



Centrifugal VAD

Does it have a future?

The R.C.H.
Spin.



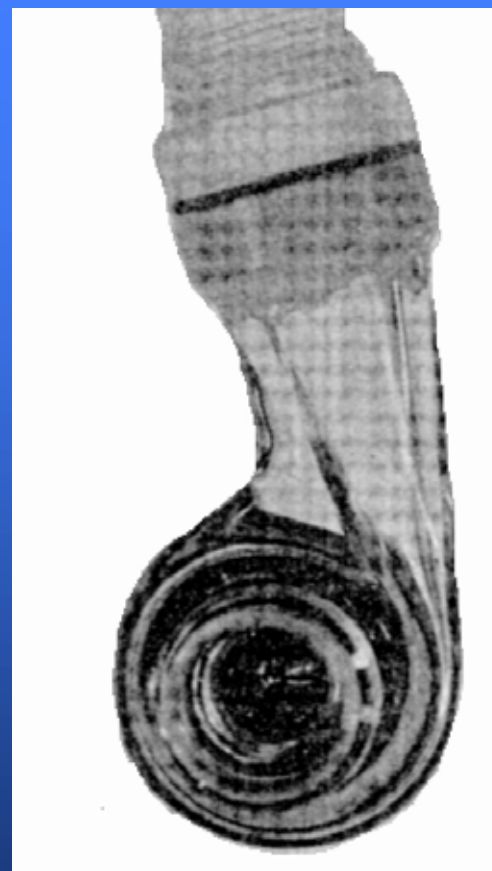
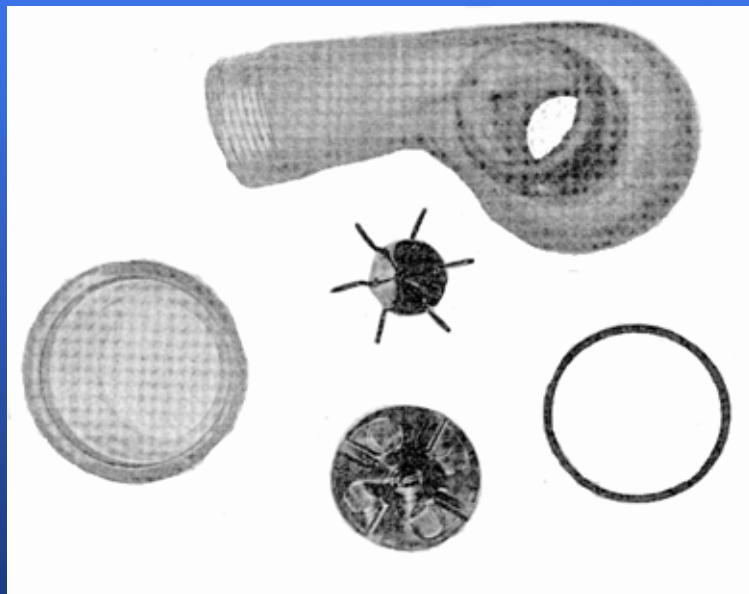
History

- Bernstein, Castaneda, Blackshear & Varco.
Prolonged mechanical support: Analysis of certain physical and physiologic considerations.
Surgery Vol 57, January 1965.
 - Minimisation of biological tolerance of the trauma to blood.
 - Adequate flow and pressure.
 - Pulsatile flow?
 - Positive displacement (insensitivity to flow resistance).
 - Variable displacement and cycling speed.
 - Absence of internal valves.
 - Simplicity of adjustment.
 - Continuous measurement of output.
 - Minimal priming volume.



History

- Bernstein, Dorman, Blackshear & Scott. An efficient compact blood pump for assisted circulation. Surgery 68 pp 105-113. 1970





History

- Golding et al. Initial clinical experience with a new temporary left ventricular assist device.
Ann Thorac Surg 1980;29:66-69.
- O.H. Frazier, J.T. Bricker, M.P. Macris & D.A. Cooley.
Use of a left ventricular assist device as a bridge to transplantation in a pediatric patient.
Texas Heart Institute Journal 1989;16;1:46-50.
- RCH: first VAD, May 1989. 4 month old ALCAPA



Why VAD?

