Publication Brief

Cardiac Output (CO) and Blood Volumes Measurement in Neonatal ICU Using Ultrasound Dilution - First Experience

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OBJECTIVE
Pilot study to test the feasibility of using COstatus® in neonatal ICU (NICU) patients:
• To measure cardiac output (CO) in babies <1kg;
• To assess blood volume changes in response to fluid therapy.

STUDY
• Two NICU patients enrolled in the study.
• The 2nd patient was measured by COstatus® before and after 70 mL of albumin infusion.
• ULTRASOUND FLOW/DILUTION MEASUREMENTS: A primed AV loop was connected between in situ umbilical arterial and dual-lumen umbilical venous catheters. To perform measurements, 2-4 mL of body temperature isotonic saline was injected into venous side of the AV loop as a roller pump circulated blood at 8-10 mL/min through the loop from the artery to vein for up to 5 minutes. Two ultrasound dilution sensors, placed on the loop, sensed the change in velocity of the blood. After measurements were performed, the AV loop was flushed with heparinized saline and blood was returned to the patient.

RESULTS

<table>
<thead>
<tr>
<th>Neonate</th>
<th>Medical Condition</th>
<th>CO (L/min)</th>
<th>CI (L/min/m²)</th>
<th>CBVI (mL/kg)</th>
<th>ACVI (mL/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 (0.9 kg) (n = 5)</td>
<td>Preterm</td>
<td>0.23 ± 0.04</td>
<td>2.4 ± 0.4</td>
<td>19 ± 1.4</td>
<td>71 ± 5</td>
</tr>
<tr>
<td>#2 (3-5 kg)</td>
<td>Hypoxic Encephalopathy</td>
<td>0.46 ± 0.02</td>
<td>2.2 ± 0.1</td>
<td>8 ± 0.9</td>
<td>35 ± 4</td>
</tr>
<tr>
<td>Before Infusion (n = 4)</td>
<td></td>
<td>0.53 ± 0.03</td>
<td>2.5 ± 0.03</td>
<td>8 ± 0.6</td>
<td>50 ± 4</td>
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<tr>
<td>After Infusion* (n = 3)</td>
<td></td>
<td></td>
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</tbody>
</table>

*Total Body Cooling Hypoperfusion (after 70 ml of albumin infusion)

STUDY’S CONCLUSIONS
• This is the first clinical experience that measures cardiac output and blood volumes in a baby < 1 kg.
• COstatus® could be used to quantitatively assess the effects of therapies.
• Further NICU clinical studies with different conditions are required.

COSTATUS® OBSERVATIONS
• Measurement of CO and blood volumes is important for the management of critically ill.
• To date, no technique can routinely measure these parameters in NICU patients.
• The new ultrasound dilution (UD) (COstatus®, Transonic Systems Inc., Ithaca, NY) measures CO and blood volumes: Central Blood Volume Index (CBVI) and Active Circulation Volume Index (ACVI)
• The system works off in-situ catheters without any blood loss.
• COstatus® extracorporeal AV tubing loop permits its use in patients of any age and weight.

REFERENCES
Marr B, “Cardiac Output (CO) and Blood Volumes Measurement in Neonatal ICU Using Ultrasound Dilution - First Experience,” Pediatric Critical Care Colloquium Pittsburgh, PA, May 15-17, 2010 NIH SBIR Grant # R44 HL061994 (Transonic Reference # CO8025A)