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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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M Tight



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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

Common Problems in Acute Care Surgery Laura J. Moore, S. Rob Todd, 2016-12-07 This text provides a comprehensive evidence based review of the most common clinical problems encountered by acute care surgeons Focusing on the clinical care of the patient this volume explores the general principles of acute care surgery and the specific disease states that are commonly encountered by acute care surgeons The work also touches upon the ethical issues and systems development behind acute care surgery including practical considerations for establishing an acute care surgery program ethical considerations in acute care surgery and the role of palliative care The second edition of the textbook include updates to all of the chapters from the first edition New topics addressed include management of intra abdominal infections management of the open abdomen and hemodynamic

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Yin,Antoine Vieillard-Baron,Nikola Dobrilovic,Xavier Monnet,2023-01-10 [Clinical Anesthesia, 8e: eBook without Multimedia](#) Paul G. Barash,2017-04-10 Where experts turn for definitive answers Clinical Anesthesia covers the full spectrum of clinical issues and options in anesthesiology providing insightful coverage of pharmacology physiology co existing diseases and surgical procedures Unmatched in its clarity and depth of coverage as well as its robust multimedia features this classic clinical reference brings you the very latest essential knowledge in the field equipping you to effectively apply today s standards of care and make optimal clinical decisions on behalf of your patients **Data Interpretation in Anesthesia** Tilak D. Raj,2017-09-09 Focusing on the interpretation of data commonly available to anesthesiologists this book presents a data point followed by discussion in a question and answer format Covering EKG s X Rays MRI s graphs paper recordings blood gas results laboratory results patient case histories and more Data Interpretation in Anesthesia provides an enhanced and stimulating learning format for residents in training and practitioners alike [Kaplan's Cardiac Anesthesia - E-Book](#) Joel A. Kaplan,2023-06-09 Current comprehensive and evidence based Kaplan s Cardiac Anesthesia Perioperative and Critical Care Management 8th Edition offers practical guidance from today s international leaders in cardiac anesthesiology helping you to optimize perioperative outcomes avoid complications and ensure maximum patient safety Dr Joel A Kaplan along with an expert team of associate editors guides you through today s clinical challenges including expanded coverage of critical care the newest approaches to perioperative assessment and management state of the art diagnostic techniques and cardiovascular and coronary physiology Covers the full spectrum of contemporary cardiothoracic anesthesia practice including preoperative assessment physiology pharmacology monitoring transesophageal echocardiography coagulation specific cardiac procedures extracorporeal circulation postoperative pain treatment and management of the complex patient with cardiac disease Includes expanded coverage of critical care topics reflecting the increased perioperative care now provided by anesthesiologists in the ICU Contains new chapters on Structural Heart Disease Procedures Cardiorespiratory Effects of COVID 19 Critical Care Ultrasound Intensive Unit Management of Patients on Mechanical Circulatory Support and Postoperative Care of the Heart and Lung Transplant Patient Features more than 900 full color illustrations decision trees charts and graphs over one third are new that aid in visual understanding of complex topics Provides access to over 120 videos including a range of echocardiography clips Contains balanced dependable and updated content on all aspects of the anesthetic management of cardiac surgical procedures as well as cardiology procedures performed in catheterization and electrophysiologic laboratories Places new emphasis on cardiac devices requiring perioperative care including cardiac implanted electrical devices and ventricular assist devices An eBook version is included with purchase The eBook allows you to access all of the text figures and references with the ability to search customize your content make notes and highlights and have content read aloud

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