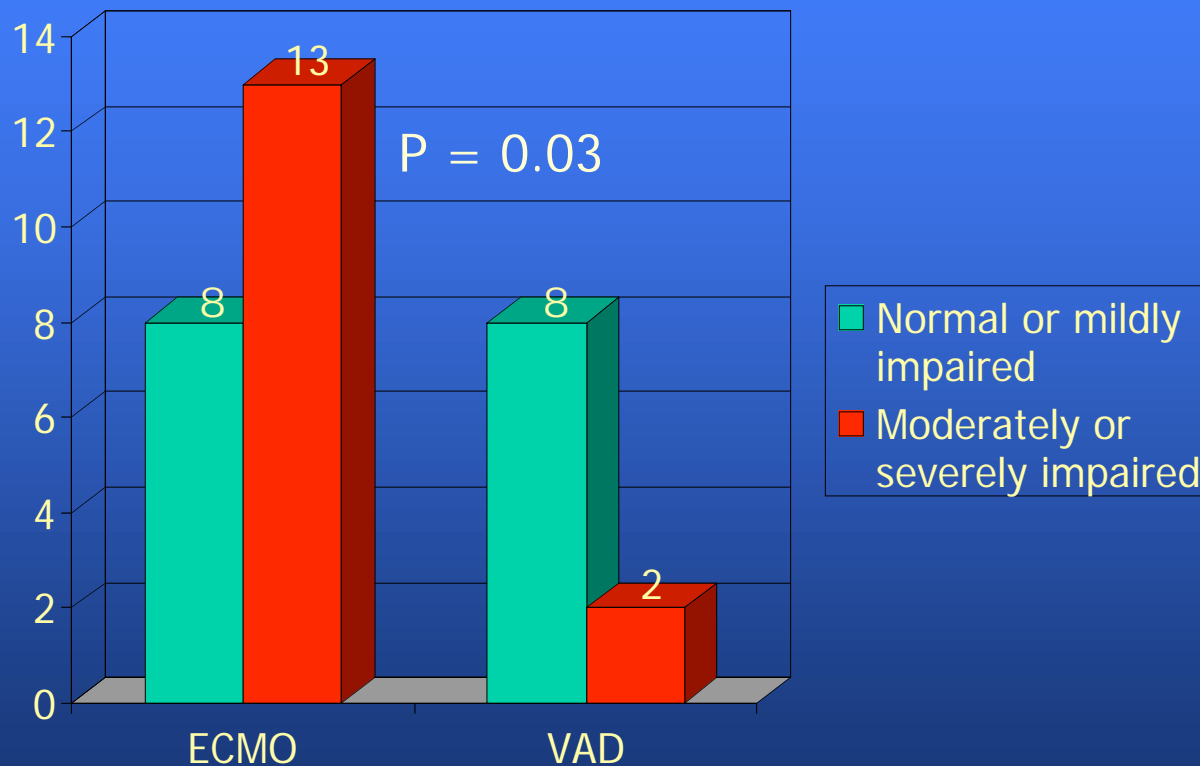
- Simplicity.
- Cost.
- Long term outcome.



Neurologic Impairment for ECMO and VAD supported pediatric patients with cardiac disease.

Ibrahim A.E, Duncan B.W, Blume E.D & Jonas R.A.

Long-term Follow-up of Pediatric Cardiac Patients Requiring Mechanical Circulatory Support. *Ann Thorac Surg* 2000;69:186-92





In current clinical use

- Biomedicus Biopump
- Terumo Capiox
- Jostra Rotaflow
- St Jude Lifestream
- Heartmate
- Nekkiso
- Cardiac Assist iVAD & pVAD
- Medos Deltastream
- CorAide
- VentrAssist

