Comparison of Cardiac Output (CO) Measured by Ultrasound Dilution (UD) and Thermodilution (TD) in a Pediatric Animal Model

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BACKGROUND
The small size of children’s vasculatures severely limits the capability of available methods to measure cardiac output (CO) in children. Therefore, it is rarely measured.

OBJECTIVE
To validate CO measured by the new COstatus system (Transonic Systems Inc.) based on ultrasound dilution technology with CO measured by pulmonary artery thermodilution in a swine model.

STUDY
• Seven pigs (16-42 kg) were instrumented with pulmonary artery, central venous and peripheral arterial catheters.

- ULTRASOUND FLOW/DILUTION MEASUREMENTS: A disposable AV loop was connected between the arterial and venous catheters inserted in the animals. A peristaltic pump circulated blood from the artery to the vein to perform 2-3 measurements. Paired ultrasound dilution sensors clamped onto the arterial and venous sides of the AV loop detected changes in blood velocity after isotonic saline (0.5-1.0 mL/kg body weight up to 30cc) was injected into the loop.

- THERMODILUTION MEASUREMENTS: 5-10cc of ice-cold saline was injected into the pulmonary artery catheter.

• Two to three consecutive measurements from each method were averaged for comparison.

RESULTS
• 44 sets of averaged data were compared between the methods.

- Thermodilution cardiac output mean was 2.64 ± 0.93 L/min (1.33 to 5.55 L/min).

- Ultrasound dilution cardiac output was 2.40 ± 0.87 L/min (1.33 to 5.32 L/min).

- The correlation between methods was r = 0.94, COUD = 0.88*(COTD) + 0.08 L/min and the bias was 0.24 L/min. Limits of agreement were -0.38 to 0.86 L/min.

STUDY’S CONCLUSIONS
Cardiac output measured by thermodilution and by ultrasound dilution (COstatus) in a pediatric animal model produced good agreement.

COSTATUS® OBSERVATIONS
• Early COstatus animal validation study.

• Small blood vessel size limits the ability to measure cardiac output in pediatric and neonatal patients by pre-existing methods. COstatus can be used with ICU patients of any size.

• Ultrasound dilution method produced no loss blood, uses in situ central venous and arterial catheters.

REFERENCES
Thuramalla NV, Darling E, Searles B, “Comparison of Cardiac Output (CO) Measured by Ultrasound Dilution (UD) and Thermodilution (TD) in a Pediatric Animal Model,” Crit Care Med 2008; 34(12): A12. Poster presentation at the World Summit on Pediatric and Congenital Heart Surgery Services, Education and Cardiac Care in Children and Adults with Congenital Heart Disease, June 19-21, 2008, Montreal, Canada (LCO7644V) [Supported by NIH SBIR R44 HL061994]

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