PERSPECTIVE

Perioperative Risk Calculators and the Art of Medicine

Nidhi Rohatgi, MD, MS
Division of Hospital Medicine, Department of Medicine, Stanford University School of Medicine, Stanford, California.

"The revised cardiac risk index score[1] is 0, so the patient can go to the operating room, right?" While patient histories and physical examinations have continued value in most other fields of medicine, perioperative risk assessment may sometimes be condensed to such a singular thought process. But are risk calculators enough by themselves?

The field of perioperative medicine has seen the development of multiple risk calculators for cardiac risk assessment (**Box**).[1-6] These calculators have been valuable in identifying the risk factors for major cardiovascular outcomes. They are easy to use by surgeons or advanced practice clinicians, anesthesiologists, and internists. Patients who are deemed to be at low or very high risk based on these calculators may not need stress testing, leading to a judicious use of resources. Some calculators, such as the American College of Surgeons' National Surgical Quality Improvement Program universal surgical risk calculator (ACS NSQIP), calculate the risk of multiple complications beyond just cardiac.[2] These calculators may help engage patients in shared decision-making before undergoing surgery, especially the high-risk patients who may otherwise underestimate their risk. These decision aids may help motivate patients toward risk-reduction strategies before undergoing surgery.

These calculators have been created with varying levels of rigor, have unique limitations and strengths, were studied in specific surgical populations, and are not all externally validated. During the past few decades, the field of statistics has also grown, with more sophisticated analyses being developed. High-power computers can now analyze hundreds of variables on millions of patients. While the creation of earlier tools, such as the original cardiac risk index by Goldman et al,[6] involved prospective clinician input and bedside reasoning, the newer tools have relied on complicated statistics and retrospective medical record data. Many of the important clinical variables, such as aortic stenosis, arrhythmias, and jugular venous distension, in the earlier calculators were not included in the new calculators.

It has also been argued that population-based evidence used in creating these calculators may imprecisely determine decisions at the patient level.[7] While the ACS NSQIP universal surgical risk calculator uses large cohorts of patients and variables and is currently the most robust,[2] no calculator can absolutely predict an individual's risk. Calculators are also limited by the variables available in administrative databases. Sometimes we are left wondering how the calculator determined the risk of acute kidney injury or venous thromboembolism when it never let us enter all the pertinent history and risk factors for that patient, or if the history of smoking was given the same covariate weight as ascites in the ACS NSQIP universal surgical risk calculator. The outcomes selected by these calculators are mostly restricted to the uncommon (although important) ones, such as nonfatal myocardial infarction, ventricular fibrillation, complete heart block, or cardiac arrest.

While a particular patient may not be at high risk of these uncommon cardiac complications perioperatively, they may be at high risk of having acute pulmonary edema, arrhythmia, delirium, or acute kidney injury. These latter outcomes are more common and also important to the patient and clinician.

Some of these calculators relied on manual medical record reviewers to accurately collect preoperative risk factors. But if important clinical diagnoses were never established or documented accurately by the surgical team, they may still not be included in the statistical modeling. Not uncommonly, patients go through the fragmented and overwhelmed US health care system without receiving a diagnosis of coronary artery disease, pulmonary hypertension, obstructive sleep apnea, congestive heart failure, cirrhosis, or chronic obstructive lung disease. While these patients may be able to manage their daily routines, these diagnoses can have important consequences perioperatively. Without a meticulous history and examination, if we solely rely on a risk calculator, important clinical details, such as dyspnea on exertion, undiagnosed irregular heartbeat, murmurs, substantial alcohol use, or cognitive impairment, could be missed. Although the benefit may still outweigh the risk for that surgery, a thorough history and examination remain invaluable in preparing clinicians to care for patients perioperatively.

Different perioperative risk calculators may give similar but not exactly the same evaluations of perioperative risk. So which one is right? For example, a patient with a history of hypertension alone for whom a hip surgery is planned would have a revised cardiac risk index score of 0.[1] This would mean a 0.4% risk of a major adverse cardiac event perioperatively, a low risk. With the ACS NSQIP universal surgical risk calculator,[2] this same patient's risk of cardiac complication would be 0.6%, and it would be 1.4% if the myocardial infarction–cardiac arrest calculator is used.[3]

A thorough review of subjective and objective data preoperatively, although somewhat time-consuming, helps the clinician identify patients at high risk for adverse outcomes and prepares the perioperative team to proactively prevent and manage any decompensation. It is also important for the medical team to understand what surgical procedure is being planned, surgical positioning, the estimated duration of surgery, estimated blood loss, and the type of anesthesia being considered. A complete risk-benefit discussion with the patient and/or family before the surgery involves a layman's explanation of the medical and surgical concerns for that particular patient based on the conglomerate of

Corresponding Author: Nidhi Rohatgi, MD, MS, 300 Pasteur Dr, HCO32D, Mail Code 5210, Stanford, CA 94305 (nrohatgi@stanford.edu).