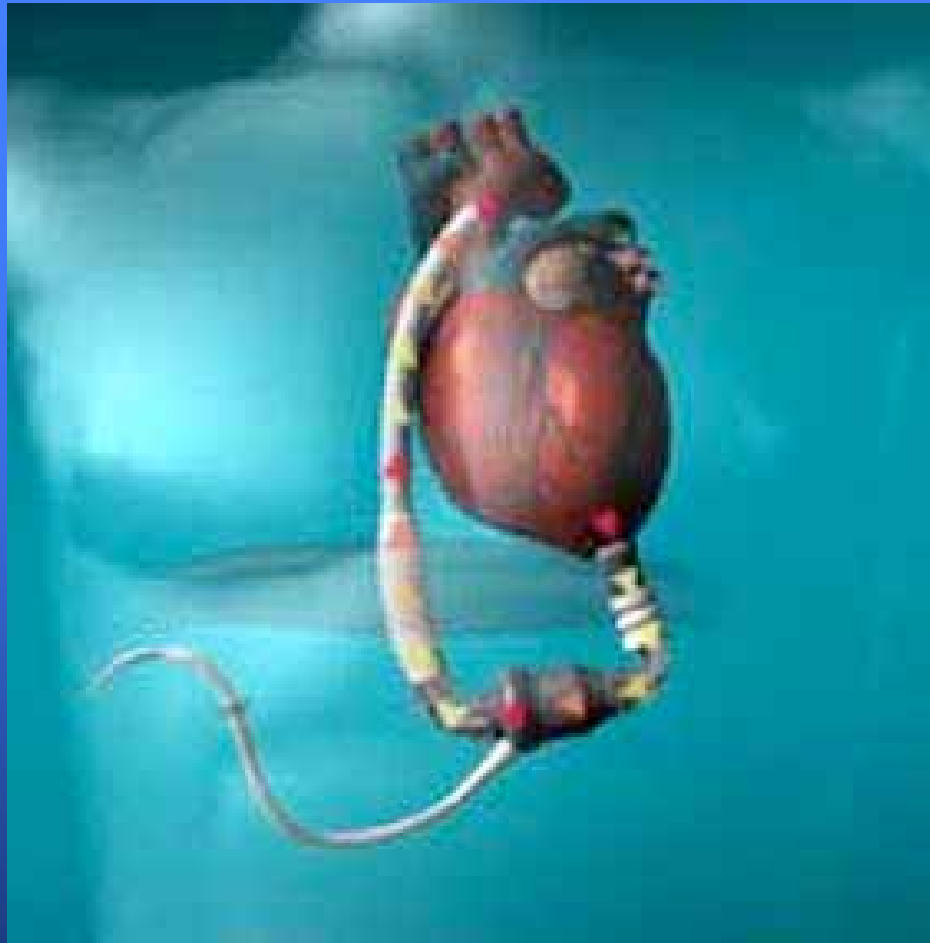


Cardiac Assist Pump System



- Delivers up to 6 liters per minute flow
- Lightweight - 280 grams
- Compact - accommodates a wide range of patients
- 7ml priming volume

Heartmate





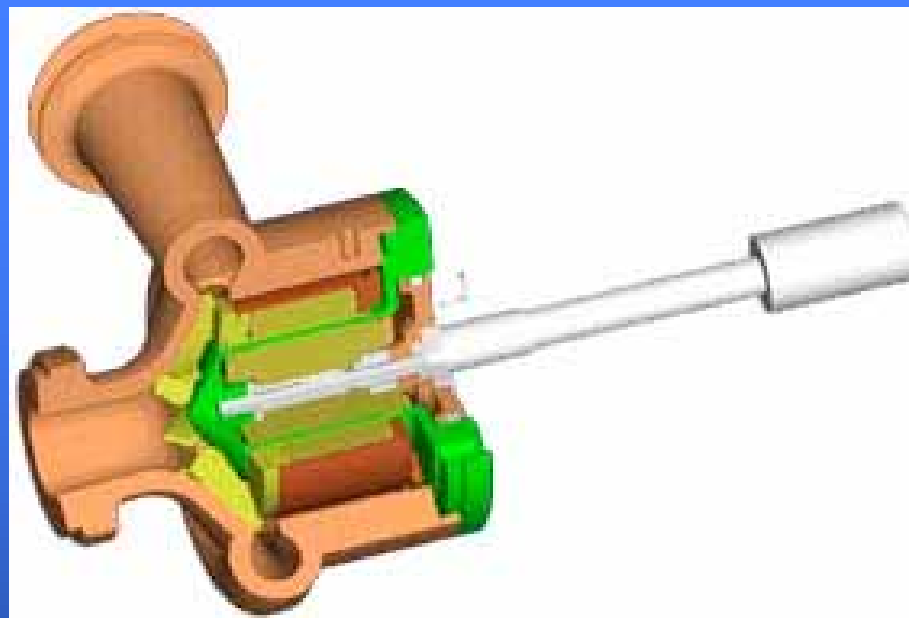
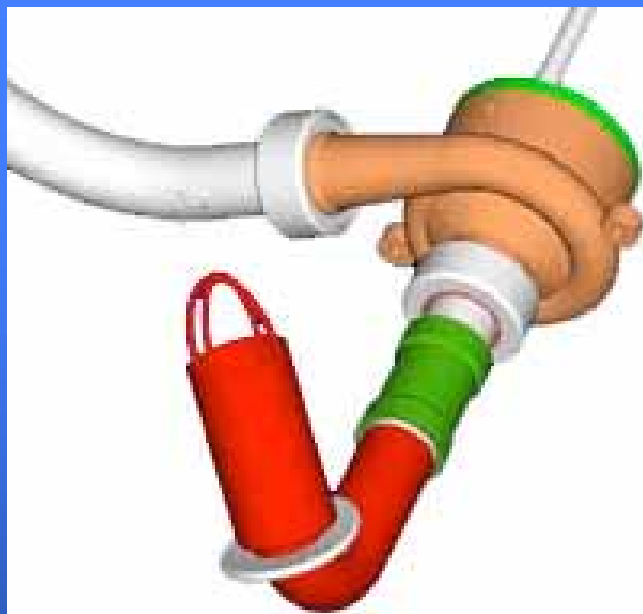
Medos DeltaStream Pump



- Cross between axial and centrifugal.
- Pulsatile flow option.
- European clinical release June 2001.



CorAide Pump



- No Seals
- Implantable

CorAide Pump





VentrAssist Pump



- Magnetic suspension with hydrodynamic bearing.
- No seals
- Diagonal flow impeller
- Passively suspended rotor.



