

CARDIOVASCULAR RISK STRATIFICATION

The algorithm on the following page is based on the AHA/ACC guidelines for perioperative cardiovascular risk stratification.¹ These guidelines, updated by the AHA/ACC in 2007, left more discretion to the provider and patient regarding noninvasive stress testing. We advocate following these guidelines while keeping in mind that patients are individuals and guidelines should not be interpreted as strict rules.

How much is 4 METs?

A “metabolic equivalent” is defined as the oxygen uptake of sitting at rest. Greater than 4 METs of energy are required for “light work around the house”, climbing a flight of stairs, walking up a hill, or walking on level ground at 4 mph.⁴

METs	Activity
1	Sitting quietly at rest.
2	Walking slowly on level ground.
3-4	Doing light work around the house.
4	Walking on level ground at 4 mph.
4-5	Climbing a flight of stairs, walking up a hill.
6	Moderate recreational activity e.g. dancing, doubles tennis, moderate cycling.
>10	Strenuous sports e.g. singles tennis, basketball, skiing.

Why does 4 METs matter?

Assessment of exercise tolerance is critical—in the current AHA/ACC guidelines, this assessment has moved ahead of cardiovascular risk factors in importance. The “4 METs” criterion has been used in numerous studies. Data from our own institution³ demonstrated that a patient’s *self-reported* exercise tolerance (asked as “How many blocks do you think you can walk?” and “How many flights of stairs can you climb?”) of less than 4 blocks and less than 2 flights of stairs was predictive of perioperative complications (sens 0.71, spec 0.47).

Clinical Risk Factors:

Note the Revised Cardiac Risk Index (RCRI), from which these risk factors were based, specified additional criteria:

- Diabetes is a risk factor only if insulin-requiring.
- Chronic kidney disease was defined as a preoperative creatinine >2.0.
- Congestive heart failure refers to a past history—active, decompensated heart failure should prompt consideration of deferring surgery until treated.
- Cerebrovascular disease is defined as history of TIA or stroke—incidentally found cerebrovascular disease on imaging or asymptomatic carotid stenosis is of uncertain significance.
- Ischemic heart disease was defined as pathologic Q waves on ECG, angina, use of nitrates, prior MI, or positive stress test—note that a patient who underwent elective coronary bypass without prior MI and who is currently asymptomatic would not have been classified as having this risk factor using the original Revised Cardiac Risk Index.

Cardiology

1. Emergency surgery? → yes → Proceed with surgery. Optimize medical management.

↓ No

2. Active cardiac conditions? → yes → Treat these conditions first prior to surgery.

- Active cardiac conditions:**
- Unstable or severe angina
 - Recent MI (within 30 days)
 - Decompensated heart failure
 - Significant arrhythmias (High grade, 3rd degree, or Mobitz II AV block; symptomatic ventricular arrhythmias, supraventricular arrhythmias with HR>100 at rest; symptomatic bradycardia, newly recognized ventricular tachycardia)
 - Severe valvular disease (Severe AS—mean gradient >40 mm Hg, valve area <1.0 cm², or symptomatic; symptomatic mitral stenosis)

↓ No

3. Low risk surgery? → yes → Proceed with surgery.

Surgical risk (estimated cardiac risk)		
Low (<~1%)	Intermediate (~1-5%)	High (>~5%)
Endoscopic	Carotid endarterectomy	Major vascular surgery
Superficial procedures	Intraperitoneal	
Breast	Intrathoracic	
Cataract	Head and Neck	
Ambulatory surgery	Orthopedic	
	Prostate	

↓ No

4. Good functional capacity? (≥ 4 METs) → yes → Proceed with surgery.

↓ No

5. All other situations: → yes → Assess number of Clinical Risk Factors:

- Clinical Risk Factors**
- Diabetes
 - Ischemic heart disease
 - History of congestive heart failure
 - Cerebrovascular disease
 - Chronic kidney disease

0: Proceed with surgery.

1-2: Consider non-invasive stress testing if it will change management. Consider perioperative beta-blockade.

3+: Consider non-invasive stress testing, especially for patients undergoing vascular surgery.

What about procedures that are not listed above?

In general, we infer risk based on similarity to the procedures listed, and based on expected blood loss, duration of anesthesia, and expected fluid shifts. There are some surgeries that appear to have lower operative risk within the same category—e.g. the laparoscopic band surgery likely has lower risk than a 6 hour, complex abdominal surgery, but there is not extensive data regarding this.

Additionally, the possibility of other surgeries being “high risk” needs consideration. The previous AHA/ACC guidelines listed procedures of “prolonged” duration or that have “extensive fluid shifts or blood loss” as being high risk. We believe this is still a reasonable distinction. For instance, a

major spine surgery lasting 10 hours and incurring several liters of blood loss may reasonably be considered high risk. ENT cases may have prolonged anesthesia time but not necessarily have large fluid shifts or blood loss—depending on the case, such surgeries might still be considered intermediate. Duration of anesthesia, especially 8 hours or greater, is a risk factor for perioperative complications, although not necessarily for cardiac complications alone (odds ratio ~6).³

ESTIMATION OF CARDIAC RISK

There are many different clinical tools to estimate risk. Some are surgery-specific (e.g. Eagle criteria for vascular surgery).

The Revised Cardiac Risk Index² is simple, well-validated, and provides a reasonable estimate of risk for cardiac complications. Patients were 50 years or older and underwent “major” noncardiac, elective/urgent surgery. (Note that this tool is not part of the ACC/AHA guidelines, and differs from AHA/ACC in what is labeled “high risk” surgery)

Risk factors (1 pt for each)

- “High risk” surgery
 - intraoperative
 - intrathoracic
 - suprainguinal vascular
- History of ischemic heart disease
- History of heart failure
- Cerebrovascular Disease
- Preoperative insulin use
- Creatinine >2.0

# of Risk Factors	Risk Class	% major cardiac complications
0	I	0.4 (0.05-1.5)
1	II	0.9 (0.3-2.1)
2	III	6.6 (3.9-10.3)
3 or more	IV	11 (5.8-18.4)

Major cardiac complications = MI, pulmonary edema, cardiac arrest, complete heart block.

The incidence of major cardiac events shown above is from the validation cohort. It represents an average across surgeries; there were differences among the different types of surgeries, with vascular surgery conferring a higher risk (see Lee, et al article for details).

References

1. Fleisher LA, Beckman JA, Brown KA, et al. ACC/AHA 2007 guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2007;116:e418-e500.
2. Lee TH, Marcantonio ER, Mangione CM, et al. *Circulation*. Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. 1999;100:1043-1049.
3. Reilly DF, McNeely MJ, DOrner D, et al. *Arch Intern Med*. Self-reported exercise tolerance and the risk of serious perioperative complications. 1999;159:2185-2192.
4. Fletcher GF, Balady G, Froelicher VF, et al. Exercise standards. A statement for healthcare professionals from the American Heart Association Writing Group. *Circulation*. 1995;91:580-615. <http://circ.ahajournals.org/cgi/content/full/91/2/580> (see table 10)