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ONE MINUTE CONSULT
BRIEF ANSWERS TO SPECIFIC CLINICAL QUESTIONS

Q: Do cardiac risk stratification indexes accurately estimate perioperative risk in noncardiac surgery patients?

A: Neither of the two cardiac risk assessment indexes most commonly used (**Table 1**)[1,2] is completely accurate, nor is one superior to the other. To provide the most accurate assessment of cardiac risk, practitioners need to select the index most applicable to the circumstances of the individual patient.

CARDIAC COMPLICATIONS ARE INCREASING

About 5% of patients undergoing noncardiac surgery have a major cardiac complication within the first 30 postoperative days.[3,4] This rate has been rising, primarily due to an increasing prevalence of cardiac comorbidities. Thus, accurate preoperative cardiac risk stratification is needed to assess the risk of perioperative major cardiac complications in all patients scheduled for noncardiac surgery. This information helps the perioperative team and patient to better weigh the benefits and risks of surgery and to optimize its timing and location (eg, inpatient vs outpatient surgery center).

CARDIAC RISK ASSESSMENT INDEXES

The 2 risk assessment indexes most often used are:

- The Revised Cardiac Risk Index (RCRI)[1]
- The National Surgical Quality Improvement Program (NSQIP) risk index, also known as the Gupta index.[2]

Both are endorsed by the American College of Cardiology (ACC) and the American Heart Association (AHA).[5] The RCRI, introduced in 1999, is more commonly used, but the NSQIP, introduced in 2011, is based on a larger sample size.

Both indexes consider various factors in estimating the risk, with some overlap. The main outcome assessed in both indexes is the risk of a major cardiac event, ie, myocardial infarction or cardiac arrest. The RCRI outcome also includes ventricular fibrillation, complete heart block, and pulmonary edema, which may be sequelae to cardiac arrest and myocardial infarction. This difference in defined outcomes between the indexes is not likely to account for a significant variation in the prediction of risk; however, this is difficult to prove.

Each index defines myocardial infarction differently. The current clinical definition[6] includes detection of a rise or fall of cardiac biomarker values (preferably cardiac troponins) with at least 1 value above the 99th percentile upper reference limit and at least 1 of the following:

- Symptoms of ischemia
- New ST-T wave changes or new left bundle branch block
- New pathologic Q waves
- Imaging evidence of new loss of viable myocardium tissue or new regional wall-motion abnormality
- Finding of an intracoronary thrombus.

As seen in **Table 1**, the definition of myocardial infarction in NSQIP was one of the following: ST-segment elevation, new left bundle branch block, Q waves, or a troponin level greater than 3 times normal. Patients may have mild troponin leak of unknown significance without chest pain after surgery. This suggests that NSQIP may have overdiagnosed myocardial infarction.

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TABLE 1

The Revised Cardiac Risk Index (RCRI) and the National Surgical Quality Improvement Program (NSQIP) index

	RCRI[1]	NSQUIP[2]
Factors used	History of ischemic heart disease History of heart failure History of cerebrovascular disease Insulin-dependent diabetes Preoperative serum creatinine > 2.0 mg/dL Undergoing suprainguinal vascular, intraperitoneal, or intrathoracic surgery	Age Serum creatinine > 1.5 mg/dL American Society of Anesthesiology (ASA) class Functional status Type of surgery
Interpretation	**Low risk** 0 risk factors: 0.4% risk 1 risk factor: 0.9% risk **Elevated risk** 2 risk factors: 7% risk ≥ 3 factors: 11% risk	Web-based calculator gives a percent risk: www.qxmd.com/calculate/calculator_245/gupta-perioperative-cardiac-risk
Derivation and validation study design	Prospective cohort 1989–1994 Single hospital 5,737 patients > age 50	Historical national database 2007–2008 Multicenter (200 hospitals) 46,8795 patients > 16 years old
Outcomes assessed	Myocardial infarction Cardiac arrest Ventricular fibrillation Pulmonary edema Complete heart block	Myocardial infarction, defined as 1 of the following: ST-segment elevation New Q waves New left bundle branch block Troponins > 3 times normal Cardiac arrest
Advantages	Used for more than a decade	Surgery-specific
Disadvantages	Advanced laparoscopic procedures were not widely performed when this index was devised Functional capacity not a variable Definition of myocardial infarction is based on creatine kinase MB (CK-MB): CK-MB > 5% of total CK, or > 3% of total CK with electrocardiographic changes Only 0.2% patients had severe aortic stenosis, so it is not included	Coronary artery disease, aortic stenosis are not variables Myocardial infarctions may have been overdiagnosed due to troponin elevation of unknown significance

