

The POISE trial highlights the importance of a clear risk-and-benefit assessment, with careful initiation and titration to therapeutic efficacy of preoperative beta blockers in patients undergoing noncardiac surgery. A recent meta-analysis which included the POISE study further supports that excessive beta blocker dosing is, in fact, harmful.

The ACC/AHA guidelines recommend the following: (1) Beta blockers *should be continued* in patients with active cardiac conditions who are undergoing surgery and are receiving beta blockers. (2) Beta blockers titrated to heart rate and blood pressure are *probably recommended* for patients undergoing vascular surgery who are at high cardiac risk defined by CAD or cardiac ischemia on preoperative testing. (3) Beta blockers are *reasonable* for high-risk patients (RCRI  $\geq 2$ ) who undergo vascular surgery. (4) Beta blockers are *reasonable* for patients with known CAD or high risk (RCRI  $\geq 2$ ) who undergo intermediate-risk surgery. (5) Nondiscriminant administration of high-dose beta blockers without dose titration to effectiveness is *contraindicated* for patients who have never been treated with a beta blocker.

**HMG-CoA REDUCTASE INHIBITORS (STATINS)** A number of prospective and retrospective studies support the perioperative prophylactic use of statins for reduction of cardiac complications in patients with established atherosclerosis. The ACC/AHA Guidelines support the protective efficacy of perioperative statins on cardiac complications in intermediate risk patients undergoing major noncardiac surgery. For patients undergoing noncardiac surgery and currently taking statins, statin therapy *should be continued* to reduce perioperative cardiac risk. Statins are *reasonable* for patients undergoing vascular surgery with or without clinical risk factors (RCRI  $\geq 1$ ).

**ANGIOTENSIN-CONVERTING ENZYME (ACE) INHIBITORS** Evidence supports the discontinuation of ACE inhibitors and angiotensin receptor blockers for 24 h prior to noncardiac surgery due to adverse circulatory effects after induction of anesthesia.

**ORAL ANTIPLATELET AGENTS** Evidence-based recommendations regarding perioperative use of aspirin and/or thienopyridine to reduce cardiac risk currently lack clarity. A substantial increase in perioperative bleeding and in the need for transfusion in patients receiving dual antiplatelet therapy has been observed. The discontinuation of thienopyridine and aspirin for 5–7 days prior to major surgery to minimize the risk of perioperative bleeding and transfusion must be balanced with the potential increased risk of an acute coronary syndrome and of subacute stent thrombosis in patients with recent coronary stent implantation. If clinicians elect to withhold antiplatelet agents prior to surgery, these agents should be restarted as soon as possible postoperatively.

**$\alpha_2$  AGONISTS** Several prospective and retrospective meta-analyses of perioperative  $\alpha_2$  agonists (clonidine and mivazerol) demonstrated a reduction of cardiac death rates among patients with known coronary artery disease who underwent noncardiac surgery.  $\alpha_2$  agonists thus *may be considered* for perioperative control of hypertension in patients with known coronary artery disease or an RCRI score  $\geq 2$ .

**CALCIUM CHANNEL BLOCKERS** Evidence is lacking to support the use of calcium channel blockers as a prophylactic strategy to decrease perioperative risk in major noncardiac surgery.

**ANESTHETICS** Mortality risk is low with safe delivery of modern anesthesia, especially among low-risk patients undergoing low-risk surgery (Table 9-4). Inhaled anesthetics have predictable circulatory and respiratory effects: all decrease arterial pressure in a dose-dependent manner by reducing sympathetic tone and causing systemic vasodilation, myocardial depression, and decreased cardiac output. Inhaled anesthetics also cause respiratory depression, with diminished responses to both hypercapnia and hypoxemia, in a dose-dependent manner; in addition, these agents have a variable effect on heart rate. Prolonged residual neuromuscular blockade also increases the risk of postoperative pulmonary complications due to reduction in functional residual lung capacity, loss of diaphragmatic and intercostal muscle function, atelectasis, and arterial hypoxemia from ventilation-perfusion mismatch.

**TABLE 9-4 GRADATION OF MORTALITY RISK OF COMMON NONCARDIAC SURGICAL PROCEDURES**

Higher	<ul style="list-style-type: none"> <li>Emergent major operations, especially in the elderly</li> <li>Aortic and other noncarotid major vascular surgery (endovascular and nonendovascular)</li> <li>Prolonged surgery associated with large fluid shift and/or blood loss</li> </ul>
Intermediate	<ul style="list-style-type: none"> <li>Major thoracic surgery</li> <li>Major abdominal surgery</li> <li>Carotid endarterectomy surgery</li> <li>Head/neck surgery</li> <li>Orthopedic surgery</li> <li>Prostate surgery</li> </ul>
Lower	<ul style="list-style-type: none"> <li>Eye, skin, and superficial surgery</li> <li>Endoscopic procedures</li> </ul>

Source: From LA Fleisher et al: Circulation 116:1971, 2007, with permission.

Several meta-analyses have shown that rates of pneumonia and respiratory failure are lower among patients receiving neuroaxial anesthesia (epidural or spinal) rather than general anesthesia (inhaled). However, there were no significant differences in cardiac events between the two approaches. Evidence from a meta-analysis of randomized controlled trials supports postoperative epidural analgesia for >24 h for the purpose of pain relief. However, the risk of epidural hematoma in the setting of systemic anticoagulation for venous thromboembolism prophylaxis (see below) and postoperative epidural catheterization must be considered.

## PREOPERATIVE PULMONARY RISK ASSESSMENT

Perioperative pulmonary complications occur frequently and lead to significant morbidity and mortality. The guidelines from the American College of Physicians recommend the following:

- All patients undergoing noncardiac surgery should be assessed for risk of pulmonary complications (Table 9-5).
- Patients undergoing emergency or prolonged (3- to 4-h) surgery; aortic aneurysm repair; vascular surgery; major abdominal, thoracic, neurologic, head, or neck surgery; and general anesthesia

**TABLE 9-5 PREDISPOSING RISK FACTORS FOR PULMONARY COMPLICATIONS**

- Upper respiratory tract infection: cough, dyspnea
- Age >60 years
- Chronic obstructive pulmonary disease
- Cigarette use
- American Society of Anesthesiologists Class  $\geq 2$
- Functional dependence
- Congestive heart failure
- Serum albumin <3.5 g/dL
- Obstructive sleep apnea
- Impaired sensorium (confusion, delirium, or mental status changes)
- Abnormal findings on chest examination
- Alcohol use
- Weight loss
- Spirometry threshold before lung resection
  - FEV<sub>1</sub> <2 L
  - MVV <50% of predicted
  - PEF <100 L or 50% predicted value
  - PCO<sub>2</sub>  $\geq 45$  mmHg
  - PO<sub>2</sub>  $\leq 50$  mmHg

Abbreviations: FEV<sub>1</sub>, forced expiratory volume in 1 s; MVV, maximal voluntary ventilation; PEF, peak expiratory flow rate; PCO<sub>2</sub>, partial pressure of carbon dioxide; PO<sub>2</sub>, partial pressure of oxygen.

Source: A Qaseem et al: Ann Intern Med 144:575-80. Modified from GW Smetana et al: Ann Intern Med 144:581, 2006, and from DN Mohr et al: Postgrad Med 100:247, 1996.