RCH VAD Results

- n = 75
- 49 weaned (0.69, CI : 0.59 – 0.81)
- 32 discharged (0.43, CI : 0.31 – 0.55)
- Median age: 3.0 months (2 days – 19 years)
- Median weight: 4.6 kg (1.9 – 70 kg)



RCH VAD Details

- Median support time: 75 hours (1 - 428) **weanable**
 - Median support time: 79.5 hours (2 - 114) **not weanable**
 - Median support time: 73.5 hours (38 - 144) **discharged**
 - Median support time: 91 hours (19 - 428) **not discharged**
-
- Median CPB time: 208 min (181 - 235)
 - Median X Clamp time: 70 min (58 - 82)
 - Median CPB time: 85 min (8 - 654) **All patients**
 - Median X Clamp time: 41 min (0 - 369) **All patients**



ELSO ECMO Results → July 2000

- N = 21,547 (total)
- 3159 children in cardiac category (14.7%)
- 2451 cardiac surgery prior to support
- 205 transplant related indication
- 108 myocarditis
- 219 other coagulopathies
- 494 other
- 1696 weaned (0.537, CI: 0.519 - 0.554)
- Overall survival 1242 (0.393, CI:0.376 - 0.510)



ELSO ECMO Results → July 2000

- RCH (0.36) wean
- ELSO (0.54) wean
- RCH (0.21) discharge
- ELSO (0.39) discharge
- RCH VAD (0.69) wean
- RCH VAD (0.43) discharge
- RCH ECLS (0.53) wean
- RCH ECLS (0.34) discharge



The Future





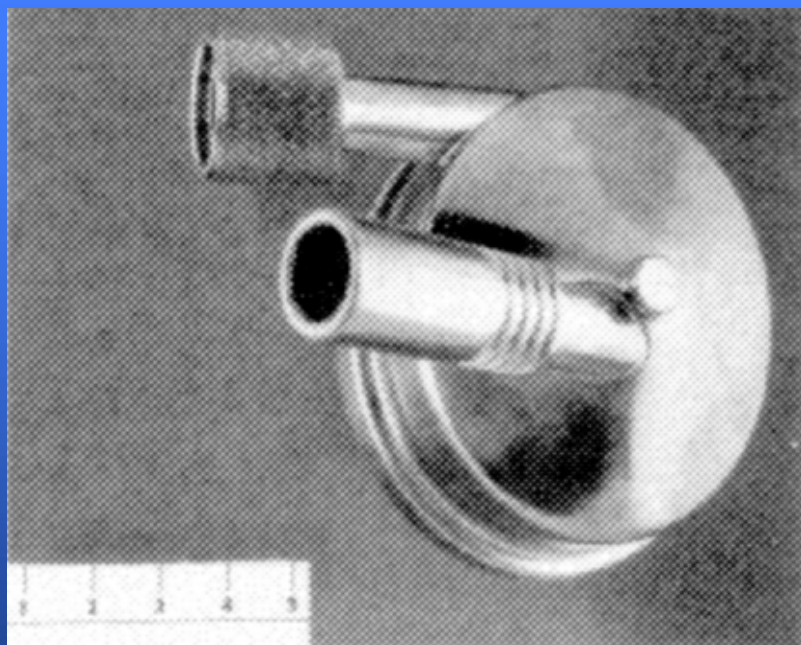
McGowan Nimbus Pump



- Designed for paediatrics
- 13 ml prime volume
- 0.3-3.0 lpm flow.
- Single use.
- 1/4" ports



Gyro Pump



- No Seals
- Double pivot bearing
- Eccentric inlet port



Other devices under development.

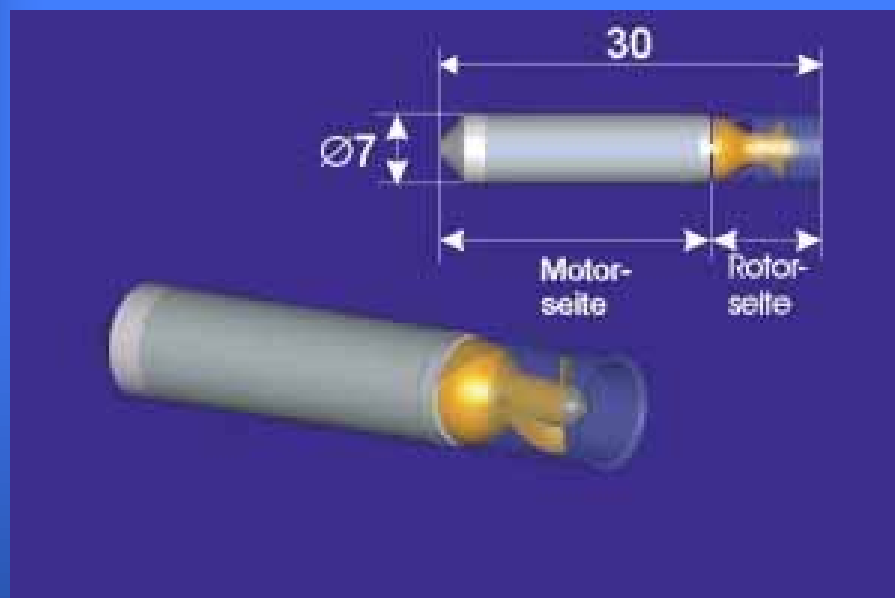
- HiFlow pump, Helmholtz Institute
- Evaheart centrifugal blood pump. Sun Medical Technology Research Corp & Pittsburgh University.
- HeartMate III LVAD. TCI/Nimbus Inc & Pittsburgh University.
- Vienna pump. Vienna University
- Abiomed CF. Abiomed Inc.
- Kriton pump. Kriton Medical Inc.
- MSCP pump. Terumo Corporation & Setsunan University.
- HeartQuest pump. MedQuest Products Inc.

