PUMP INDUCED HAEMOLYSIS:

A COMPARISON OF SHORT TERM VENTRICULAR ASSIST DEVICES
Introduction

• DeBakey - first successful use of a Ventricular Assist Device (VAD) in 1971
• New VAD systems suitable for patients down to 20kg
• Q: Can a child with complex congenital heart disease requiring univentricular support be supported without an oxygenator?
Indications & Contraindications

• Postoperative support - palliative & reparative procedures
• Refractory low Cardiac Output
• Multiorgan failure, neurological impairment, prolonged cardiac arrest
• A child accepted for heart surgery is a candidate for VAD
Royal Children’s Hospital
VAD circuit
VAD Outcomes

• 1989 - 2000 supported 75 patients using VAD
• 1.2% of CPB cases
• Median age 3 months, weight 4.6 kg
• 49 weaned (69%)
• 32 discharged (43%)
• Median support time 75 hours (1 - 428)
Haemolysis & the Centrifugal Pump

- Haemolysis = release of free Haemoglobin into plasma
- Renal damage, tissue ischemia
- Upper limit 0.6 mg/l
- Pump head change out
  - air embolism
  - circuit contamination
  - no patient support
  - additional costs

Haemolysis & the Centrifugal Pump

- Known contributors to haemolysis
  - mechanical trauma
  - areas of high shear stress
  - surface contact & exposure time
  - friction heat produced on bearings and seals
Biomedicus Bio-Pump

• Clinical use for over 20 years
• “Standard” for centrifugal pumps
• Familiar to the perfusion community
• Rotating cones
• Drive axle bearing and flexible seal
Biomedicus Bio-Pump
Jostra RotaFlow

• New generation shrouded impeller pump
• Magnetically stabilized rotor on a monopivot
• Low friction, fewer dead zones
• DEKRA approval for 4 days usage
Jostra RotaFlow

INLET

IMPELLER VANE

MAGNET

SAPPHIRE MONOPIVOT
In-vitro Bench Test

Test Circuit

- Pressure Transducer
- Transducer Isolator
- Pressure Monitoring Connection
- Flow Probe
- Centrifugal or Roller Pump
- Transducer Isolator
- Blood Reservoir
- Variable Clamp
- Sampling Point
- Variable Height
- Pump Console
Plasma Free Haemoglobin

Week 1

Time (Hours)

Plasma Hb (mg/L)

RotaFlow
Biomedicus
Roller Pump
Control
Plasma Free Haemoglobin

Week 2

Time (Hours)

Plasma Hb (mg/L)

RotaFlow  Biomedicus  Roller Pump  Control
Plasma Free Haemoglobin

Week 3

Time (Hours)

Plasma Hb (mg/L)

Week 3

RotaFlow Biomedicus Roller Pump Control
Haemolytic Index 95% Confidence Interval

Discussion

- Week 3 produced meaningful result
- RotaFlow produced lower incidence of haemolysis
- Further studies required
- Coagulation status important
Conclusion

• RotaFlow has theoretical design advantages
• Potential to be less haemolytic in clinical setting
• Retrospective trial comparing VAD results from patients supported by Bio-Cone Vs RotaFlow
• 6 hour FDA approval Vs 4 day DEKRA approval