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REVIEW TOPIC OF THE WEEK

Cardiac Risk of Noncardiac Surgery

Akshar Y. Patel, MD, Kim A. Eagle, MD, Prashant Vaishnava, MD

ABSTRACT

Major perioperative cardiac events are estimated to complicate between 1.4% and 3.9% of surgeries. Because most surgeries are elective, there is the opportunity to implement strategies to reduce this risk. Accurate identification of patients at risk for such events will allow patients to be better informed about the benefit-to-risk ratio of procedures, and guide allotment of limited clinical resources, utilization of preventive interventions, and areas of future research. This review focuses on important features of the initial pre-operative clinical risk assessment, indications for diagnostic testing to quantify cardiac risk, and the methods and indications for pre-emptive therapies. (J Am Coll Cardiol 2015;66:2140–8)

More than 50 million surgical procedures are performed annually in the United States (1). Pooled analyses estimate that 1.4% to 3.9% are complicated by a major perioperative cardiac event (2). The vast majority of surgeries are performed electively, allowing an interlude where strategies to reduce risk may be implemented. Accurate identification of patients at risk may not only help to better inform patients about the benefit-to-risk ratio of procedures, but also guide the allotment of limited clinical resources, utilization of preventive interventions, and areas of future research. Herein, we review important features of the initial pre-operative clinical risk assessment, indications for diagnostic testing to quantify cardiac risk, and methods and indications for pre-emptive therapies.

PRE-OPERATIVE CLINICAL RISK ASSESSMENT

CORONARY ARTERY DISEASE. The incidence of a major adverse cardiac event (MACE) of death or myocardial infarction (MI) perioperatively is first and foremost related to the baseline risk. Coronary artery disease (CAD) is estimated to affect 6.2% of the U.S. adult population (3). Higher rates of perioperative morbidity and mortality are associated with unstable angina or recent MI (4). Timing of surgery after a recent myocardial event also impacts rates of perioperative MACE. Livhits et al. (5) demonstrated a marked increase in the post-operative incidence of MACE as the length of time from the myocardial event to surgery shortened. This risk was attenuated by prior successful coronary revascularization at the time of the cardiac event. On the basis of these data, American College of Cardiology (ACC)/American Heart Association (AHA) guidelines recommend at least a 60-day interval between an acute coronary syndrome (ACS) and elective noncardiac surgery (6).

HEART FAILURE. Whereas an estimated 5.7 million Americans currently have heart failure (HF), this number is projected to grow to more than 8 million by 2030 (3). Actively decompensated HF with clinical features is a significant risk factor for perioperative MACE and is a component of many cardiac risk stratification indexes. van Diepen et al. (7) demonstrated that a history of HF increased perioperative risk, even in a currently compensated patient, finding significantly higher 30-day post-operative mortality rates in patients with nonischemic HF (9.3%), ischemic HF (9.2%), and atrial fibrillation (AF) (6.4%) than in those with stable CAD (2.9%). Diastolic dysfunction with and without systolic dysfunction is

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From the Department of Medicine, Samuel and Jean A. Frankel Cardiovascular Center, University of Michigan Health System and Medical School, Ann Arbor, Michigan. All authors have reported that they have no relationships relevant to the contents of this paper to disclose. Nora Goldschlager, MD, served as Guest Editor for this paper.

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associated with a significantly higher rate of MACE, prolonged length of stay, and higher rates of post-operative HF (8). Current guidelines state that the effect of asymptomatic left ventricular (LV) dysfunction on perioperative outcomes is unknown, but note that a single-center prospective cohort study has reported evidence for increased perioperative cardiac risk in patients with asymptomatic LV dysfunction (9). Flu et al. (9) reported that in patients undergoing elective vascular surgery, the 30-day cardiovascular event rate was 49% in patients with symptomatic HF, 23% in those with asymptomatic systolic LV dysfunction, 18% in those with asymptomatic diastolic LV dysfunction, and 10% in those with normal LV function.

