

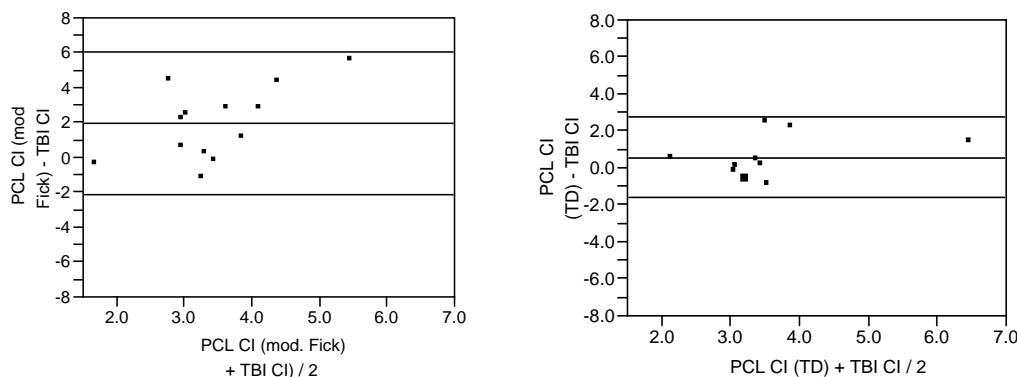
Evaluation of a New Noninvasive, Thoracic Bioimpedance Monitor for Hemodynamic Monitoring in Pediatric Patients

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Introduction: Hemodynamic monitoring with a pulmonary artery catheter is a common practice in adults, but anesthesiologists and surgeons rarely use invasive monitoring routinely because of the technical difficulties and risks associated with it. A reliable, non-invasive method for determining cardiac output and hemodynamic values may be very useful in pediatric anesthesia for optimal anesthetic management. We report preliminary data evaluating a new thoracic bioimpedance (TBI) system for the determination of hemodynamic values in pediatric patients in a prospective, observational study.

Methods: Following Institutional Board Review approval and written parental informed consent, we studied 28 patients presenting for diagnostic cardiac catheterization. There were no restrictions to enrollment. All procedures were performed under general anesthesia or moderate sedation. All patients had cardiac output measured by either a) a modified Fick principle application where oxygen content of arterial and pulmonary artery blood was measured directly and oxygen uptake was estimated or b) measured with thermodilution (TD) catheters of appropriate size for the patient. TBI determinations of cardiac output were made with the PhysioFlow PF-05 (Mannatec, Inc, Paris, FR). Cardiac index determinations (Fick or TD versus TBI) were analyzed using the Bland-Altman analysis.¹

Results: Twenty-eight patients were enrolled (11 males, 17 females). The average age was 8.9 ± 7.7 years (range: 3 mo – 25 yr) and the mean weight was 33.8 ± 27.2 Kg (range: 4.3 – 96). All patients completed the study but three patients could not be evaluated because of either signal acquisition or administrative problems. The reference CI was measured by Fick in 15 patients and TD in 10 patients. The Bland-Altman plots for TBI CI compared to the modified Fick and TD values are shown in Fig. 1. The average difference between the PhysioFlow and thermodilution methods was $0.57 \text{ L} \pm 1.13$ while the average difference was $1.92 \text{ L} \pm 2.08$ with the modified Fick method.



Discussion:

TBI determines CO by measuring the change in an electrical impedance signal, Z. This is measured by attaching skin electrodes at the base of the neck and sternum. Some devices use the absolute value of the signal (Z_0), which has been described as a limiting factor in the usefulness of TBI. We evaluated a new monitor that uses relative values of the impedance signal rather than absolute values. This system has good agreement with the TD method for measuring CI in adults.²

The data provided by this monitor has good agreement with values obtained by thermodilution. Difficulties in obtaining simultaneous TBI readings while obtaining blood samples for the modified Fick and using estimates for oxygen uptake instead of measuring oxygen consumption accounts for the greater difference between TBI and Fick CI values. TBI may be a useful method for the noninvasive monitoring pediatric hemodynamics.

References:

1. Bland JM, Altman DG (1986) Statistical method for assessing agreement between two methods of clinical measurement. *The Lancet*, i, 307-310.
2. Haynes GR, Moreau X, Rousseau JM et al. Cardiac output with a new bioimpedance monitor : comparison with thermodilution methods. *Anesthesiology* 2006:A470.