USE IN CLINICAL PRACTICE

In clinical practice, which risk index is more accurate? Should clinicians become familiar with one index and keep using it? The 2014 ACC/AHA guidelines[5] do not recommend one over the other, nor do they define the clinical situations that could lead to significant underestimation of risk.

The following are cases in which the indexes provide contradictory risk assessments.

Case 1. A 60-year-old man scheduled for surgery has diabetes mellitus, for which he takes

insulin, and stable heart failure (left ventricular ejection fraction 40%). His RCRI score is 2, indicating an elevated 7% risk of cardiac complications; however, his NSQIP index is 0.31%. In this case, the NSQIP index probably underestimates the risk, as insulin-dependent diabetes and heart failure are not variables in the NSQIP index.

Case 2. A 60-year-old man who is partially functionally dependent and is on oxygen for severe chronic obstructive pulmonary disease is scheduled for craniotomy. His RCRI score is 0 (low risk), but his NSQIP index score (4.87%) indicates an elevated risk of cardiac complications based on his functional status, symptomatic chronic obstructive pulmonary disease, and high-risk surgery. In this case, the RCRI probably underestimates the risk.

These cases show that practitioners should not rely on just one index, but should rather decide which index to apply case by case. This avoids underestimating the risk. In patients with poor functional status and higher American Society of Anesthesiology class, the NSQIP index may provide a more accurate risk estimation than the RCRI. Patients with cardiomyopathy as well as those with insulin-dependent diabetes may be well assessed by the RCRI.

The following situations require additional caution when using these indexes, to avoid over- and underestimating cardiac risk.

PATIENTS WITH SEVERE AORTIC STENOSIS

Neither index lists severe aortic stenosis as a risk factor. The RCRI derivation and validation studies had only 5 patients with severe aortic stenosis, and the NSQIP validation study did not include any patients with aortic stenosis. Nevertheless, severe aortic stenosis increases the risk of cardiac complications in the perioperative period,[7] making it important to consider in these patients.

Although patients with severe symptomatic aortic stenosis need valvular intervention before the surgery, patients who have asymptomatic severe aortic stenosis without associated cardiac dysfunction do not. Close hemodynamic monitoring during surgery is reasonable in the latter group.[5,7]

PATIENTS WITH RECENT STROKE

What would be the cardiac risk for a patient scheduled for elective hip surgery who has had a stroke within the last 3 months? If one applies both indexes, the cardiac risk comes to less than 1% (low risk) in both cases. However, this could be deceiving. A large study[8] published in 2014 showed an elevated risk of cardiac complications in patients undergoing noncardiac surgery who had had an ischemic stroke within the previous 6 months; in the first 3 months, the odds ratio of developing a major adverse cardiovascular event was 14.23. This clearly overrides the traditional expert opinion-based evidence, which is that a time lapse of only 1 month after an ischemic stroke is safe for surgery.

PATIENTS WITH DIASTOLIC DYSFUNCTION

A 2016 meta-analysis and systematic review found that preoperative diastolic dysfunction was associated with higher rates of postoperative mortality and major adverse cardiac events, regardless of the left ventricular ejection fraction.[9] However, the studies investigated included mostly patients undergoing cardiovascular surgeries. This raises the question of whether asymptomatic patients need echocardiography before surgery.

Neither index specifies severe aortic stenosis as a risk factor

In a patient who has diastolic dysfunction, one should maintain adequate blood pressure control and euvolemia before the surgery and avoid hypertensive spikes in the immediate perioperative period, as hypertension is the worst enemy of those with diastolic dysfunction. Patients with atrial fibrillation may need more stringent heart rate control.