© 2019 American Medical Association. All rights reserved.

Downloaded From: https://jamanetwork.com/ Hubnet by Edward Stehlik on 12/22/2019

Box. Perioperative Cardiac Risk Calculators

- ACS NSQIP universal surgical risk calculator (Bilimoria et al,[2] 2013)
- MICA risk calculator (Gupta et al,[3] 2011)
- Revised cardiac risk index (Lee et al,[1] 1999)
- Cardiac risk assessment criteria (Eagle et al,[4] 1989)
- Modified multifactorial clinical risk index (Detsky et al,[5] 1986)
- Original cardiac risk index (Goldman et al,[6] 1977)

Abbreviations: ACS, American College of Surgeons; MICA, myocardial infarction–cardiac arrest calculator; NSQIP, National Surgical Quality Improvement Program.

subjective and objective data obtained by a trained clinician, as well as a discussion on what steps can be taken in conjunction with medicine, anesthesiology, and surgery to mitigate these risks. This tradition of taking a thorough history and physical examination is also effective in establishing a rapport and confidence with patients and families.

Perioperative care of the patient is best accomplished by combining the science of medicine with the "old fashioned" art of medicine that involves talking to patients, examining them, and making medical decisions together with patients. The risk calculators are meant to serve as decision aids. Numbers, whether taken in isolation or as an index, are not a substitute for clinical evaluation and clinical judgment. If we choose a solely calculator-based risk assessment and categorization of patients into low or elevated risk without individualized clinical evaluation, then have we really made any progress from the taboo and unhelpful words, "the patient is medically cleared for surgery"?

Published Online: October 21, 2019. doi:10.1001/jamainternmed.2019.4914

Conflict of Interest Disclosures: None reported.

1. Lee TH, Marcantonio ER, Mangione CM, et al. Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. *Circulation*. 1999;100(10):1043-1049. http://www.ncbi.nlm.nih.gov/pubmed/10477528. doi:10.1161/01.CIR.100.10.1043

2. Bilimoria KY, Liu Y, Paruch JL, et al. Development and evaluation of the universal ACS NSQIP surgical risk calculator: a decision aid and informed consent tool for patients and surgeons. *J Am Coll Surg*. 2013;217(5):833-842.e1, 3. doi:10.1016/j.jamcollsurg.2013.07.385

3. Gupta PK, Gupta H, Sundaram A, et al. Development and validation of a risk calculator for prediction of cardiac risk after surgery. *Circulation*. 2011;124(4):381-387. doi:10.1161/CIRCULATIONAHA.110.015701

4. Eagle KA, Coley CM, Newell JB, et al. Combining clinical and thallium data optimizes preoperative assessment of cardiac risk before major vascular surgery. *Ann Intern Med*. 1989;110(11):859-866. http://www.ncbi.nlm.nih.gov/pubmed/2655510. doi:10.7326/0003-4819-110-11-859

5. Detsky AS, Abrams HB, Forbath N, Scott JG, Hilliard JR. Cardiac assessment for patients undergoing noncardiac surgery: a multifactorial clinical risk index. *Arch Intern Med*. 1986;146(11):2131-2134. http://www.ncbi.nlm.nih.gov/pubmed/3778043. doi:10.1001/archinte.1986.00360230047007

6. Goldman L, Caldera DL, Nussbaum SR, et al. Multifactorial index of cardiac risk in noncardiac surgical procedures. *N Engl J Med*. 1977;297(16):845-850. doi:10.1056/NEJM197710202971601

7. Kent DM, Shah ND. Risk models and patient-centered evidence: should physicians expect one right answer? *JAMA*. 2012;307(15):1585-1586. doi:10.1001/jama.2012.469

© 2019 American Medical Association. All rights reserved.

Downloaded From: https://jamanetwork.com/ Hubnet by Edward Stehlik on 12/22/2019