Point-of-Care Guides

Predicting the Risk of Postoperative Pulmonary Complications

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Clinical Question

What is the best approach to evaluate postoperative pulmonary risk?

Evidence Summary

The incidence of pulmonary complications following major surgery is estimated to be 1% to 23%, with the risk varying based on patient factors and the type of surgery.[1] Postoperative pulmonary complications include pneumonia, tracheobronchitis, pulmonary edema, pulmonary embolism, atelectasis, pleural effusion, pneumothorax, bronchospasm, aspiration, respiratory failure, and acute respiratory distress syndrome. Postoperative pulmonary complications increase 30-day and 90-day mortality, making pulmonary risk stratification an important part of the primary care preoperative assessment.[1,2]

Several tools have been developed to stratify patients according to their risk of postoperative pulmonary complications. The ARISCAT (Assess Respiratory Risk in Surgical Patients in Catalonia Tool) was derived using a Spanish registry to predict postoperative pulmonary pneumonia.[3] A trial that externally validated the ARISCAT using a larger, European data registry showed that the tool performed differently in different geographic populations, calling into question its application in a U.S. population without specific validation.[4-6]

This guide is one in a series that offers evidence-based tools to assist family physicians in improving their decision-making at the point of care.

This series is coordinated by Mark H. Ebell, MD, MS, deputy editor for evidence-based medicine.

A collection of Point-of-Care Guides published in *AFP* is available at https://www.aafp.org/afp/poc.

CME **This clinical content** conforms to AAFP criteria for continuing medical education (CME). See CME Quiz on page 465.

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The Respiratory Failure Risk Index was derived from the National Veterans Affairs Surgical Quality Improvement Program.[7] Because it was created using mostly male veteran patients, it is unclear whether this tool would be generalizable to a broader patient population.

Two other risk stratification tools have been developed using data from the American College of Surgeons National Surgical Quality Improvement Program (NSQIP). The NSQIP Pneumonia Risk Tool and the NSQIP Respiratory Failure Risk Tool predict the risk of developing pneumonia and respiratory failure within 30 days of surgery.[2,8] Both tools were developed using a comprehensive data registry from the American College of Surgeons that included more than 180 hospitals. A 2007 data set (211,410 patients) and 2008 data set (257,385 patients) were used for derivation and validation, respectively.

Registry patients included males and females, patients undergoing cardiothoracic and noncardiothoracic surgeries, and patients undergoing emergent and nonemergent procedures.[2,8] The type of surgery had the greatest impact on the risk of developing postoperative respiratory failure or pneumonia. The high C statistics for both tools (0.855 for pneumonia, 0.897 for postoperative respiratory failure) indicate excellent discrimination (the ability to distinguish between patients who do and do not develop a complication, where 0.5 is worst and 1.0 is best).[2,8]

The NSQIP tools use clinical data that are easily accessible preoperatively and do not require additional blood tests or imaging. Both risk tools include the type of surgery, the patient's functional status (best level of self-care demonstrated by the patient within the 30 days prior to surgery[9]), American Society of Anesthesiology class,[10] and the presence or absence of sepsis *(Table 1[2,8])*. The Respiratory Failure Risk Tool also includes whether it is an emergency, and the Pneumonia Risk Tool also includes patient age and smoking status and whether

the patient has chronic obstructive pulmonary disease. Adding to the ease of use for physicians, these risk tools are available as online calculators, such as at https://www.mdcalc.com/gupta-postoperative-respiratory-failure-risk and https://www.mdcalc.com/gupta-postoperative-pneumonia-risk, and in the QxMD smartphone app (https://qxmd.com/calculate/calculator_261/postoperative-respiratory-failure-risk-calculator).

Other risk scores not discussed in this article include the LAS VEGAS tool, Surgical Lung Injury Prediction model, and Score for Prediction of Postoperative Respiratory Complications.[11-13]

Applying the Evidence

A 54-year-old woman with a body mass index of 42 kg per m^2 presents for a preoperative assessment before elective bariatric surgery. She is currently asymptomatic and afebrile and has had no recent hospitalizations. She lives independently and has poorly controlled diabetes mellitus complicated by stage 3 chronic kidney disease and proliferative retinopathy. She is a former smoker (quit four years ago) with stage 2 chronic obstructive pulmonary disease according to the Global Initiative for Chronic Obstructive Lung Disease staging system. She also has a history of myocardial infarction, which occurred three years ago, and obstructive sleep apnea controlled with use of a continuous positive airway pressure machine. What is her postoperative pulmonary risk?

Answer: The patient would be considered in American Society of Anesthesiology class III given her body mass index and multiple moderate to severe diseases.[10] She lives independently and is having elective surgery without signs or symptoms of sepsis or recent pneumonia. Her risk scores on the NSQIP Pneumonia Risk Tool and NSQIP Respiratory Failure Risk Tool are 1.2% and 0.9%, respectively. Because obstructive sleep apnea is not included in the NSQIP tools, there is a potential that her postoperative pulmonary risk is underestimated.

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TABLE 1

Factors Required to Predict Postoperative Pulmonary Complications

Factors	Postoperative respiratory failure prediction	Postoperative pneumonia prediction
Type of surgery		
Anorectal	X	X
Aortic	X	X
Bariatric	X	X
Brain	X	X
Breast	X	X
Cardiac	X	X
Ears, nose, throat	X	X
Foregut/hepatopancreatobiliary	X	X
Gallbladder, appendix, adrenal, and spleen	X	X
Hernia (ventral, inguinal, femoral)	X	X
Intestinal	X	X
Neck (thyroid and parathyroid)	X	X
Nonesophageal thoracic	X	X
Obstetric/gynecologic	X	X
Orthopedic and nonvascular extremity	X	X
Other abdominal	X	X
Peripheral vascular	X	X
Skin	X	X
Spine	X	X
Urologic	X	X
Vein	X	X
American Society of Anesthesiology class*		
Normal healthy patient	X	X
Patient with mild systemic disease	X	X
Patient with severe systemic disease	X	X
Patient with severe systemic disease that is a constant threat to life	X	X
Moribund patient who is not expected to survive without the surgery	X	X
Functional status†		
Totally dependent	X	X
Partially dependent	X	X
Totally independent	X	X

continues

TABLE 1 *(continued)*

Factors Required to Predict Postoperative Pulmonary Complications

Factors	Postoperative respiratory failure prediction	Postoperative pneumonia prediction
Sepsis		
Preoperative systemic inflammatory response syndrome	X	X
Preoperative septic shock	X	X
Preoperative sepsis	X	X
None	X	X
Emergency case		
Yes	X	
No	X	
Age (in years)		X
COPD		
GOLD stage 2-4		X
Without COPD		X
Smoking		
Yes (prior to surgery)		X
No		X

Note: This table is based on risk assessment tools from the American College of Surgeons National Surgical Quality Improvement Program. The tools are available as online calculators at https://www.mdcalc.com/gupta-postoperative-respiratory-failure-risk and https://www.mdcalc.com/gupta-postoperative-pneumonia-risk.

COPD = chronic obstructive pulmonary disease; GOLD = Global Initiative for Chronic Obstructive Lung Disease.

*—See https://www.asahq.org/standards-and-guidelines/asa-physical-status-classification-system.

†—Defined as the best level of self-care demonstrated by the patient within the 30 days prior to surgery (https://riskcalculator.facs.org/RiskCalculator/PatientInfo.jsp).

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