The Nexfin – a new non-invasive monitor for the measurement of continuous cardiac output

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The Nexfin HD monitor (BMeye, Amsterdam; http://www.bmeye.com) measures cardiac output (CO) continuously in a totally non-invasive manner by an inflatable finger cuff which is the only interface with the patient. The Nexfin HD measures continuous finger blood pressure (BP) by the Volume Clamp Technology and transforms it into a brachial artery waveform. Applying a 3rd third generation pulse contour method which is based on a full 3-element Windkessel model, and following the input of patient's gender, age, height and weight, continuous CO (CCO) is measured and displayed. The CCO is calculated without external calibration although it can be calibrated externally. This technology is based on an extension and combination of elements of two previous generations of algorithms, the so-called corrected characteristic impedance or cZ method (Wesseling 1974) and the Modelflow method (Wesseling 1993). The parameters that are measured by the Nexfin HD include continuous BP (systolic, diastolic, mean), heart rate, continuous cardiac output (CCO), stroke volume (SV), systemic vascular resistance (SVR), and left ventricular contractility (dP/dT).

The truly non-invasive nature of the Nexfin HD allows the measurement of CCO in a much wider variety of patients than was hitherto possible. Originally, the Nexfin HD was introduced in Cardiology clinics for the performance of tilt-test for the detection of orthostatic hypotension. A recent study using the Modelflow has shown that the early postoperative postural cardiovascular response is impaired after radical prostatectomy with a risk of orthostatic intolerance, limiting early postoperative mobilization. Both the tilt test and the sit-stand test take advantage of the fact that the Nexfin HD provides real-time CCO, allowing the detection of the immediate response to diagnostic and therapeutic challenges. These include passive leg raising, fluid challenge, start of inotropes, optimization of cardiac resynchronization therapy, etc. Indeed, the continuous real-time CO measurement by this uncalibrated method may be more useful and provide more accurate information about the changes in CO than intermittent CO measurements by thermodilution with their inherent variance.

One of the most interesting areas where the potential of the Nexfin HD can be fully expressed is perioperative care. It is well recognized that a small group of patients account for the majority of peri-operative morbidity and mortality. These 'high-risk' patients have a poor outcome due to their inability to meet the oxygen transport demands imposed on them by the nature of the surgical response during the peri-operative period. It has been shown that by targeting specific hemodynamic and oxygen transport goals at any point during the peri-operative period, the outcomes of these patients can be improved. Most studies on perioperative optimization have used repetitive fluid challenges in order to maximize the CO. CO was measured in most of these studies by the esophageal Doppler and by the FlowTrac. However, the esophageal Doppler can be used only after induction of anesthesia, while the FlowTrac necessitates the presence of an arterial line. The non-invasive nature of the Nexfin HD and its semi-disposable finger probe make the use of this monitor to seem ideal in this important setting, and the preliminary results are very promising. In fact, the Nexfin is perfectly suitable for any patient who is sick or at risk enough, in terms of hemodynamic instability, to warrant the need for continuous real-time hemodynamic monitoring, but who is not sick enough to warrant the use of invasive lines and catheters with their associated complications.