A risk index with 14 variables predicted 30-day postoperative pneumonia after major noncardiac surgery

Arozullah AM, Khuri SF, Henderson WG, Daley J, for the Participants in the National Veterans Affairs Surgical Quality Improvement Program. **Development and validation of a multifactorial risk index for predicting postoperative pneumonia after major noncardiac surgery.** Ann Intern Med. 2001 Nov 20;135:847-57.

QUESTION

In patients who have had major noncardiac surgery, what variables form a risk index to predict 30-day postoperative pneumonia?

DESIGN

2 patient cohorts from the Department of Veterans Affairs National Surgical Quality Improvement Program: 1 for derivation and 1 for validation.

SETTING

100 Veterans Affairs (VA) medical centers.

PATIENTS

Patients who had noncardiac surgery under general, spinal, epidural, local, or monitored anesthesia. Exclusion criteria included preoperative pneumonia, major transplants, and preoperative ventilator dependence. 160 805 patients (mean age 61 y, 95% men) formed the derivation cohort, and 155 266 patients formed the validation cohort.

DESCRIPTION OF PREDICTION GUIDE

The clinical prediction index grouped patients into 5 risk classes by using the following preoperative risk factors, weighted on the basis of their independent contribution to pneumonia risk by logistic regression and adding their point values: type of surgery (abdominal aortic aneurysm repair [15], thoracic [14], upper abdominal [10], neck [8], neurosurgery [8], vascular [3]); age (≥ 80 y [17], 70 to 79 y [13], 60 to 69 y [9], 50 to 59 y [4]); functional status (totally dependent [10], partially dependent [6]); weight loss > 10% in the past 6 months (7); history of chronic obstructive pulmonary disease (5); general anesthesia (4); impaired sensorium (4); history of cerebrovascular accident (4); blood urea nitrogen level (< 2.86 mmol/L [4], 7.85 to 10.7 mmol/L [2], ≥ 10.7 mmol/L [3]); transfusion of > 4 units (3); emergency surgery (3); steroid use for a chronic condition (3); current smoker within 1 year (3); and alcohol intake > 2 drinks/d in the past 2 weeks (2).

MAIN OUTCOME MEASURE

Postoperative pneumonia (Centers for Disease Control and Prevention diagnosis).

MAIN RESULTS

The incidence of postoperative pneumonia among all patients was 1.6%. In the derivation cohort, 30-day postoperative mortality was 21% among those with pneumonia (n = 2466) and 2% among those without pneumonia (n = 158 339) (P < 0.001). The average predicted probability of postoperative pneumonia for the derivation cohort using a logistic regression model and the rates of pneumonia in both cohorts are shown in the Table.

CONCLUSION

A 14-variable risk index predicted 30-day postoperative pneumonia in patients who have had major noncardiac surgery.

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For correspondence: Dr. A.M. Arozullah, University of Illinois College of Medicine, Chicago, IL, USA. E-mail arozulla@uic.edu.

Prediction of postoperative pneumonia 30 days after major noncardiac surgery

Risk class (point range)	Average predicted probability in derivation cohort (95% CI)	Rate of postoperative pneumonia	
		Derivation	Validation
1 (0 to 15)	0.24% (0.24 to 0.25)	0.24%	0.24%
2 (16 to 25)	1.20% (1.19 to 1.20)	1.19%	1.18%
3 (26 to 40)	4.0% (3.98 to 4.01)	4.0%	4.6%
4 (41 to 55)	9.4% (9.34 to 9.42)	9.4%	10.8%
5 (> 55)	15.3% (15.1 to 15.5)	15.8%	15.9%

COMMENTARY

Arozullah and colleagues used a database with a large sample size to develop and validate a risk index for postoperative nosocomial pneumonia. The rigor and standardization of the data-collection process are important strengths of the study. Although a major limitation is the well-recognized challenge of establishing a diagnosis of pneumonia in hospitalized patients (1), the authors have convincingly shown that the readily obtained preoperative variables can reliably stratify surgical patients into risk groups, with excellent discrimination and reproducibility and a > 60-fold difference in average predicted probability between the lowest and highest-risk groups. As the authors point out, another limitation is that the index is derived from an almost exclusively male patient population in VA hospitals. However, no reason exists why the identified risk factors could not be generalizable to women or nonveterans.

Patients at increased risk for pneumonia may be an appropriate population in which to use more expensive or labor-intensive prophylactic interventions to reduce that risk (2); they certainly are the best target population for clinical trials to evaluate the efficacy of such strategies. But risk stratification is less useful in making decisions about patient management unless the risk factors can be modified. With the possible exception of transfusion (3), none of the risk factors identified in this study are amenable to therapeutic manipulation, and therefore, the major utility of this index will be its ability to quantify risk to better evaluate clinical outcomes.

The ultimate utility of the reliable, easy-to-use risk stratification index shown in this study will be established as it is used in the design of clinical trials or clinical practice guidelines that seek to reduce the risk for postoperative pneumonia.

John C. Marshall, MD
University of Toronto
Toronto, Ontario, Canada

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