In a prospective study involving 1,005 consecutive vascular surgery patients, the 30-day cardiovascular event rate was highest in patients with symptomatic heart failure (49%), followed by those with asymptomatic systolic left ventricular dysfunction (23%), asymptomatic diastolic left ventricular dysfunction (18%), and normal left ventricular function (10%).[10]

Further studies are needed to determine whether the data obtained from the assessment of ventricular function in patients without signs or symptoms are significant enough to require updates to the criteria.

WHAT ABOUT THE ROLE OF BNP?

In a meta-analysis of 15 noncardiac surgery studies in 850 patients, preoperative B-type natriuretic peptide (BNP) levels independently predicted major adverse cardiac events, with levels greater than 372 pg/mL having a 36.7% incidence of major adverse cardiac events.[11]

A recent publication by the Canadian Cardiovascular Society[12] strongly recommended measuring N-terminal-proBNP or BNP before noncardiac surgery to enhance perioperative cardiac risk estimation in patients who are age 65 or older, patients who are age 45 to 64 with significant cardiovascular disease, or patients who have an RCRI score of 1 or higher.

Further prospective randomized studies are needed to assess the utility of measuring BNP for preoperative cardiac risk evaluation.

PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

Patients with obstructive sleep apnea scheduled for surgery under anesthesia have a higher risk of perioperative complications than patients without the disease, including higher rates of cardiac complications and atrial fibrillation. However, the evidence is insufficient to support canceling or delaying surgery in patients with suspected obstructive sleep apnea.

After comorbid conditions are optimally treated, patients with obstructive sleep apnea can proceed to surgery, provided strategies for mitigating complications are implemented.[13]

Cardiac BNP measurement may have an important role in routine preoperative evaluation in certain groups of patients

TO STRESS OR NOT TO STRESS?

A common question is whether to perform a stress test before surgery. Based on the ACC/AHA guidelines,[5] preoperative stress testing is not indicated solely to assess surgical risk if there is no other indication for it.

Stress testing can be used to determine whether the patient needs coronary revascularization. However, routine coronary revascularization is not recommended before noncardiac surgery exclusively to reduce perioperative cardiac events.

This conclusion is based on a landmark trial in which revascularization had no significant effect on outcomes.[14] That trial included high-risk patients undergoing major vascular surgery who had greater than 70% stenosis of 1 or more major coronary arteries on angiography, randomized to either revascularization or no revascularization. It excluded patients with severe left main artery disease, ejection fraction less than 20%, and severe aortic stenosis. Results showed no differences in the rates of postoperative death, myocardial infarction, and stroke between the 2 groups. Furthermore, there was no postoperative survival difference during 5 years of follow-up.

Stress testing may be considered for patients with elevated risk and whose functional capacity is poor (< 4 metabolic equivalents) or unknown if it will change the management strategy. Another consideration affecting whether to perform stress testing is whether the surgery can be deferred for a month if the stress test is positive and a bare-metal coronary stent is placed, to allow for completion of dual antiplatelet therapy.

SHOULD WE ROUTINELY MONITOR TROPONIN AFTER SURGERY IN ASYMPTOMATIC PATIENTS?

Currently, the role of routine monitoring of troponin postoperatively in asymptomatic patients is unclear. The Canadian Cardiovascular Society[12] recommends monitoring troponin in selected group of patients, eg, those with an RCRI score of 1 or higher, age 65 or older, a significant cardiac history, or elevated BNP preoperatively. However, at this point we do not have strong evidence regarding the implications of mild asymptomatic troponin elevation postoperatively and how to manage it. Two currently ongoing randomized controlled trials will answer those questions:

- The Management of Myocardial Injury After Noncardiac Surgery (MANAGE) trial, comparing the use of dabigatran and omeprazole vs placebo in myocardial injury postoperatively
- The Study of Ticagrelor Versus Aspirin Treatment in Patients With Myocardial Injury Post Major Non-cardiac Surgery (INTREPID).

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