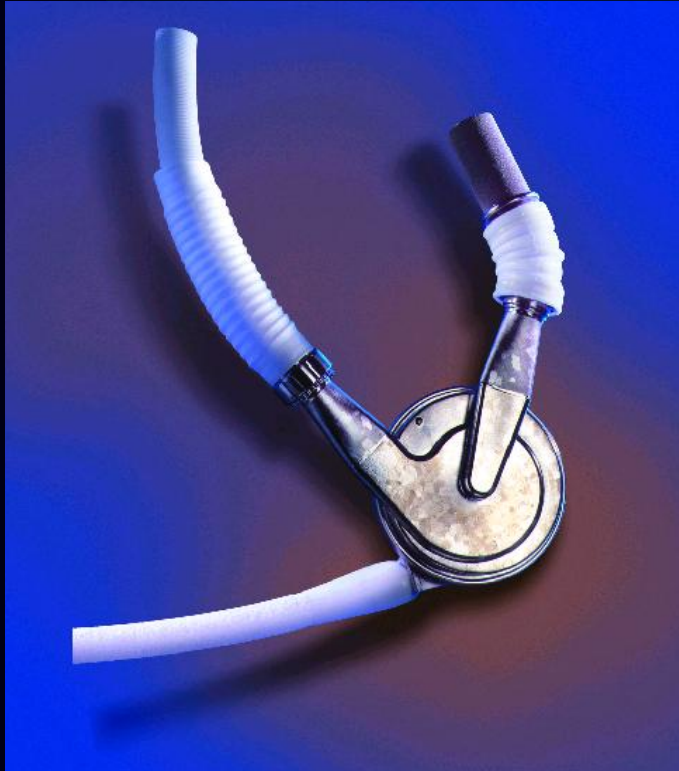
# Sternotomy



# External Equipment



# Next: HeartMate III...



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


# VAD Emergency Management

## ➤ 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](http://mikemcevoy.com)

