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Accuracy of an autocalibrated pulse contour analysis in cardiac surgery patients: a bi-center clinical trial

Ole Broch^{1*}, Jose Carbonell², Carlos Ferrando², Malte Metzner³, Arne Carstens¹, Martin Albrecht¹, Matthias Gruenewald¹, Jan Höcker¹, Marina Soro², Markus Steinfath¹, Jochen Renner^{1,4} and Berthold Bein^{4†}

Abstract

Background: Less-invasive and easy to install monitoring systems for continuous estimation of cardiac index (CI) have gained increasing interest, especially in cardiac surgery patients who often exhibit abrupt haemodynamic changes. The aim of the present study was to compare the accuracy of CI by a new semi-invasive monitoring system with transpulmonary thermodilution before and after cardiopulmonary bypass (CPB).

Methods: Sixty-five patients (41 Germany, 24 Spain) scheduled for elective coronary surgery were studied before and after CPB, respectively. Measurements included CI obtained by transpulmonary thermodilution (CI_{TTPD}) and autocalibrated semi-invasive pulse contour analysis (CI_{PCC}). Percentage changes of CI were also calculated.

Results: There was only a poor correlation between CI_{TTPD} and CI_{PCC} both before ($r^2 = 0.34$, $p < 0.0001$) and after ($r^2 = 0.31$, $p < 0.0001$) CPB, with a percentage error (PE) of 62 and 49 %, respectively. Four quadrant plots revealed a concordance rate over 50 % indicating an acceptable correlation of trends between CI_{TTPD} and CI_{PCC} before (concordance: 93 %) and after (concordance: 94 %) CPB. In contrast, polar plot analysis showed poor trending before and an acceptable trending ability of changes in CI after CPB.

Conclusions: Semi-invasive CI by autocalibrated pulse contour analysis showed a poor ability to estimate CI compared with transpulmonary thermodilution. Furthermore, the new semi-invasive device revealed an acceptable trending ability for haemodynamic changes only after CPB.

Trial registration: ClinicalTrials.gov: NCT02312505 Date: 12.03.2012

Keywords: Cardiac index, Pulse contour analysis, Haemodynamic monitoring, Transpulmonary thermodilution

Background

Most of the studies applying algorithms for haemodynamic optimization of high-risk surgical patients have used cardiac index (CI) as one important target. Furthermore, these investigations could demonstrate that optimization of CI was associated with a significant lower rate of postoperative morbidity and mortality [1]. In the past, estimation of CI was mostly performed by pulmonary or transpulmonary thermodilution (TTPD) which due to their invasiveness are

associated with considerable complications [2–4]. Therefore, interest has focused on less-invasive, readily available and easy to install techniques which are based for example on continuous arterial waveform analysis [5–7]. By using established arterial catheters, pulse contour analysis offers the opportunity for continuous estimation of CI and other haemodynamic variables like systemic vascular resistance or stroke volume variation, enabling the clinician to respond quickly and effectively to abrupt haemodynamic changes. The recently introduced semi-invasive monitoring system Pulsioflex (Pulsion Medical Systems, Munich, Germany) was developed for continuous CI trending and consists of an algorithm that provides beat-to-beat estimation of CI by analysis of the arterial blood pressure tracing. By using a proprietary “autocalibration” mode this software

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Congenital Heart Disease in Pediatric and Adult Patients Ali Dabbagh, Antonio Hernandez Conte, Lorraine Lubin, 2017-03-09 Congenital Heart Disease in Pediatric and Adult Patients Anesthetic and Perioperative Management provides a comprehensive up to date overview of care of the pediatric patient undergoing cardiac surgery and anesthesia After introductory chapters that encompass pediatric cardiovascular embryology physiology and pharmacology diagnostic approaches and preoperative considerations are explained The intraoperative management of a wide range of specific lesions is then discussed with full descriptions of anesthesia plans added with descriptions on diagnostic methods and surgical interventions Postoperative care is also addressed and a concluding section considers anesthesia outside the cardiac operating room In the twenty first century advances in minimally invasive technology have led to the introduction of a wide array of pediatric cardiac procedures More traditional surgical procedures have also been transformed by new devices and surgical approaches The cardiac anesthesiologist is faced with an ever increasing role in the perioperative care of pediatric patients undergoing cardiologic procedures in operating rooms as well as less conventional locations In this book accomplished experts from around the world in the fields of pediatric anesthesia cardiology and cardiac surgery describe the multiple facets of caring for this very unique patient population

Advanced Hemodynamic Monitoring: Basics and New Horizons Mikhail Y. Kirov, Vsevolod V. Kuzkov, Bernd Saugel, 2021-08-31 This book describes how to monitor and optimize cardiovascular dynamics using advanced hemodynamic monitoring in perioperative and intensive care medicine The book outlines basic skills of hemodynamic monitoring different techniques including invasive minimally invasive and non invasive methods and algorithms and treatment strategies for perioperative goal directed hemodynamic therapy in different groups of surgical patients Thus the book reflects current diagnostic and therapeutic approaches in perioperative and intensive care medicine All sections of this book have a learning oriented style and are illustrated with tables and figures summarizing the main content The volume is addressed both to specialists and residents using advanced hemodynamic monitoring it reflects indications and limitations of current monitoring tools and discuss therapeutic strategies It also helps readers to integrate new knowledge on monitoring of cardiovascular dynamics into clinical practice

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