Who Needs a Preoperative Evaluation?

**Anthony N. Passannante, MD, Professor of Anesthesiology and Executive Vice-Chair, University of North Carolina at Chapel Hill School of Medicine**

**Coronary stents:** 600,000 placed in US patients annually; 10% of these patients undergo noncardiac surgery within 1 yr and 20% within 2 yr; optimal management requires protocols

**Hip fractures:** 11% of men and 23% of women fracture hip at some time; mortality in first year after hip fracture, =25%, and within first 30 days, 10%; patients frequently have significant comorbidities; with exception of patients with unstable clinical conditions, outcomes improved if repair of hip fracture not delayed for management of coexisting medical problems

**Death after surgery:** according to Centers for Disease Control and Prevention, heart disease number one cause of death in United States, followed by cancer and “death within 30 days of admission for surgery”; many postsurgical deaths related to myocardial infarction (MI); mortality rate for postoperative MI 10%; studies indicate that additional cardiac workup around noncardiac surgery rarely improves outcome unless patient decompensated

**Trends in major conditions:** from 2008 to 2013, outcomes improved for MI, congestive heart failure, and pneumonia; outcomes stable but not improved for “conditions requiring integrated approach; patients with anemia have poorer perioperative outcomes and higher risk for renal failure vs patients who do not have anemia; low platelet count — associated with increases in mortality and red blood cell transfusions

**Specific conditions:** diabetes mellitus — pervasive in United States; current management strategies improved over past decades; major perioperative complications decreasing; anticoagulation therapy — article by Baron et al (2013) offers suggestions for bridging therapy; anemia — cannot be treated preoperatively on day of surgery; perioperative transfusion worsens outcomes; preoperative diagnosis and treatment require integrated approach; patients with anemia have poorer perioperative outcomes and higher risk for renal failure vs patients who do not have anemia; low platelet count — associated with increases in mortality and red blood cell transfusions

**Preoperative assessment of difficult airway:** study by Khetarpal et al (2013) showed that ≈5% of patients have difficult mask ventilation or difficult laryngoscopy, and both occur in 0.4%; only 1 of ≈492,000 patients in study required cricothyrotomy; improved technology for managing airway available; airway can be adequately assessed in holding area

**Cataract surgery:** performed at high rate in our increasingly aging population; unless unstable, patients have good outcomes with local anesthetics; surgery without preoperative testing acceptable

**Perioperative surgical home:** anesthesiologists should take responsibility for preoperative assessment; subspecialty consultations and excess testing increase costs without improving outcomes

**Suggested Reading**


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**Educational Objectives**

The goals of this program are to improve the process of preoperative evaluation and the prevention and management of perioperative pulmonary complications. After hearing and assimilating this program, the clinician will be better able to:

1. Maximize the value of the preanesthesia assessment.
2. Implement targeted strategies for preoperative testing.
3. Determine the underlying causes of respiratory failure.
4. Optimize the use of reversal agents to avoid residual neuromuscular blockade.
5. Employ appropriate ventilation strategies to minimize the risks of pulmonary complications.

**Faculty Disclosure**

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Postoperative Respiratory Failure

Mark E. Nunnally, MD, Director, Adult Critical Care Services, and Professor, Departments of Anesthesiology, Medicine, Surgery, and Neurology, New York University School of Medicine, New York, NY

Case scenario #1: A patient aged 68 yr with esophageal cancer scheduled for transthiatal esophagectomy; pulmonary service cleared patient for surgery; procedure included thoracic epidural; on postoperative day 2, increasing respiratory rate, hyperglycemia, fever, and increasing fraction of inspired oxygen (FiO₂) requirement necessitated reintubation

Lessons: sepsis — surgical complication with respiratory manifestations; pulmonary dysfunction reflects systemic illness; epidural — good modality for pain control but not panacea; pulmonary function tests (PFTs) — poor predictors of outcomes

Case scenario #2: A healthy patient aged 22 yr underwent arthroscopic knee surgery; laryngeal mask airway (LMA) became dislodged and upper airway became obstructed; mask ventilation attempted, succinylcholine administered, and patient reintubated; endotracheal tube revealed pink frothy sputum; FiO₂ requirement increased; patient taken to intensive care unit (ICU) on ventilator

