Validation of an Ultrasound Dilution Cardiac Output Measurement Technique in Critically Ill Children

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BACKGROUND

• Routine and accurate measurement of cardiac output (CO) in critically ill children may be useful in optimizing outcomes. Existing CO measurement techniques for infants and children have limitations.

• A novel ultrasound dilution-based technique (CO-UD), utilizing in situ catheters and an isotonic saline indicator may be useful to routinely measure CO in critically ill infants and children.

OBJECTIVE

Pilot study to determine if ultrasound dilution technology (COstatus® Transonic Systems Inc., Ithaca, NY) accurately measures CO in critically ill infants and children when compared to the Fick method (CO-Fick).

STUDY

9 PICU and CICU patients [ages: 8 days to 17 years] with existing peripheral arterial and central venous catheters were studied using COstatus® ultrasound dilution technology and CO-Fick, calculated from oxygen consumption and arterial and systemic venous oxygen saturation levels.

RESULTS

<table>
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<tr>
<th>CARDIAC OUTPUT RANGE L/min</th>
<th>CO-UD</th>
<th>CO-Fick</th>
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<tbody>
<tr>
<td>0.44 - 9.5</td>
<td>0.4 - 9.9</td>
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• Bland Altman analysis showed a small bias of -0.01 L/min (Fig. 1).

• The percentage error (2SD/mean) was 24.7% below the clinically acceptable 30% limit.²

STUDY’S CONCLUSIONS

• There was acceptable agreement in CO determined by ultrasound dilution and Fick methods in critically ill infants and children.

• COstatus® can be used to measure CO in children using existing catheter lines.

TRANSONIC OBSERVATIONS

• COstatus® ultrasound flow/dilution measurements utilizes an extracorporeal AV loop connected between a peripheral arterial catheter and the central venous line. A roller pump circulates blood at 10-12 ml/min through the loop for 5 to 8 minutes. To perform measurements, body temperature isotonic saline is injected into venous side of the AV loop. Two ultrasound dilution sensors, placed on the loop, sensed the change in concentration of blood as saline mixes in the circulation of the blood.

• COstatus® minimally invasive extracorporeal AV tubing loops permits its use in any age patients.

REFERENCES

Rajagopal 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 (Transonic Reference # CO8028V)

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Fig. 1: Bland Altman plot.