Title: Non-Invasive Cardiac Output: Comparison of Two Different Methods with Thermodilution


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Introduction: Two non-invasive methods of measuring cardiac output are now commercially available. Although each have been compared with thermodilution (I-4), their relative usefulness is unclear. The purpose of this study was to compare the usefulness and agreement of cardiac output measured by Doppler ultrasound (C0Dopp) and thoracic bioimpedance (C0Bi) with cardiac output measured by thermodilution (C0td).

Methods: This study was approved by the Institutional Review Board. Critically ill patients requiring pulmonary artery catheters were eligible for study entry. C0Dopp was measured with a Bomed NCCOM 3 monitor. C0td was measured with Edwards Swan-Ganz catheters by injecting 10cc of DSW at room temperature. All devices were calibrated and used according to manufacturer's recommendations. Simultaneous measurements of C0Bi, C0Dopp, and C0td were obtained by two data collectors. The NCCOM electrodes were applied first. The fluid-filled syringe was attached to a three-way stopcock in-line with the proximal part of the pulmonary artery catheter. The suprasternal Doppler probe was then applied. When maximal signal strength was obtained, one data collector injected the fluid for thermodilution measurement and recorded C0Bi while the second data collector simultaneously recorded C0Dopp. C0td was then recorded after calculation and display. Heart rate is displayed and used by both noninvasive devices to calculate cardiac output. We decided that if either noninvasive device worked properly, the reported heart rate should be the same as the heart rate measured by EKG. When the heart rate reported by the NCCOM 3 or the Lawrence 3000 was not within 3 beats of the EKG heart rate, we concluded that that device did not work in that particular patient. C0Dopp and C0Bi were compared with C0td by correlation coefficient, regression analysis, bias and precision. Problems with each measurement technique were noted.

Results: Fourteen patients entered the study. Neither C0Bi nor C0Dopp worked in one patient. C0Bi but not C0Dopp was measurable in one patient with large chest excursions receiving positive pressure ventilation. C0Dopp but not C0Bi was measurable in one patient with pectus excavatum. Simultaneous C0Bi and C0td were available in 98 data sets. These are presented in Fig. 1. C0Bi had a correlation coefficient of 0.73 with C0td, a bias of -0.021 and a precision of 1.421. Simultaneous C0Dopp and C0td were available in 100 data sets. These are presented in Fig. 2. C0Dopp has a correlation coefficient of 0.70 with C0td, a bias of -0.451 and a precision of 1.441.

Discussion: When they report heart rates within 3 beats of the EKG heart rate, both C0Bi and C0Dopp correlate with C0td. Both methods worked in 14 of 16 patients. Both methods worked in a patient with 12 PVC/min. The correlation of both C0Bi and C0Dopp with C0td were less than previously reported (1-4). Almost all the C0td in reports 2-4 ranged from 2.0 - 8.0 l/min. In this study, the discrepancy between both C0Bi and C0Dopp with C0td was greater at C0td more than 10 l/min. Using only data sets with C0td less than 10 l/min improved precision to 0.921 (C0Bi) and 0.921 (C0Dopp). The problem C0Dopp had in a patient with large chest excursions may be due to software which required 12 consecutive beats before calculating C0Dopp.

References: