COstatus® Monitoring

- Cardiac Function
- Blood Volumes to Guide Fluid Therapy
- Shunt Identification & Quantification
- Use During Cardiac Support (ECMO, Impella, LVAD)

- Used on more than 700 neonatal, pediatric, & adult patients (0.6-115 kg)
- More than 100 publications (20 full papers)
- Hemodynamic parameters measured at various stages in single ventricle patients
- Largest pediatric single center hemodynamic study - 100 patients
- COstatus® was validated in the OR and multiple human & animal studies versus
  - Thermodilution PA Catheter
  - Direct Fick
  - Perivascular Flowsensors
Most Minimally Invasive, Universal Dilution Method

- Able to be used on patients of any age and any pathology including hypoplastic heart
- Minimally invasive - uses existing arterial & central venous catheters (no need to insert specialized catheter)
- Safe isotonic saline indicator
- No blood loss
- Quick 10 minute test

Neonatal Single Ventricle Patient 2.8 kg

Courtesy: Dr. Ana Rodrigues & Prof. Manuel Sanchez, Hospital General Universitario Gregorio Marañón Madrid, Spain

Adult Patient 108 kg

Courtesy: Prof. Eremenko, Center for Surgery Moscow, Russia

Transonic Systems Inc. is a global manufacturer of innovative biomedical measurement equipment. Founded in 1983, Transonic sells “gold standard” transit-time ultrasound flowmeters and monitors for surgical, hemodialysis, pediatric critical care, perfusion, interventional radiology and research applications. In addition, Transonic provides pressure and pressure volume systems, laser Doppler flowmeters and telemetry systems.
COstatus® Schematic

Schematic of AV Loop with connections to the patient’s existing arterial and CV catheters.

AV Loop Priming Volume:
- HCS3021: 5.3 mL
- Injection Volume: 0.5 - 1 mL/kg
- Maximum Injection Volume: 30 mL
- Pump Rate: 8-12 mL/min
- Measurement Time: 5 - 8 min

transonic
THE MEASURE OF BETTER RESULTS.
Hypo- and Hypervolemic Status Assessment in Pediatric and Neonatal Patients

**TEDVI**
Volume of Blood in the
- Heart at end of diastole

**CBVI**
Volume of Blood in the
- Heart
- Lungs
- Large Central Vessels

**ACVI**
Volume of Blood in the
- Heart
- Lungs
- Brain, Liver, Kidneys, etc.

*ACVI is close to total blood volume in infants*

---

**Total End Diastolic Volume Index (TEDVI), mL/kg**

Hypovolemic: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Hypervolemic: 11, 12, 13, 14, 15, 16

---

**Central Blood Volume Index (CBVI), mL/kg**

Hypovolemic: 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

Hypervolemic: 21, 22, 23, 24, 25, 26, 27, 28, 29, 30

---

**Active Circulation Volume Index (ACVI), mL/kg**

Hypovolemic: 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68

Hypervolemic: 70, 72, 74, 76, 78, 80, 82, 84, 86, 88, 90, 92
Identifying and Quantifying Shunts with Qp/Qs

**Left to Right**

- **First Case**
  - CO: 0.73 L/min
  - CI: 3.35 L/min/m²
  - SVI: 25 ml/m²
  - CBV: 18 ml/kg
  - TEVI: 13 ml/kg
  - SVR: 860 (dyne·s/cm²·m²)
  - AWC: 68 ml/kg
  - TEF: 48%
- **Second Case**
  - CO: 0.75 L/min
  - CI: 3.45 L/min/m²
  - SVI: 21 ml/m²
  - CBV: 21 ml/kg
  - TEVI: 21 ml/kg
  - SVR: 1000 (dyne·s/cm²·m²)
  - AWC: 69 ml/kg
  - TEF: 25%
- **Third Case**
  - CO: 1.08 L/min
  - CI: 2.42 L/min/m²
  - SVI: 20 ml/m²
  - CBV: 28 ml/kg
  - TEVI: 62 ml/kg
  - SVR: 1450 (dyne·s/cm²·m²)
  - AWC: 62 ml/kg
  - TEF: -----

**Possible L-R shunt**: Qp/Qs = 1.2+0.2

**Possible L-R shunt**: Qp/Qs = 3.1+0.4

**Possible L-R shunt**: Qp/Qs = 2.7+0.4

**Right to Left**

- **First Case**
  - CO: 1.97 L/min
  - CI: 2.14 L/min/m²
  - SVI: 28 ml/m²
  - CBV: 16 ml/kg
  - TEVI: 11 ml/kg
  - SVR: 2390 (dyne·s/cm²·m²)
  - AWC: 39 ml/kg
  - TEF: 39%
- **Second Case**
  - CO: 2.02 L/min
  - CI: 4.23 L/min/m²
  - SVI: 39 ml/m²
  - CBV: 13 ml/kg
  - TEVI: 20 ml/kg
  - SVR: 930 (dyne·s/cm²·m²)
  - AWC: 68 ml/kg
  - TEF: 34%
- **Third Case**
  - CO: 0.85 L/min
  - CI: 4.09 L/min/m²
  - SVI: 30 ml/m²
  - CBV: 13 ml/kg
  - TEVI: 13 ml/kg
  - SVR: 780 (dyne·s/cm²·m²)
  - AWC: 47 ml/kg
  - TEF: 55%

**Possible R-L shunt**: Qp/Qs = 0.84+0.13

**Possible R-L shunt**: Qp/Qs = 0.59+0.10

**Possible R-L shunt**: Qp/Qs = 0.72+0.11
Is a Residual Shunt Hemodynamically Significant?

Patient (3.5 kg) after VSD surgery

A post-op COstatus® measurement indicated a possible residual left-to-right shunt (Qp/Qs = 1.2) after shunt surgery.

