Novel System for Measurement of Cardiac Output (CO) and Blood Volumes in Neonatal ICU Patients

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OBJECTIVE
Pilot study to test the feasibility of using COstatus® with neonatal ICU (NICU) patients to measure CO and blood volumes.

STUDY
- Four NICU patients were studied. The fourth patient had two sets of measurements performed: before infusion and after albumin infusion (70 mL).
- 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 the vein for up to 5 minutes. Two ultrasound dilution sensors, placed on the loop, sensed the change in the velocity of the blood. After measurements were completed, the loop was flushed with heparinized saline and blood was returned to the patient.

RESULTS

<table>
<thead>
<tr>
<th>Neonate</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)</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 (1.13 kg)</td>
<td>0.13 ± 0.01</td>
<td>1.28 ± 0.1</td>
<td>12 ± 0.6</td>
<td>55 ± 3.6</td>
</tr>
<tr>
<td>#3 (2.33 kg)</td>
<td>0.28 ± 0.03</td>
<td>1.59 ± 0.2</td>
<td>8 ± 0.6</td>
<td>52 ± 4.9</td>
</tr>
<tr>
<td>#4 (3.4 kg) BEFORE INFUSION</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>#4 (3.4 kg) AFTER INFUSION</td>
<td>0.53 ± 0.03</td>
<td>2.5 ± 0.1</td>
<td>8 ± 0.6</td>
<td>50 ± 4</td>
</tr>
</tbody>
</table>

STUDY’S CONCLUSIONS
- COstatus® can be used to measure CO and blood volumes in babies as small as 0.9 kg.
- This data could be used to quantitatively assess the effect of therapies.
- The authors noted that the limited number of patients in this clinical study requires that further studies are needed to confirm these findings.

COSTATUS® OBSERVATIONS
- Measurement of CO and blood volumes are important for the management of critically ill.
- To date, no technique can be routinely used to 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 loops permits its use in patients of any age and weight.

REFERENCES
Marr B, “Novel System for Measurement of Cardiac Output (CO) and Blood Volumes in Neonatal ICU Patients,” Crit Care Med 2010; (38) (Suppl 12) Abstract 219. NIH SBIR grant # R44 HL061994 (Transonic Reference # CO8065A)
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)