The leading cause of morbidity and mortality following anesthesia is major adverse cardiac events, or MACE (Smilowitz et al., 2017; Sabate et al., 2011). These events include cardiac arrest, myocardial infarction, new onset congestive heart failure and dysrhythmias, and angina (Sabate et al., 2011). MACE has been reduced over the last decade likely due to the advent of beta-blocker and statin therapy, yet continues to occur at approximately 2.6% of adult non-cardiac surgeries (Smilowitz et al., 2017). To add, the 2009 Healthcare Information Technology for Economic and Clinical Health Act and the 2010 Affordable Care Act provide incentives for certified electronic health records, yet only 27% of perioperative services were using this tool as of 2011 (Simpao, Ahumada, & Rehman, 2015; Wanderer & Ehrenfeld, 2013). There are two potential pathways for improvement of this issue during pre-operative assessment and prevention: updating cardiac risk assessment guidelines, and improving guideline adherence and risk assessment accuracy with clinical decision support tools. The PICOT question is “Do clinical decision support tools in pre-anesthesia evaluation and intraoperative management reduce major adverse cardiac events (MACE) in adult non-cardiac surgery patients immediately to 30 days post-anesthesia?” Current literature demonstrates poor predictive abilities of current guidelines and lack of consensus at data end-points for decision making (Cohn & Fleisher, 2017; Arora et al., 2016; Bihorac, 2015; Devereaux & Sessler, 2015; Hobson et al., 2015; Carabini et al., 2014; Fleisher et al., 2014a; Fleisher et al., 2014b; Tashiro et al., 2014; American College of Surgeons, 2013; Aitken et al., 2013; Kidney Disease Improving Global Outcomes, 2012; Nallegowda et al., 2012; The VISION Pilot Study Investigators, 2011). Clinical decision support tools have demonstrated their use with an enhanced learning experience for anesthesia students (Ehrenfeld, McEvoy, Furman, Snyder, & Sandberg, 2014), improved clinical outcomes such as decreased post-operative nausea and vomiting (Simpao et al, 2017, Kappen et al., 2015, Koojie et al., 2012), and decreased unnecessary testing for patients (Hand et al, 2014; Flamm et al., 2013). There are additional applications of clinical decision support tools such as provider alerts along the continuum of anesthesia care to prevent further insult to patients at risk of a major adverse cardiac event. Clinical decision support tools offer a valuable strategy in real time use of clinical data and show strong evidence in assisting providers to thoroughly apply guidelines for practice (Hand et al., 2014; Wanderer & Ehrenfeld, 2013), which are particularly complex in cardiac risk assessment.

Title:
Decreasing Incidence of Major Adverse Cardiac Events in Non-Cardiac Surgery Patients

Keywords:
cardiac risk assessment, clinical decision support and major adverse cardiac events

References:


Abstract Summary:

The leading cause of morbidity and mortality following anesthesia is major adverse cardiac events, or MACE. There are two potential pathways for improvement of this issue during pre-operative assessment and prevention: updating cardiac risk assessment guidelines, and improving guideline adherence and risk assessment accuracy with clinical decision support tools.

Content Outline:

1. PICOT Question: Do clinical decision support tools in pre-anesthesia evaluation and intraoperative management reduce major adverse cardiac events (MACE) in adult non-cardiac surgery patients immediately to 30 days post-operatively?

2. Purpose: MACE, the most common cause of perioperative morbidity and mortality, occurs at a rate of 2.6% within 30 days of surgery. Three tools utilized to assess cardiac risk are the Revised Cardiac Risk Index, the American College of Surgeons Surgical Risk Calculator, and the 2014 American Heart Association/ American College of Cardiology Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery. Not only are none of these tools externally validated, each lack updated recommendations and clinical criteria for comprehensive assessment. Furthermore, the first two tools have shown to under-estimate true risk by at least 50%, and anesthesia providers can fully implement the 2014 AHA/ACC guidelines only 67% of the time from memory alone. Clinical decision support (CDS) tools offer a platform, once integrated into an electronic medical record, in which guideline adherence, recommendations in care, summary of clinical patient data, and accurate risk stratification can occur.