Postobstructive pulmonary edema: develops rapidly; may preferentially occur in young healthy patients; not related to organ dysfunction, hypervolemia, or excessive resuscitation; develops because of generation of massive negative intrathoracic pressure

Case scenario #3: A woman aged 46 yr underwent breast surgery; she underwent intubation because of reflux; surgery proceeded uneventfully; patient extubated and taken to recovery room; she developed progressively worsening shallow breathing and increased FiO₂ requirement; chest radiograph demonstrated obliteration of bases of lungs; patient reintubated; diagnosis: residual neuromuscular blockade

Definition of pulmonary complications: Severe respiratory dysfunction based on criterion as objective as possible (eg, increasing FiO₂ requirement, requirement for reintubation, inability to be extubated) that reflects systemic or pulmonary-based problem; review by Shander et al (2011) — suggested that >48 hr of cumulative mechanical ventilation or need for reintubation best criteria for measuring pulmonary complications in most objective way possible

Risk factors for pulmonary complications: Gupta online risk calculator for pulmonary complications includes ASA class, type of surgery, emergency surgery, and functional status Site of surgery: wide range of literature and risk indices indicate that site of surgical incision and type of surgery among factors most predictive of pulmonary complications; risk increases as site of incision moves closer to diaphragm; gastrectomy, Whipple procedure, or any large upper abdominal incision carries high risk

Functional status: healthier patients at lower risk; patients with reflux or poor oral hygiene at increased risk after aspiration Smoking: worsens outcomes; risk decreases with increasing length of abstinence (after ≈8 wk, risk equals that of non-smoker; changes in lung due to smoking (eg, alterations in mucociliary elevator, flora in lungs, airway diameter, and reactivity) improve over time after smoking stops; studies suggest that even abstinence for <8 wk associated with decreased risk for pulmonary complications

Lung disease: predicts pulmonary complications, but not as well as once believed; PFTs poor predictors; administer bronchodilators if reactive airway disease suspected; use pulse oximeter to assess oxygenation; serum bicarbonate increases by 1 mEq/L for every 3 mm Hg of increased PaCO₂; use predictive postoperative spirometry for patients undergoing lung resection

Neuraxial vs general anesthesia: neuraxial anesthesia theoretically reduces splinting and inadequate deep breathing caused by pain in chest; largest effect sizes favoring neuraxial anesthesia noted in 1970s and 1980s; effect sizes and overall signal has diminished over time; since 1970s, safety of general anesthesia (relative to neuraxial anesthesia) has changed enormously; neuraxial anesthesia not panacea for preventing pulmonary complications; blinded study by Norris et al (2001) identified earlier extubation in ICU as only statistically significant effect associated with epidural use in patients undergoing open repair of abdominal aortic aneurysm (ie, no benefit for rates of mortality, pneumonia, reintubation or worsening of FiO₂); conclusions — neuraxial anesthesia best used for pain control and lowering risk for thromboembolic complications; not recommended for routine use in patients at high risk for pulmonary complications, particularly if expertise in technique lacking

Neuromuscular blocking agents: have wide range of effects on respiratory system at subclinical serum concentrations; train-of-4 ratio of 0.7 (previous standard) not adequate indicator of return of neuromuscular function; current standard 0.9; visually distinguishing 0.7 from 0.9 difficult

Study by Murphy et al (2013): demonstrated increased risk for upper airway obstruction and hypoxemia with train-of-4 ratio <0.9 in postanesthesia care unit (PACU) Randomized cohort study: demonstrated residual neuromuscular blockade in ≈50% of patients in PACU Study by McLean et al (2015): patients who received neostigmine with <2 twitches or who received >60 μg/kg neostigmine at greater risk for pulmonary complications

Additional recommendations: administer modest doses of neostigmine unless patient has received no nondepolarizing neuromuscular blockers for at least 2 to 3 serum half-lives; recognize agitation, labored breathing, and increasing FiO₂ requirement as indications of residual neuromuscular blockade

Epidual: likely to cause hypotension, which can be treated; benefit of treating hypertension by stopping epidural should be weighed against risk associated with increased pain

Ventilation strategies: include using noninvasive ventilation, avoiding high FiO₂ ensuring good posture, and using low tidal volumes; positive-pressure ventilation and positive end-expiratory pressure (PEEP) prevent collapse of lungs High FiO₂ can lead to absorption atelectasis; atelectasis measured by computed tomography correlates directly with elevated FiO₂ and time of exposure; recruitment maneuvers only temporarily re-recruit lung, but combination of recruitment maneuvers and PEEP leads to longer-lasting re-recruitment of lung; preoxygenation with 70% O₂ may prevent atelectasis
and provide equal or better times to desaturation compared with 100% oxygen.

