

1114. NON-INVASIVE CARDIAC OUTPUT MEASUREMENT IN CHILDREN AND ADULTS IN THE CARDIAC SURGICAL ENVIRONMENT.

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Introduction:

Measurement of cardiac output (CO) in the cardiac surgical environment is important for management. A number of methods are commonly used ranging in complexity, accuracy and invasiveness. However there remains a need for a non-invasive alternative, particularly in children. USCOM (USCOM Ltd, Sydney, Australia) is a novel non-invasive point and measure Doppler device specialised for simple accurate CO measurement. This study compared USCOM measurements with various standards of care methods in children and adults.

Method:

560 paired CO measures were analysed from 24 subjects of various ages attending a heart failure transplantation clinic. CO was measured using the clinical standards of care methods (STD), including Fick(3), Echo(2), PAC(11), and mechanical assist devices (CardioWest(7) and BiVad(1)), and USCOM (figure 1). Methods were compared using Two Tailed T-Tests, Bland-Altman analysis and linear regression.

Results:

USCOM was feasible in all subjects (mean age 46.5yrs, range 3mths to 82yrs), with a mean CO by USCOM and STD of 4.69 ± 2.35 and 4.68 ± 2.39 l/min respectively (range 0.85 to 8.00 l/min). The mean difference between methods was 0.002 ± 0.204 l/min, with a mean % error of -1% (figure 2). There was excellent correlation of measures without significant difference ($r=0.996$, $p<0.005$), and $CO\ STD=1.012CO\ USCOM-0.06$ l/min (figure 3). No particular measurement method demonstrated conspicuous disagreement with USCOM values as demonstrated in figure 4.

Discussion:

The potential for a single CO measurement method to be used contiguously across a range of ages and CO values has the potential to significantly change clinical practice, particularly if the method is non-invasive so that repeated measurements can be made without risk cost.

Conclusion:

USCOM measurements of CO compared favourably to current clinical measures across a range of COs in children and adults. USCOM is a single, non-invasive alternative to many currently used methods in the cardiac surgical environment. A contiguous method of CO measurement may improve clinical practice.

METHODS FOR USCOM COMPARISON

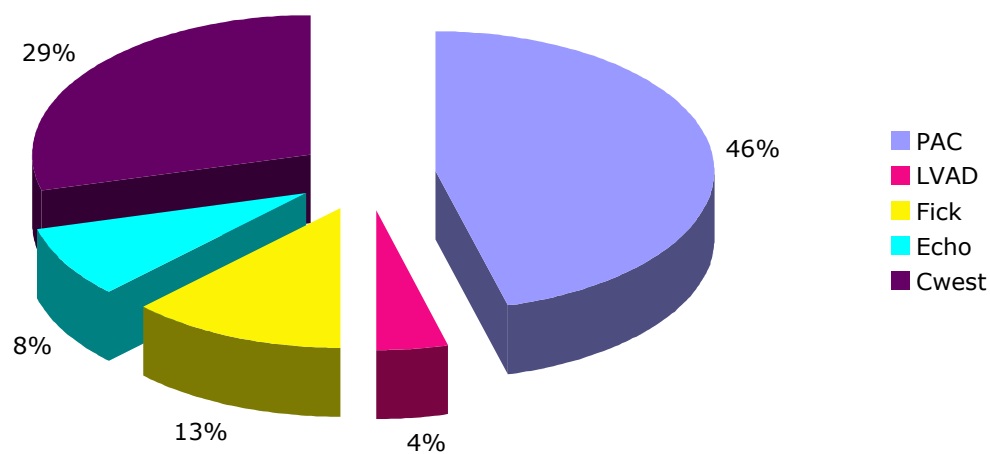


Figure 1. Standard methods used for comparison with USCOM in this clinical series (%).

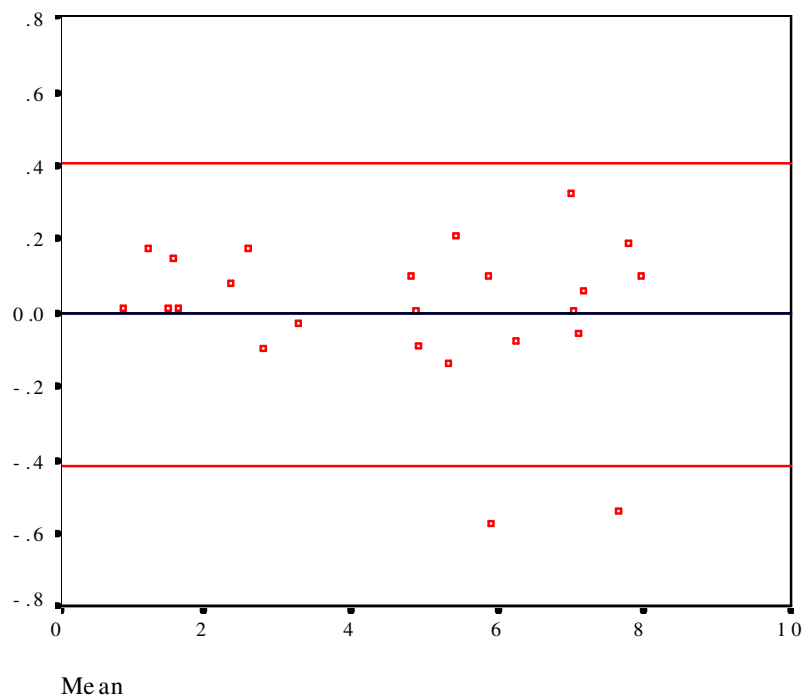


Figure 2. Bland Altman plot demonstrating mean difference between methods of $0.002 \pm 0.2041/\text{min}$, with a mean % error of -1%.

