Publication Brief

Assessing cardiac output and derived blood volumes in a neonatal lamb model with a left-to-right shunt

1Department of Neonatology, 2Laboratory of Clinical Physics, 3Department of Pediatric Cardiothoracic Surgery, Radboud University Nijmegen Medical Centre, Nijmegen, The Netherlands

OBJECTIVE
To assess cardiac output and derived blood volumes in lambs with a left-to-right shunt using the ultrasound dilution technique (UDCO) and the COstatus® Monitor.

STUDY
• A Gore-Tex® aortopulmonary shunt was inserted between the left pulmonary artery and the descending aorta in eight newborn lambs (mean weight 6.4 kg).
• Arterial and venous catheters were inserted and connected to a COstatus® monitor for ultrasound dilution measurements of cardiac output (CO), central blood volume index (CBVI), active circulating volume index (ACVI) and total end diastolic volume index (TEDVI).
• Hemorrhagic hypotension was induced during the experiment to manipulate Cardiac Output while the shunt was intermittently opened and closed followed by fluid administration while the shunt was closed.
• A total of 342 measurements were performed.

RESULTS
• Mean cardiac output was 160 mL/kg/min.
• Mean Qp/Qs ratio during open shunt was 1.7.
• Mean total hemorrhage was 17.8 mL/kg and mean total fluid administration 28.5 mL/kg.
• During shunt opening, only changes in TEDVI were significant (p=0.038).
• During hemorrhage, CBVI and TEDVI decreased significantly with closed and open shunt (CBVI: p<0.001 respectively p<0.001 and TEDVI: p<0.001 respectively p=0.027).
• Ultrasound dilution cardiac output (UDCO) only decreased significantly with closed shunt (p=0.03).
• There were no significant ACVI changes, probably due to redistribution.
• During fluid administration, (UDCO) and all volumes increased significantly.

STUDY’S CONCLUSIONS
Expected changes in cardiac output and derived blood volumes can be detected with COstatus ultrasound dilution technology, even in the presence of left-to-right shunts.

COSTATUS® OBSERVATIONS
This is the first lamb study in which blood volumes was measured and compared in addition to cardiac output.

REFERENCES
Vrancken SL(1), De Boode W(1), Hopman J(2), Singh S(3), Liem K(1), “Assessing Cardiac Output and Derived Blood Volumes in a neonatal Lamb Model with a Left to Right Shunt,” 3rd Congress of European Academy of Paediatric Societies (EAPS) Copenhagen, Denmark, 2010; Poster Presentation 1322. (Transonic Reference # LCO8040A)