Positive-pressure ventilation: in 2005 study, associated with reduced rate of reintubation in patients who failed postoperatively; spirometric measures show that obese patients respond well to positive-pressure ventilation.

Low tidal volumes: shown to improve outcomes in patients with acute respiratory distress syndrome; multimodal interventions studied by Futier et al (2013) using low tidal volumes, PEEP, and recruitment maneuvers demonstrated decrease in combined outcome of pneumonia, respiratory failure, sepsis, and death, and decrease in noninvasive ventilation or intubation; other data suggest low tidal volumes may increase mortality; some data suggest possible optimal tidal volume of ≤ 8 mL/kg, but results not conclusive.

Physiologic considerations: include chest wall compliance and end-inspiratory pressures; increasing end-inspiratory pressure appears to correlate with increasing mortality; additional data suggest driving pressure as determining factor; increasing end-inspiratory pressure with increasing tidal volumes suggests low compliance and potential risk.

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Suggested Reading

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Estimated time to complete the educational process:
- Review Educational Objectives on page 1: 5 minutes
- Take pretest: 10 minutes
- Listen to audio program: 60 minutes
- Review written summary and suggested readings: 35 minutes
- Take posttest: 10 minutes
1. Surgery should be delayed in a patient with hip fracture for the management of which of the following coexisting medical problems?
   (A) Cancer  
   (B) Dementia  
   (C) Unstable angina  
   (D) Diabetes mellitus

2. Which of the following optimizes the time spent in a preoperative visit?
   (A) Answering the patient’s questions  
   (B) Performing chest radiography  
   (C) Performing an anticoagulation study  
   (D) Obtaining a hemoglobin assessment

3. According to the American Society of Anesthesiologists 2012 practice advisory for preanesthesia evaluation, tests in a stable patient’s chart remain valid for:
   (A) 1 wk  
   (B) 30 days  
   (C) 3 mo  
   (D) 6 mo

4. Which of the following is recommended for the management of the surgical patient with anemia?
   (A) Preoperative transfusion on the day of surgery  
   (B) Postsurgical transfusion  
   (C) Treatment of anemia well before surgery  
   (D) None of the above

5. According to the 2013 study by Kheterpal et al, which of the following is the approximate rate at which difficult mask ventilation is encountered?
   (A) 0.4%  
   (B) 1%  
   (C) 5%  
   (D) 10%

6. Which of the following is a characteristic of postobstructive pulmonary edema?
   (A) It predominantly affects elderly and debilitated patients  
   (B) It reflects underlying organ dysfunction  
   (C) It is caused by hypervolemia  
   (D) It develops rapidly

7. An increase in serum bicarbonate of 1 mEq/L indicates which of the following changes in PaCO₂?
   (A) Increase of 3 mm Hg  
   (B) Increase of 5 mm Hg  
   (C) Decrease of 3 mm Hg  
   (D) Decrease of 5 mm Hg

8. According to current standards, what is the minimum train-of-4 ratio that indicates adequate return of neuromuscular function?
   (A) 0.6  
   (B) 0.7  
   (C) 0.8  
   (D) 0.9

9. The combination of agitation, labored breathing, and increasing fraction of inspired oxygen (FiO₂) requirement indicates which of the following pulmonary complications?
   (A) Sepsis-related respiratory failure  
   (B) Postobstructive pulmonary edema  
   (C) Residual neuromuscular blockade  
   (D) Aspiration pneumonia

10. Atelectasis measured by computed tomography correlates _______ with elevated FiO₂ and _______ with time of exposure.
   (A) Directly; directly  
   (B) Directly; inversely  
   (C) Inversely; directly  
   (D) Inversely; inversely

Answers to Audio Digest Anesthesiology Volume 58, Issue 18: 1-C, 2-D, 3-C, 4-C, 5-B, 6-A, 7-A, 8-A, 9-C, 10-A