A188 - Assessment of right heart function during extracorporeal therapy by modified thermodilution

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Introduction:
Extracorporeal membrane oxygenation (ECMO) therapy is an emerging treatment modality for acute respiratory and/or cardiac failure. Cardiac output monitoring during ECMO therapy remains challenging. This study aims to validate a new method of thermodilution technique during ECMO therapy.

Methods:
16 healthy pigs under general anesthesia were centrally cannulated for veno-arterial ECMO and precision flow probes were placed on the pulmonary artery main trunk for reference. 10ml boluses of iced 0.9% saline chloride solution were injected into the ECMO circuit and right atrium at different ECMO flow settings (4, 3, 2, 1 L/min). Rapid response thermistors of standard PA-catheters in the ECMO circuit and pulmonary artery recorded the temperature change. After calibration of the catheter constants for different injection volumes in the ECMO circuit, the distribution of injection volumes passing each circuit were assessed and enabled calculation of pulmonary blood flow. Analysis of the exponential decay of the recorded signals allowed assessment of right ventricular function.

Results:
Averaged, calculated blood flow correlated well with true blood flow ($r^2 = 0.74$, $p < 0.001$, Panel A, individual measurements). The calculated changes in blood flow tracked the true changes in blood with 100% concordance (Panel B, average of 5 measurements). Bias was $-11.6 [95\% CI -59 – 3753 – 48] \text{ml/min}$ with clinically acceptable limits of agreement (654668 [95\% CI 486 – 822502 – 834]) ml/min, Panel C, average of 5 measurements). Right ventricular ejection fraction (RVEF) was 17 [13 – 14 – 20] %. ECMO flow reductions increased end-diastolic (EDV) and end-systolic (ESV) volumes (Panel D) with reductions in pulmonary vascular resistance, but without changing central venous pressure (CVP) and only little changes in right ventricular ejection fractions. EDV correlated highly with ESV ($r^2 = 0.9698$, $p < 0.001$, Panel D).

Conclusion:
Adapted thermodilution allows reliable measurements of cardiac output and assessment of right ventricular behavior. During ECMO weaning, the right ventricle dilates even with stable function, possibly due to increased venous return.
Cardiac output monitoring (Panel A, B, C) and right heart function (Panel D) during VA ECMO weaning, assessed by modified thermodilution.