Review: Surgical site, advanced age, and comorbid conditions increase risk for postoperative pulmonary complications

Smetana GW, Lawrence VA, Cornell JE. **Preoperative pulmonary risk stratification for noncardiothoracic surgery: systematic review for the American College of Physicians.** Ann Intern Med. 2006;144:581-95.

Clinical impact ratings: Hospitalists ★★★★★★☆ Pulmonology ★★★★★☆☆

QUESTION

Which patient- and procedure-related factors and test results predict postoperative pulmonary complications (PPCs) after noncardiothoracic surgery?

METHODS

Data sources: MEDLINE (1980 to June 2005) and bibliographies of relevant studies.

Study selection and assessment: English-language studies of any design that provided primary data on well-defined PPCs after noncardiothoracic surgery in adults. Excluded were studies with < 25 patients/group; that studied only nonclinical outcomes, identified PPCs by administrative data, or had outcomes unique to certain types of surgery; from developing countries; involving gastric pH manipulation; or involving ambulatory, cardiopulmonary, or organ transplant surgery. Studies that met the selection criteria included 27 studies (26 prospective cohort studies and 1 case–control study) with multivariate analysis (324 648 patients with 10 960 PPCs) and 83 studies of various designs with univariate analysis (173 500 patients with 11 851 PPCs). Quality assessment was done using the U.S. Preventive Services Task Force criteria.

Outcomes: PPCs including atelectasis, pneumonia, and respiratory failure.

MAIN RESULTS

Pooled odds ratios (random-effects model) were derived from the studies with multivariate analysis. Factors with good evidence of an association with PPCs included the patient-related factors advanced age, comorbid conditions, heart failure, chronic obstructive pulmonary disease (COPD), and functional dependence; the procedure-related factors surgical site, prolonged surgery, emergency surgery, and use of general anesthesia; and the laboratory test serum albumin level (Table). Good evidence exists that obesity; well-controlled asthma; and hip, gynecologic, and urologic surgery are not risk factors for PPCs.

CONCLUSION

Certain surgical sites (especially abdominal aortic aneurysm repair, thoracic surgery, and abdominal surgery) and patient characteristics (such as advanced age and presence of comorbid conditions) are associated with increased risk for postoperative pulmonary complications after noncardiothoracic surgery.

Source of funding: Veterans Evidence-based Research, Dissemination, and Implementation Center (VERDICT).

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Factors associated with postoperative pulmonary complications after noncardiothoracic surgery*

Factors	Number of studies	Odds ratio (95% CI)†
Age 60 to 69 y	7	2.1 (1.7 to 2.6)
Age 70 to 79 y	4	3.0 (2.1 to 4.4)
ASA class ≥ II	6	4.9 (3.3 to 7.1)
ASA class ≥ III	11	2.6 (1.7 to 3.8)
Heart failure	3	2.9 (1.02 to 8.0)
Chronic obstructive pulmonary disease	8	1.8 (1.4 to 2.2)
Functional dependence (partial)	2	1.7 (1.4 to 2.0)
Functional dependence (total)	2	2.5 (2.0 to 3.2)
Abdominal aortic aneurysm repair	2	6.9 (2.7 to 17)
Thoracic surgery	3	4.2 (2.9 to 6.2)
Abdominal surgery	6	3.0 (2.4 to 3.7)
Prolonged surgery	5	2.3 (1.5 to 3.5)
Emergency surgery	6	2.2 (1.6 to 3.1)
General anesthesia	6	1.8 (1.4 to 2.5)
Serum albumin < 30 g/L	1	2.5 (2.3 to 2.8)

*ASA = American Society of Anesthesiologists; CI defined in Glossary.
†Trim-and-fill method used to adjust for publication bias if ≥ 3 studies pooled.

COMMENTARY

The systematic reviews by Smetana and Lawrence and their colleagues are important contributions to the field of perioperative care and serve as the basis for a new practice guideline by the American College of Physicians (ACP) (1). Both reviews used well-designed search strategies and inclusion and exclusion criteria, and standardized level-of-evidence ratings for their recommendations. The authors are to be commended for excluding studies that reported only physiologic endpoints, as these are often of unclear clinical importance.

The review by Smetana and colleagues serves as a wake-up call, reminding clinicians that PPCs are an important cause of morbidity and mortality and are at least as common as postoperative cardiac complications. Finding new ways of assessing and reducing perioperative risk is especially important now: It was recently found that, for all but the highest-risk patients, administration of perioperative β-blockers is less beneficial, and more clearly harmful, than previously thought (2).