- Definitions of MACE
  1. New onset cardiac arrhythmias, angina, new onset congestive heart failure, non-fatal and fatal cardiac arrest, and acute myocardial infarction.
  2. Two types of perioperative MI: plaque rupture and hemodynamic insult.
  3. Population: age over 50, within 30 days of surgery; most commonly in vascular, thoracic, and transplant surgeries.
  4. Incidence: 2.6% in 2013, declining over a decade; suggested to be due to beta-blocker therapy (POISE recommendations), statin therapy, and improved surgical and anesthesia techniques.

1. Stakeholders: patients, families, anesthesia providers, surgeons, primary care team, hospital staff, cardiologist, clinical informatics specialists, government

2. Literature search
   1. Search engines: PubMed, CINAHL, Web of Science, Google
   2. 32 articles; 24 academic research, 11 for use of CDS

3. Limitations of Current Guidelines
   1. American College of Surgeons Surgical Risk Calculator
      1. Due to copyright laws, can only be accessed on the website; cannot be integrated into patient chart for real-time analysis
      2. Excludes trauma and transplant patients, where transplant patients have the third highest incidence of MACE

- Predicting risk of a MACE outcome is limited to cardiac arrest and myocardial infarction

1. Calculator criteria do not follow most up to date guidelines

1. Revised Cardiac Risk Index
   1. Developed in early 1990s, in a single-cohort study
   2. Risk estimates found to be 50% lower than observed outcomes by at least two studies
• Cannot be applied to emergency surgeries

1. Does not include valvular disease

• Gaps in Clinical Factor Identification
  1. Anemia and Intraoperative Blood Loss
     1. Not included in RCRI or ACS SRC
  2. Amputation
     1. No matter the type of amputation, all patients carry higher atherosclerotic disease than control group
     2. Significantly higher perioperative mortality than emergency cardiac surgery cases

• Most common cause of post-operative death in amputation patients is myocardial infarction due to "silent" coronary artery disease

1. Amputation as a risk assessment criteria missing from all three tools

1. Hypo-, Hyperkalemia, and Acute Kidney Injury
   1. Metabolic acidosis, hypo-, and hyperkalemia are all independent risk factors for dysrhythmias and other MACE events within 30 days.
      1. Serum potassium is also strongly correlated with new onset atrial fibrillation
   2. MACE risk increased by hypo- and hyperkalemia, 2.2 and 3.2-fold, respectively.

• Potassium trends are not included in any current cardiac risk assessment tool or guideline

1. 41% of patients who develop a post-operative AKI also experience a cardiovascular complication
   1. These patients have a 12.6% hospital mortality and 16% 90-day mortality. Second study finds mortality is higher by 4-fold.
2. Providers fail to act in a timely fashion in the biochemical presentation of AKI 41% of the time.
3. Nosocomial development of AKI is higher mortality risk (27%) than AKI at admission (11.8%).

• Admission AKI is unrecognized in 23.5% of cases, and two-thirds of patients are discharged without treatment.

• Clinical Decision Support
  1. Improved pre-operative risk assessment, intraoperative and hemodynamic management
     1. Ability to detect hemodynamic collapse within 2 hours using standard monitoring
     2. Decreases unnecessary pre-operative testing
  2. Improved anesthesia education, training, and performance outcomes.
  3. As visual cue and interactive checklist
     1. Significantly improve non-MACE outcomes and mitigate costs
  4. Unintended Consequences
     3. May add 3.4 minutes to pre-operative assessment; include false positives
  5. Barriers and Facilitators to Implementation
     3. Facilitators: automation, dedicated facility coordinator
     4. Barriers: poor usability, difficulty of integration, software and hardware issues, training concerns, insufficient technical support, lack of coordinating roles.
  6. Alternatives

• Cost-Benefit Analysis
  1. Conservative measure of hypothetical 15% effectiveness of a MACE CDS net savings over 5 years
1. In a hospital with 10,000 annual surgeries à $280,865
2. 43,000 annual surgeries, approximately $3.2 million

First Primary Presenting Author

Primary Presenting Author

Kristin M. Kunze, DNP, CRNA
Quinnipiac University
School of Nursing
Student Registered Nurse Anesthetist
Hamden CT
USA


Author Summary: Kristin Kunze is a recent graduate of the Doctor of Nursing Practice Nurse Anesthesia Program at Quinnipiac University. She assembled this presentation by way of her DNP Project and experiences with five clinical sites.