The reliability of Non-Invasive Cardiac System (NICaS) haemodynamic monitoring in the Cardiac Intensive Care Patient requiring mechanical circulatory support

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Following concerns regarding the safety of the pulmonary artery catheter to measure cardiac output (CO), there has been extensive development of non-invasive devices, based on a number of different physical and physiological principles, including revisiting the potential of bioimpedance technology. These devices are based on the principle that the conductivity of a high-frequency, low magnitude alternating current passed across the thorax changes as blood flow varies with each cardiac cycle. This is then used to calculate cardiac output (CO) from generated waveforms. The theoretical benefit of such a device in patients receiving mechanical circulatory support is that they might provide an early indicator of the increasing stroke volume during myocardial recovery, and therefore be a potentially useful tool in predicting response to weaning from mechanical circulatory support.

Objective: We undertook a pilot study to determine whether the newest such device, the Non-Invasive Cardiac System (NICaS®), correlated with continuous monitoring of ventricular function and CO in the full range of patients requiring support on the cardiac intensive care unit, including those being weaned from mechanical circulatory support.

Methods: We performed echocardiography (echo) and NiCAS® on 11 patients (2 weaning trial from circulatory mechanical support (CMS); 4 post-cardiac surgery undergoing pacemaker optimisations and 5 simple monitoring of post cardiac surgery patients on inotropic support). The two measurements were carried out simultaneously on the same patient. Two experienced physician echocardiographers performed and interpreted the studies.

Results: Both the Pearson correlation coefficient and linear regression demonstrated an excellent correlation between CO measured by echo and NiCAS® in all the patients without CMS (p<0001 CI 95% 0.50-0.98). However, in the patients with CMS NiCAS® CO evaluation both at the baseline and during blood flow manipulation didn’t correlate with the values obtained by echo and the ones maintained by the CMS (p .22 CI 95%.-25 -.96). Table 1 shows the linear regression for the two populations.

Conclusion NiCAS® looks to be a reliable non-invasive CO monitoring in ICU patients, also providing direct changes in CO during pacemaker optimization, however, in patients with CMS, where sudden changes in load condition, circulatory instability and total blood flow partitioning occur, it is not clinical acceptable.