HeartQuest pump



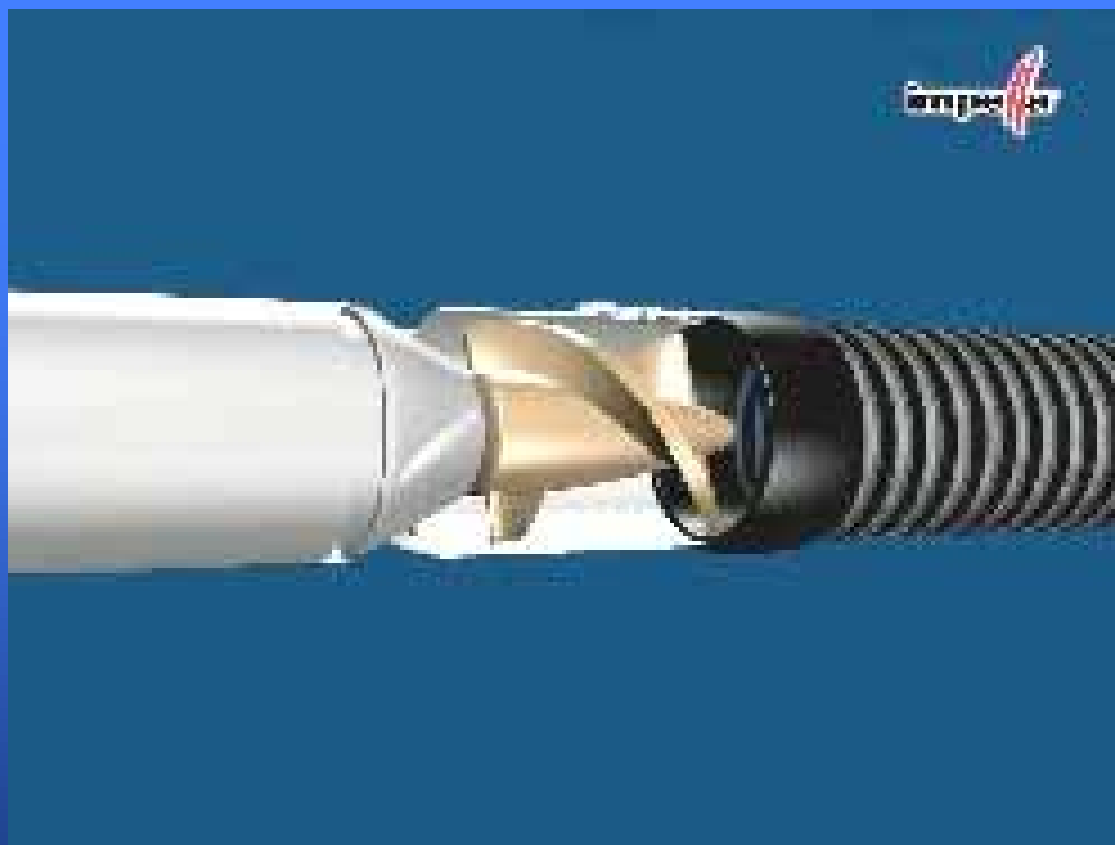


Is this the future?



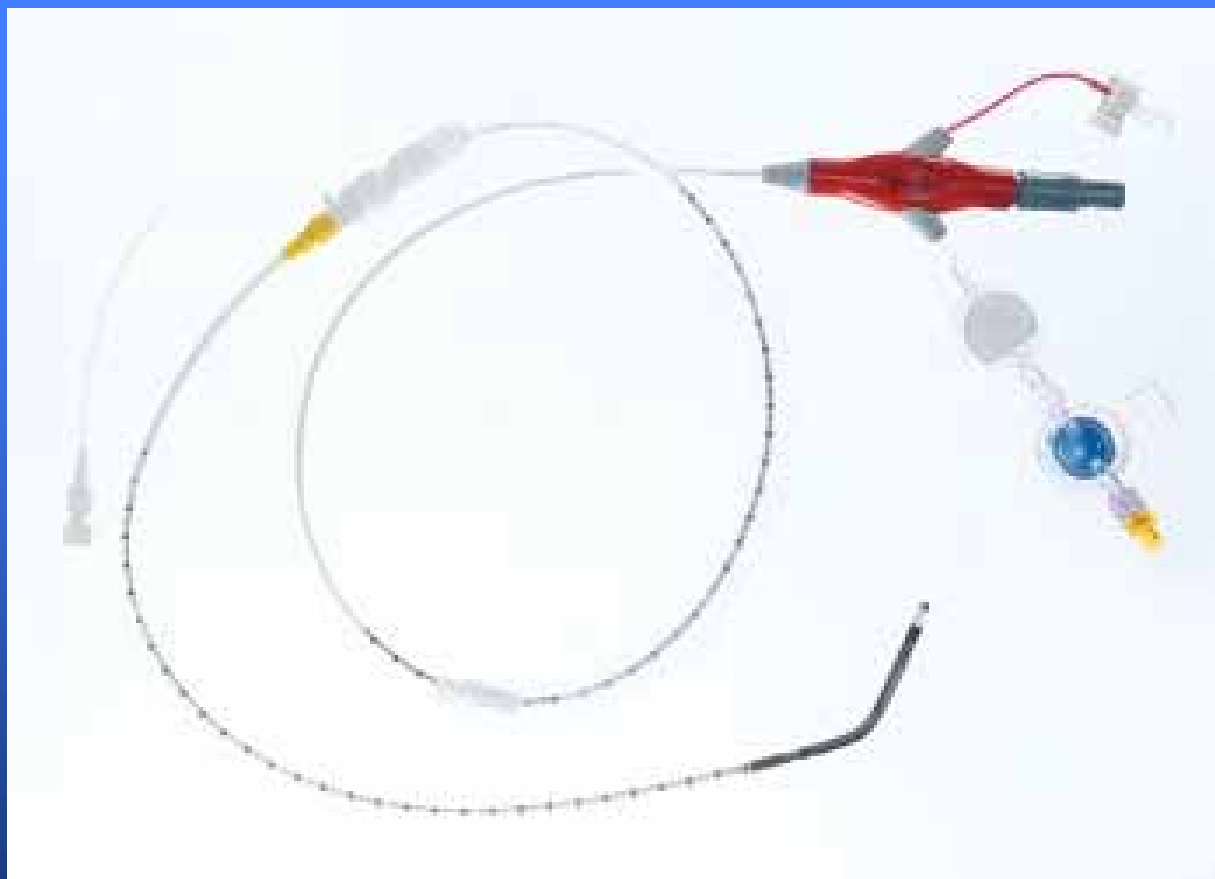


Impella Recover

