TITLE: NON-INVASIVE MEASUREMENTS OF CARDIAC OUTPUT AFTER CARDIAC SURGERY

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INTRODUCTION: Cardiac output (Q) and mixed venous oxygen saturation (SvO₂) are important clinical indicators of heart failure. These are difficult to obtain after discharge from the intensive care unit (CVICU). Measuring (Q) non-invasively via the differential Fick (dFQ) method requires precise control of alveolar ventilation (VA) and is only suitable in ventilated patients. Bio-impedance methods on the other hand rely on assumptions of water lung content and spatial distribution of thoracic electrical impedance both often affected by cardiac surgery or poor cardiac performance. Probably for these reasons bio-impedance methods correlated poorly with the thermodilution method in previous studies. We evaluated a simple, automated method of a Fick based measurements of Q, which requires no patient cooperation except for breathing through a facemask for a period of 5 minutes.

METHODS: Following REB approval we employed a sequential gas delivery circuit to measure O₂ consumption (VO₂), CO₂ elimination (VCO₂) and to control VA independent of breathing pattern in a cohort of extubated, awake patients after on-pump coronary bypass surgery (CABG). This allowed calculation of dFQ during spontaneous ventilation. We used VO₂, dFQ and arterial haemoglobin O₂ saturation to calculate SvO₂. We compared dFQ and SvO₂ obtained by dFQ with thermodilution (TD) and directly sampled pulmonary artery (PA) blood respectively. VO₂ and VCO₂ was measured breath-by-breath. After drawing blood for SvO₂ analysis, 3 dFQ and 3 concurrent TD measurements were made. SvO₂, Q and TD were recorded in a blinded fashion and compared for bias and precision using Bland-Altman analysis.

RESULTS: Thirty one tests were conducted in 25 ICU patients on the first and second day after CABG surgery. Bias and SD for (TD-dFQ) was -0.08 L/min $\pm$ 0.80 L/min. For (PA- SvO₂) bias was -15 %; however, SD was only 5.7 %.

CONCLUSION: This is the first report of bias and variability of dFQ and SvO₂ compared to invasively measured values in spontaneously breathing patients. We demonstrated that non-invasive dFQ are accurate in CABG patients and may be used after cardiac surgery outside the CVICU setting or after the removal of indwelling catheters. Further investigation for non-invasive SvO₂ measurements is warranted.