The authors found a crude PPC rate of 3.4% across 27 cohort studies. Use of the Bayes' nomogram allows clinicians to estimate an individual patient's risk for PPCs using the odds ratios (ORs) provided (3). For example, assuming the risks are multiplicative, a 65-year-old man (OR 2.1) with a serum albumin < 30 g/L (OR 2.5) having abdominal surgery (OR 3.0) has a combined OR for PPCs of 15.75 ($2.1 \times 2.5 \times 3.0$). Using 3.4% as an estimate of baseline risk, a straight-edge nomogram calculation reveals that this patient has > 25% risk for PPCs.

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Review: Lung expansion modalities and selective nasogastric decompression prevent postoperative pulmonary complications

Lawrence VA, Cornell JE, Smetana GW. **Strategies to reduce postoperative pulmonary complications after noncardiothoracic surgery: systematic review for the American College of Physicians.** Ann Intern Med. 2006;144:596-608.

Clinical impact ratings: Hospitalists ★★★★☆☆☆ Pulmonology ★★★★★★☆

QUESTION

Which strategies are effective for prevention of postoperative pulmonary complications (PPCs) after noncardiothoracic surgery?

METHODS

Data sources: MEDLINE (1980 to June 2005) and bibliographies of relevant studies.

Study selection and assessment: English-language, randomized controlled trials (RCTs) and systematic reviews (SRs) that evaluated strategies to prevent PPCs after noncardiothoracic surgery in adults. Excluded were trials with < 25 patients/group; that studied only nonclinical outcomes, identified PPCs by administrative data, or had outcomes unique to certain types of surgery; from developing countries; or involving gastric pH manipulation, cardiopulmonary surgery, or organ transplant surgery. 20 RCTs and 11 SRs met the selection criteria. Quality assessment was done using the U.S. Preventive Services Task Force criteria for RCTs and the Quality of Reporting of Meta-analyses (QUOROM) criteria for SRs.

Outcomes: PPCs including atelectasis, pneumonia, and respiratory failure.

MAIN RESULTS

Lung expansion modalities (e.g., incentive spirometry, deep breathing exercises, chest physical therapy, and continuous positive-airway pressure [CPAP]) reduced PPCs after abdominal operations more than no treatment, with no difference among modalities (Table). 1 RCT (n = 204) showed a reduced rate of severe hypoxemia with nasal CPAP compared with oxygen by nasal cannula. Selective use of nasogastric decompression reduced PPCs more than routine nasogastric decompression (Table). Strategies found not to be effective in reducing PPCs included routine total parenteral or enteral nutrition and right-heart catheterization. Evidence of effectiveness was insufficient for laparoscopic compared with open surgery, smoking cessation, intraoperative neuraxial blockade, postoperative epidural analgesia, and immunonutrition.

CONCLUSION

Postoperative lung expansion treatments and selective (as opposed to routine) nasogastric decompression are effective in preventing postoperative pulmonary complications after noncardiothoracic surgery.

Source of funding: Veterans Evidence-based Research, Dissemination, and Implementation Center (VERDICT).

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Strategies to prevent postoperative pulmonary complications (PPCs)*

Strategies	Comparisons	Number of studies	Results
Lung expansion modalities	No treatment or other modalities	2 SRs (14 RCTs, n = 1337; 4 RCTs, n = no data); 5 RCTs (n = 81 to 876).	All interventions reduced PPCs by > 50% compared with no treatment. No difference among modalities.
Selective nasogastric decompression	Routine use	2 SRs (26 studies, n = 3964; 19 RCTs, n = 2892)	PPCs reduced by 50% to 75%.

*SR = systematic review; RCT = randomized controlled trial.

COMMENTARY *(continued from page 37)*

Patient-specific estimates of risk, and use of the new ACP guideline, will help identify those who will benefit most from techniques shown to prevent PPCs, such as lung expansion modalities and selective nasogastric decompression. Although no clear difference among lung expansion modalities is evident, CPAP should be reserved for patients who cannot participate in less-intensive and cheaper methods, such as incentive spirometry, deep breathing exercises, and chest physiotherapy.

Routine preoperative chest radiography and spirometry are not recommended, adding little value in patients with an unremarkable history and physical examination. However, because interval radiographic changes can be important in the early diagnosis of pneumonia, I would consider obtaining a preoperative chest film in patients at high risk for PPCs. Smetana and colleagues point out that, in patients with dyspnea of unclear cause or in select patients with COPD or asthma, preoperative spirometry may be reasonable to determine if airflow obstruction has been maximally treated.

Insufficient evidence exists to answer many important questions. As these debates continue, it is important to remember that lack of evidence is not evidence of lack of effect. Further studies are needed to define the role of spirometry, obstructive sleep apnea, and poor exercise capacity in preoperative pulmonary risk stratification. Also still unsettled are whether preoperative smoking cessation reduces (or increases) risk for PPCs, whether laparoscopic surgery causes fewer PPCs than open surgery, and whether epidural anesthesia and analgesia reduce PPCs. RCTs of adequate power to detect important differences in clinical outcomes are needed.

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