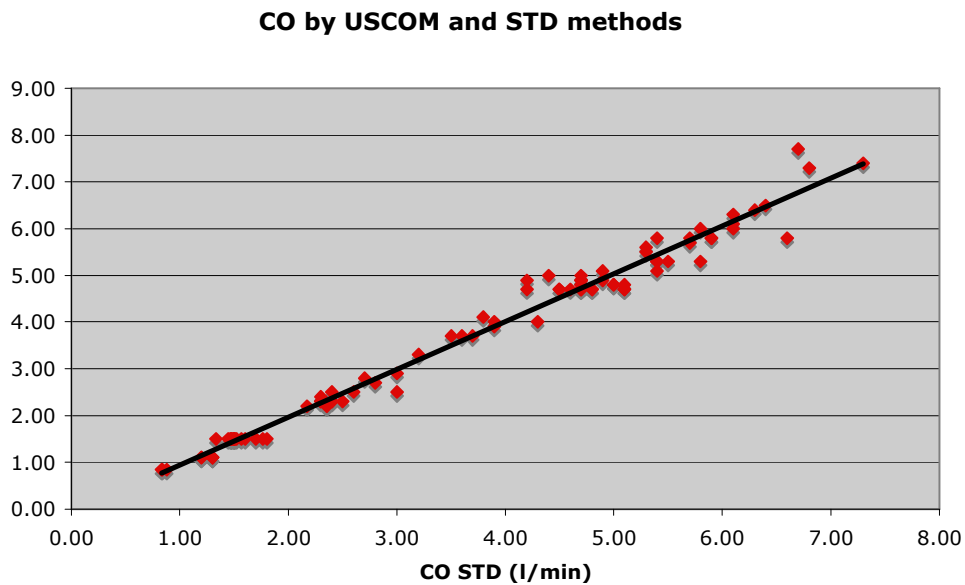


Figure 3. Scatterplot of values from all measures by standard methods against USCOM demonstrating good linear agreement ($CO\ STD = 1.012CO\ USCOM - 0.06\ l/min$).

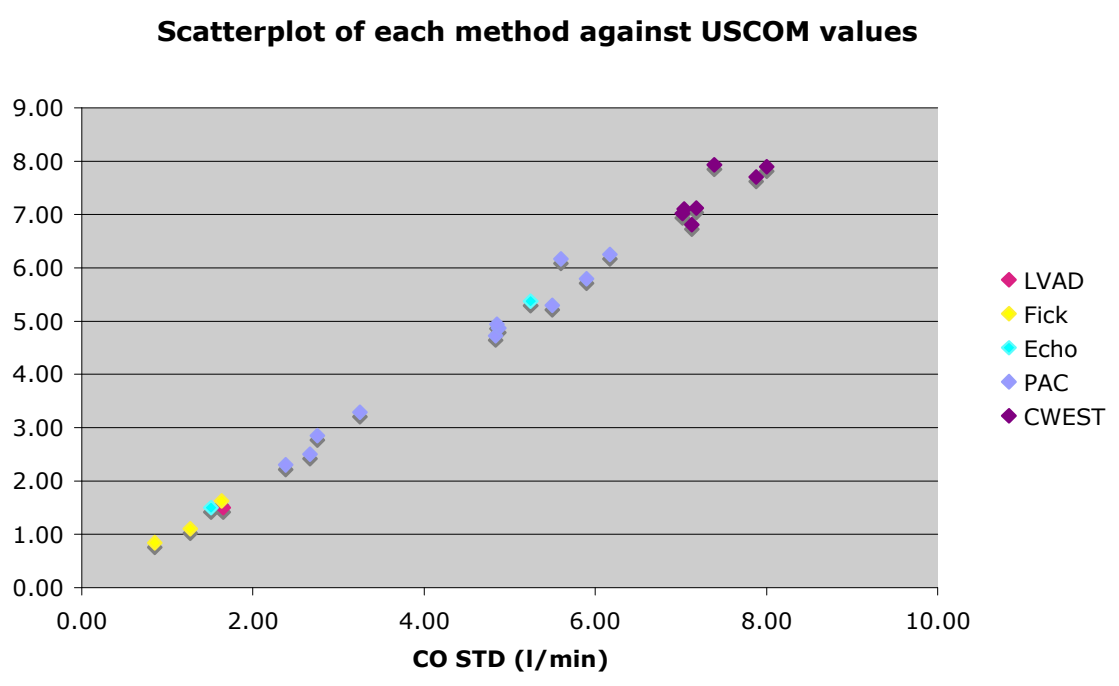


Figure 4. Scatterplot of mean CO values from standard methods against USCOM demonstrating good linear agreement of values with no outstanding disagreement associated with any particular method.

REFERENCES:

Knobloch K, et al. Noninvasive Cardiac Output Determination by Two-Dimensional Independent Doppler During and After Cardiac Surgery. *Ann Thorac Surg* 2005;80:1479-84

HL Tan, et al. Clinical Evaluation of the USCOM Ultrasonic Cardiac Output Monitor in Cardiac Surgical Patients in the Intensive Care Unit. *Br J Anaesth* 2005;94:287-91

Chand R, Mehta Y, Trehan N. Cardiac Output Estimation With a New Doppler Device After Off-Pump Coronary Artery Bypass Surgery. *Journal Of Cardiothoracic and Vascular Anesthesia* 2006; 20(3): 315-319