ELSA Publication Brief: (ELS7177VMelchoir)

A novel method of measuring cardiac output in infants following extracorporeal procedures: preliminary validation in a swine model

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OBJECTIVE
To validate ultrasound dilution cardiac output (CO) measurements against transit-time ultrasound (TTU) perivascular flowprobe and pulmonary artery (PA) catheter thermodilution measurements in a pilot swine model study.

METHOD
• Three anesthetized and heparinized 11-14 kg Yorkshire pigs were included in the study
• Each pig was cannulated to mimic the arterial (aortic arch) and venous (ext. jugular vein or right atrium) cannulation used during standard cardiopulmonary bypass (CPB) and veno-arterial extracorporeal membrane oxygenation (VA ECMO)
• Both venous and arterial lines were instrumented with ultrasonic flow/dilution sensors. A stopcock bridge between the arterial and venous cannulas provided an access port for a 5 - 10 cc bolus saline injection and for use as a controlled AV-shunt.
• A 10-12 mm PAX perivascular flow probe was positioned directly on the PA in two animals and on the ascending aorta in one animal.
• A PA thermodilution catheter was advanced to the PA in the largest animal.
• Baseline CO measurements were recorded from the TTU flowprobe and the PA catheter.
• Cardiac Output (CO) ultrasound dilution measurements (L/min) were performed

RESULTS
The correlation between the ultrasound dilution CO, the perivascular flowprobe, and the PA thermodilution catheter was $R^2 = 0.94$ (n = 3) and 0.81 (n = 1) respectively, from linear regression analysis

CONCLUSION
CO measured by ultrasound dilution technique correlates to other benchmark CO measurements.

DISCUSSION
In infants, a particularly vulnerable subgroup of patients, technologies for obtaining rapid, quantified measurements of cardiac output (CO) following weaning from cardiopulmonary bypass (CPB) or extracorporeal membrane oxygenation (ECMO) are not readily available. Ultrasound dilution methodology provides rapid CO measurements that could greatly assist clinicians in therapy strategies and decision making in weaning patients from CPB or ECMO.

REFERENCE