# The Cardiac Patient for Non-Cardiac Surgery: Where Are We Now, What's New and Where Next


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Major surgery imposes stresses that can cause significant perioperative morbidity and mortality occurring in a small subset of patients. In the U K, perioperative mortality is approximately 2%, but 80% of these deaths in a high risk subset of only 12% population. Identifying these individuals early through risk stratification has theoretic value at least.

Simple risk indices allow risk to be estimated with moderate accuracy using readily available preoperative clinical information. The American Society of Anesthesiologists Physical Status (ASA-PS) classification has moderately good performance in predicting death and some complications after surgery. The classification scheme also has limitations. Specifically, it has moderate interrater reliability does not incorporate surgery-specific risks, and has diminished accuracy in settings with high overall mortality rates.

The RCRI is a simple and widely used index for predicting major cardiac complications after non-cardiac surgery. Despite being developed in 1999, it still discriminates moderately well between individuals with varying perioperative cardiac risk. RCRI also has important limitations, it does not accurately predict an individual patient's absolute risk of cardiac complications. Some components of the index may warrant elimination as they provide minimal associated prognostic information or the index may be re-formatted to include other prognostically important risks (age, PVD, anemia, and functional capacity) The great advantage of the RCRI was its relative simplicity. Simplicity, however, may not be as important in the internet age as online web-based risk calculators have facilitated implementation of more complex risk prediction tools.

The American College of Surgeons calculator (http://riskcalculator.facs.org) has moderate-to-good accuracy at predicting a range of postoperative events, such as death, cardiac complications, pneumonia, and acute kidney injury. It is however premature to fully endorse these tools since they have limitations. They have not been externally validated, especially in settings outside the United States. In addition, some prediction models are limited by the manner in which the NSQIP registry ascertains the outcome. For example, routine postoperative troponin surveillance was not implemented in all participating sites thereby leading to potentially significant underreporting of postoperative MI rates.

Specific specialized tests are widely performed before surgery to with the thought that they better inform perioperative risk estimation. Routine preoperative echocardiography has not been associated with improved survival after major elective non-cardiac surgery. The prognostic value of information and limitations from cardiac stress testing, focused on the provocation of ischemia, has been extensively studied. It is not widely appreciated however that the ability to reach seven or more METs is indicative of low perioperative cardiovascular risk suggesting that the ongoing CPET trials will yield highly valuable prognostic information. The failure to reach four METs predicts increased risk. Newer technologies, like CT angiography, are emerging and have shown potential to identify patients with extensive coronary artery disease (Left Main) who are otherwise deemed as low risk. Targeted use of CTCA may identify at risk populations.

Biomarkers are measurable markers of organ dysfunction that can independently predict postoperative complications or augment prognostic information from clinical risk indices. Two preoperative biomarkers cardiac troponins and natriuretic peptides show great promise in improving risk prediction. Both markers have been shown to improve the accuracy of the RCRI. BNP less than 100 ng/l, that are measured preoperatively have a negative predictive value of 97-99%.

Despite recognition of the intraoperative and immediate postoperative period as being associated with significant physiologic derangements from both surgery and anesthesia, relatively few studies have evaluated how information from this period can help better identify high-risk surgical patients. For example, poor postoperative outcomes are associated emergent procedures, more extensive tissue injury, and of longer surgical duration. The magnitude and duration of intraoperative hypotension is associated with

increased risks of myocardial injury and acute kidney injury and death. Although intraoperative and immediate postoperative characteristics have been shown to be associated with postoperative outcomes there is little research on incorporating these characteristics into clinical risk indices. Two examples of intra-operative risk indices that are available include the Portsmouth Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity (P-POSSUM) score and the surgical Apgar score.

Presently there is great interest in using early postoperative biomarkers to further improve identification of surgical patients at elevated risk. Early postoperative elevations in troponin concentrations are consistently and reproducibly associated with increased mortality in non-cardiac surgery. Importantly, this association is not just mediated by the occurrence of postoperative MI, but is also associated with increased mortality in the absence of a formal diagnosis of MI. Furthermore, troponin elevations also predict non-cardiac complications and death. Routine early postoperative monitoring for troponin elevations will undoubtedly lead to increased identification of patients at risk for postoperative mortality. The appropriate clinical management of individuals with postoperative biomarker detection has yet to be defined and is an area of intense ongoing research.

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