Publication Brief

Can Dilution Methods Be Used to Assess Cardiac Performance in Patients with Complex Congenital Heart Disease? Cardiac Output and Shunt Calculation Following a Fenestrated Fontan Operation

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OBJECTIVE
To determine whether ultrasound dilution technology (COstatus® Monitor, Transonic Systems Inc., Ithaca, NY) can be used to measure cardiac output and associated parameters in children with congenital heart abnormalities that require a fenestrated Fontan operation.

STUDY
- Ultrasound dilution measurements were performed on a 20 kg patient with a single ventricle after a Fenestrated (4 mm) Extra-Cardiac Fontan operation.
- 20 ml of body temperature normal saline was injected via femoral central venous catheter.

RESULTS
COstatus® measured an average cardiac index of 2.3 L/min/m². Shunt flow was 1.0 L/min/m². The estimate of a Qp/Qs=0.57 ratio was a value consistent with a child’s low arterial oxygen saturation.

CONCLUSION
On the basis of this first patient observation, the authors concluded that ultrasound dilution technology merited further investigation as a tool to measure hemodynamic variables in infants and children with congenital heart disease.

COSTATUS® OBSERVATIONS
- This was one of the first abstracts presented introducing the COstatus® Monitor.

REFERENCES

HOW COSTATUS® MEASURES SHUNT FLOW
- Ultrasound dilution technology (COstatus®) utilizes a nontoxic indicator (normal saline) that can be used to obtain repeated measurements of cardiac index over time.
- The normal saline indicator used by ultrasound dilution methodology separates into either pulmonary (Q/p) or shunt flow (Q/s) components in patients with a congenital heart defect,
  a) The indicator in shunted flow has a shorter circulation time as it bypasses the lungs and flows directly into the systemic ventricle. It produces an early, rapid upstroke in the dilution curve proportionate to the magnitude of the right-to-left shunt.
  b) The indicator in non-shunted flow traverses the pulmonary circulation and therefore takes longer.
  c) CI and shunt fraction (Qp/Qs) calculation uses two assumptions:
    (i) Recirculation volume of the shunted normal saline is clinically insignificant;
    (ii) Estimated shunt flow is valid as calculated by the Dow Method, which integrates the initial upslope portion of the dilution curve to calculate flow parameters.