Courtesy: Dr. Perez de Sá & Dr. Lindberg, Skåne University Hospital Lund, Sweden
Evaluating Patients with Single Ventricle Anatomy

Select Single Ventricle Patient on COstatus® Screen

Specify Single Ventricle Anatomy
Measurements Pre- and Post- Norwood Surgery

2.8 kg Patient

Pre-stage 1 Repair

<table>
<thead>
<tr>
<th></th>
<th>Pre-Repair</th>
<th>Post-Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Qp/Qs</strong></td>
<td>2.5</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>SVRI</strong></td>
<td>2710 (dy/cm²)m²</td>
<td>1700 (dy/cm²)m²</td>
</tr>
<tr>
<td><strong>Qs</strong></td>
<td>0.23 L/min</td>
<td>0.35 L/min</td>
</tr>
<tr>
<td><strong>Cl</strong></td>
<td>1.2 L/min/m²</td>
<td>1.8 L/min/m²</td>
</tr>
</tbody>
</table>

Post-stage 1 Repair

- CO and Cl are total cardiac output and index
- Qs and Cls are systemic cardiac output and index
- Qp/Qs calculations are based on mathematical model

Courtesy: Dr. Ana Rodrigues & Prof. Manuel Sanchez,
Hospital General Universitario Gregorio Marañón Madrid, Spain
Cardiac Status to Wean Patient from VA ECMO

Heart Flow = Cardiac Output - Pump Flow

CO = total systemic flow from pump and heart

3.2 kg Patient

Total CO measured by COstatus®: 0.34 L/min
ECMO Pump Flow: 300 mL/min

Heart Flow = 340 mL/min - 300 mL/min = 40 mL/min

*Venous part of AV loop gets connected to the ECMO system (Between oxygenator and pump)

Courtesy: Dr. Ana Rodrigues & Prof. Manuel Sanchez, Hospital General Universitario Gregorio Marañón Madrid, Spain

transonic

THE MEASURE OF BETTER RESULTS.
Bibliography: COstatus® References

PART I: CARDIAC OUTPUT

CARDIAC OUTPUT VALIDATIONS/COMPARISONS: CLINICAL STUDIES AND METHODOLOGY


Rajaopal SK, Costello M, “Validation of an Ultrasound Dilution Cardiac Output Measurement Technique in Critically Ill Children,” Pediatric Critical Care Colloquium, Pittsburgh, PA, May 15-17, 2010 [PICU, Vs. Metabolic Cart (indirect Fick)] Boston Childrens, USA. (Transonic Reference # CO8028V)


CARDIAC OUTPUT VALIDATIONS/COMPARISONS: ANIMAL MODELS


CARDIAC OUTPUT VALIDATIONS/COMPARISONS: ANIMAL MODELS CONT.


PART II: SHUNTS

SHUNT IDENTIFICATION: METHODOLOGY


Krivitski N, Kislukhin V, Thuramalla N, “Identification of Shunts based on the Shape of the Dilution Curve,” 3rd Congress of European Academy of Paediatric Societies (EAPS), Copenhagen, Denmark, Oct. 23-26 2010, Poster Presentation #121. (Transonic Reference # CO8042)


Krivitski N, Kislukhin V, Thuramalla N, “Identification of Shunts based on the Shape of the Dilution Curve,” 3rd Congress of European Academy of Paediatric Societies (EAPS), Copenhagen, Denmark, Oct. 23-26 2010, Poster Presentation #121. (Transonic Reference # CO8042)

SHUNT IDENTIFICATION: PEDIATRIC AND NEONATAL CLINICAL STUDIES


Marr B, “Can Ultrasound Dilution (UD) Identify and Qualify the Type of Shunt in Neonates with Patent Ductus Arteriosus (PDA)?” Pediatric Critical Care Colloquium, Pittsburgh, PA, May 15-17, 2010. (Transonic Reference # CO8026A)


SHUNT IDENTIFICATION: PEDIATRIC AND NEONATAL ANIMAL MODELS


PART III: SINGLE VENTRICLE
SINGLE VENTRICLE: THEORY AND CLINICAL STUDIES


PART IV: BLOOD VOLUMES
BLOOD VOLUMES: PEDIATRIC AND NEONATAL CLINICAL STUDIES


Ostrowicki R et al, “Effect of Furosemide on Cardiac Index and Circulating Blood Volumes in Pediatric ICU Patients,” Pediatric Critical Care Colloquium, Pittsburgh, PA, May 15-17, 2010 (Transonic Reference # CO8027A)


Eremenko AA and Safarov PN, “Central blood volume index and total end-diastolic volume index as indicators of cardiac preload,”Abstract # 312, Critical Care Medicine, A83, Vol. 35 Supplement 12, Dec 2007. Poster Presentation at the SCCM 37th. Critical Care Congress, Feb 2-6, 2008, Hawaii, USA.


BLOOD VOLUMES: PEDIATRIC AND NEONATAL ANIMAL MODELS


Bandt C et al, “Effects of Norepinephrine on Dynamic versus Static Variables of Fluid Responsiveness during Hemorrhage and after Resuscitation in a Pediatric Model,” Poster Presentation: Pediatric Cardiac Int. Care Soc 2010, Dec 8-11 2010, Miami Beach, FL, USA. (Transonic Reference # CO8116A)


Available in the UK from:
SLE Limited.
Twin Bridges Business Park, 232 Selsdon Road,
South Croydon Surrey CR2 6PL UK
Telephone:+44 (0)20 8681 1414 • Fax: +44 (0)20 8649 8570
E-mail: sales@sle.co.uk • Web: www.sle.co.uk