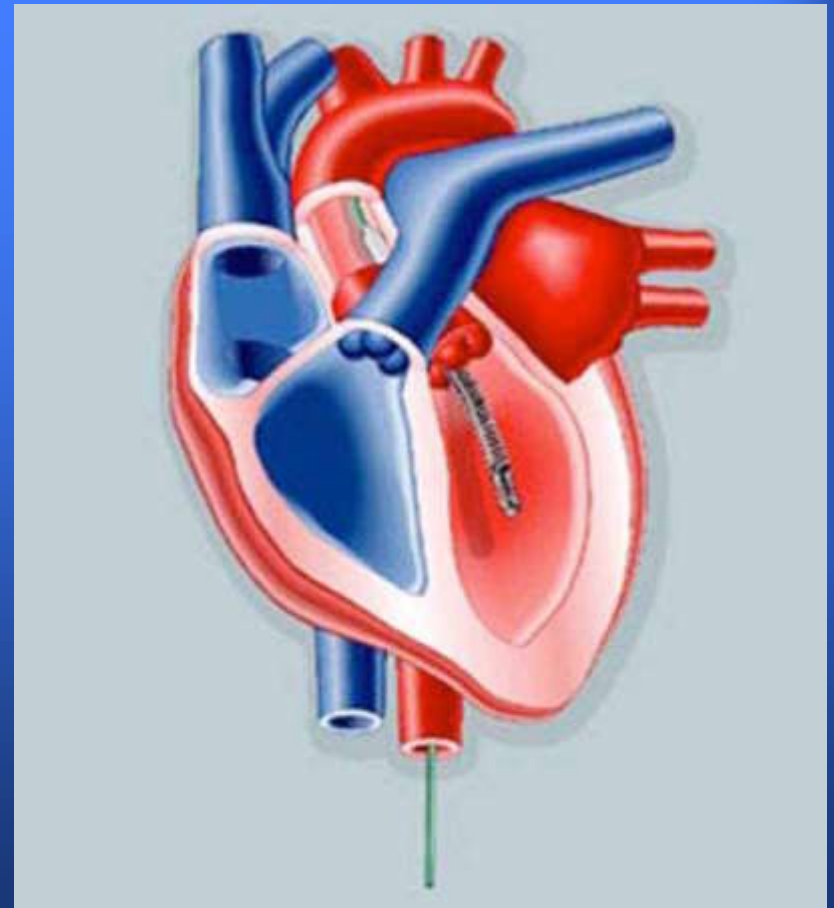
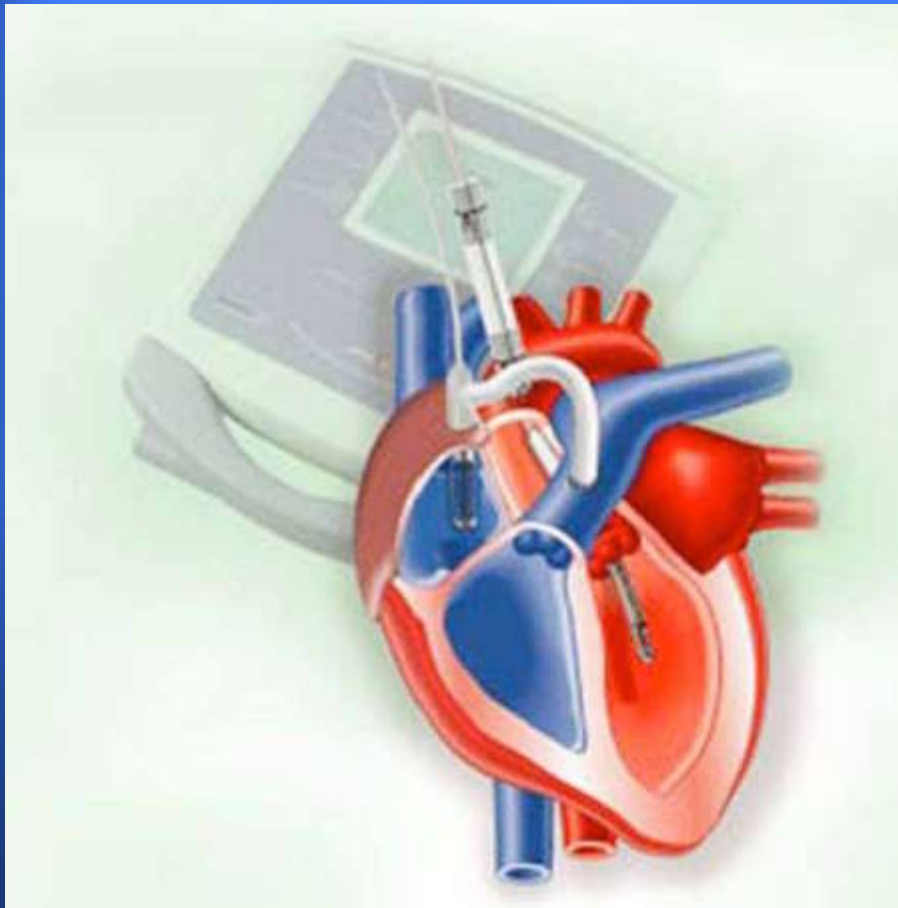