VALVULAR HEART DISEASE. Older studies found severe valvular heart disease to significantly increase the risk of perioperative MACE (10). Agarwal et al. (11) reported that patients with moderate or severe aortic stenosis undergoing nonemergency noncardiac surgery had a 30-day mortality rate double that of propensity score-matched patients without aortic stenosis (2.1% vs. 1.0%). Post-operative MI was almost 3 times as frequent in patients with aortic stenosis than in those without (3.0% vs. 1.1%; $p = 0.001$) (11). However, Tashiro et al. (12) reported that patients with truly asymptomatic severe aortic stenosis and those without aortic stenosis had similar MACE rates. These data were not incorporated into the recent ACC/AHA guidelines.

In patients with severe mitral regurgitation, Bajaj et al. (13) demonstrated worse 30-day composite outcomes (death and post-operative MI, HF, and stroke) than in patients without mitral regurgitation (22.2% vs. 16.4%; $p < 0.02$). Key predictors of adverse post-operative outcomes after noncardiac surgery included ejection fraction <35%, ischemic mitral disease, and diabetes (13). Lai et al. (14) reported a 5-fold increase in-hospital mortality rate (9.0% vs. 1.8%; $p = 0.008$) in patients with moderate-to-severe and severe aortic regurgitation compared with case-matched controls without aortic regurgitation. In this study, key predictors of in-hospital death included LV ejection fraction <55% and creatinine >2 mg/dl (14). Because there are no trials regarding their perioperative care, current guidelines advise that patients with moderate-to-severe aortic regurgitation and severe aortic regurgitation could be monitored with invasive hemodynamics and echocardiography, in addition to being admitted to an intensive care unit setting in the post-operative period (6).

ARRHYTHMIAS. Although few studies have evaluated perioperative cardiac risk due to cardiac arrhythmias, there appears to be little risk associated with asymptomatic arrhythmias. A consecutive, prospective study from the Veterans Affairs demonstrated no increased risk of perioperative MACE due to asymptomatic ventricular arrhythmias or AF (15). Whereas older studies (16) demonstrated an association with intraoperative and post-operative arrhythmias, but no increased risk of MI or cardiac death, more recent reports demonstrate increased perioperative cardiac risk from the presence of increased numbers of premature ventricular contractions or nonsustained ventricular tachyarrhythmia (17).

PULMONARY VASCULAR DISEASE. In patients with pulmonary vascular disease undergoing noncardiac surgery, mortality rates vary from 4% to 26%, and cardiac and/or respiratory failure rates from 6% to 42% (18,19). As such, current guidelines recommend continuation of pulmonary vasodilator therapy perioperatively (Class I) and preoperative evaluation by a pulmonary hypertension specialist before major elective noncardiac surgery (Class IIa) (6).

PROCEDURE TYPE. The type of surgery the patient will undergo contributes substantially to the perioperative cardiac risk. Differing from prior versions, the 2014 guidelines characterize risk as either low or elevated. A low-risk procedure is defined as a procedure wherein the combined surgical and patient characteristics predict a risk of MACE <1%. Generally, these surgeries are those with a less invasive approach, limiting fluid shifts and cardiac stress; procedures typical of this category include cataract surgery and endoscopy (19). Conversely, procedures with a >1% risk of MACE are considered to be elevated risk and include open and vascular procedures (20). It is thought that this risk may be attenuated in certain circumstances with a less invasive technique.

CALCULATION OF RISK. Several multivariate risk indexes may be helpful for pre-operative assessment. The Revised Cardiac Risk Index (RCRI) is, perhaps, the most well-known and simplest tool. It consists of 6 predictors of risk, including: high-risk surgery (defined as intraperitoneal, intrathoracic, or suprainguinal vascular); history of ischemic heart disease; history of congestive HF, history of cerebrovascular disease; preoperative treatment with insulin; and pre-operative creatinine >2 mg/dl (16). The presence of 2 or more of these predictors carries an elevated risk level for post-operative major cardiac complication (21).

ABBREVIATIONS AND ACRONYMS

ACC = American College of Cardiology

ACE = angiotensin-converting enzyme

ACS = acute coronary syndrome(s)

AF = atrial fibrillation

AHA = American Heart Association

CAD = coronary artery disease

DAPT = dual-antiplatelet therapy

DES = drug-eluting stent(s)

ESC = European Society of Cardiology

HF = heart failure

LV = left ventricle/ventricular

MACE = major adverse cardiac event(s)

MET = metabolic equivalent

MI = myocardial infarction

PCI = percutaneous coronary intervention

RCRI = Revised Cardiac Risk Index