Impella Acute

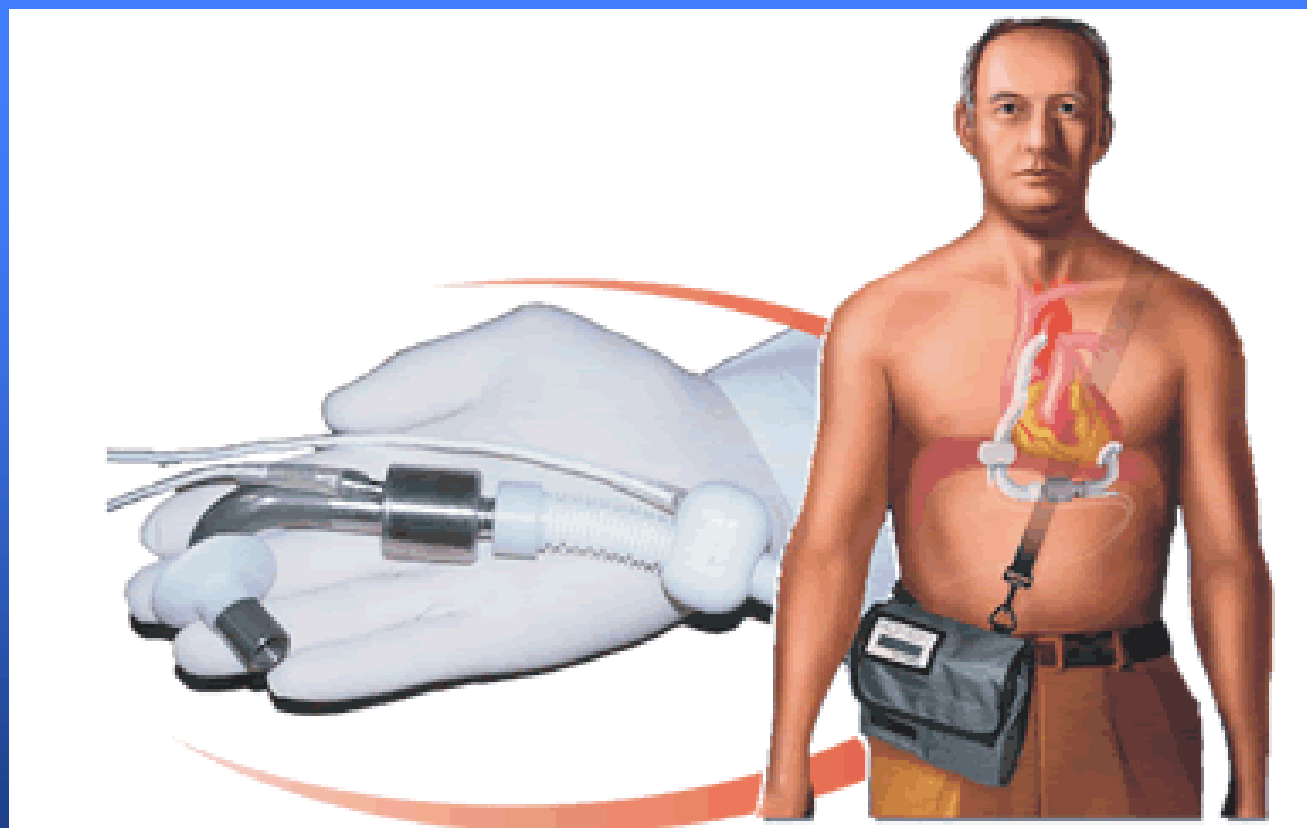


Impella

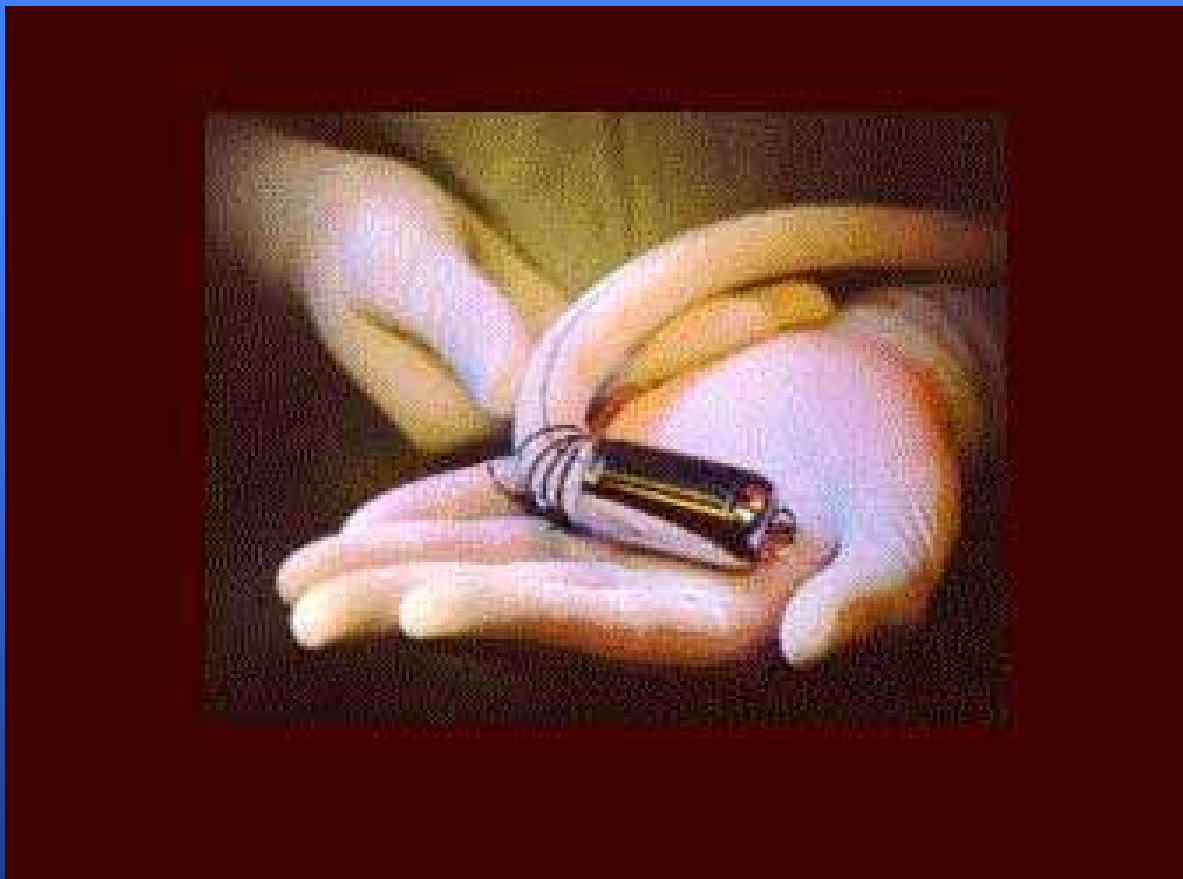




DeBakey



Jarvik 2000



Berlin Heart Incor





Conclusion

Neurological follow-up suggests VAD does less harm than ECMO for short term support.

Centrifugal VAD is cost effective for short term support.

If micro-axial pumps become less expensive they may become cost effective for short term support.