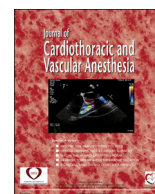




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Original Article

Perioperative Risk Factors Associated With Postoperative Unplanned Intubation After Lung Resection

Brittany N. Burton, MHS*, Swapnil Khoche, MD*,
Alison M. A'Court, MD*, Ulrich H. Schmidt, MD, PhD, MBA*,
Rodney A. Gabriel, MD, MAS*^{†,1}

*Department of Anesthesiology, University of California, San Diego, San Diego, California

[†]Department of Biomedical Informatics, University of California, San Diego, San Diego, California

Objective: Postoperative respiratory failure requiring reintubation is associated with a significant increase in mortality. However, perioperative risk factors and their effects on unplanned 30-day reintubation and postoperative outcomes after unplanned reintubation following lung resection are not described well. The aim of this study was to determine whether certain comorbidities, demographic factors, and postoperative outcomes are associated with 30-day reintubation after thoracic surgery.

Design: This was a retrospective observational study using multivariable logistic regression to identify preoperative risk factors and consequences of unplanned 30-day reintubation.

Setting: Multi-institutional, prospective, surgical outcome-oriented database study.

Participants: Using the American College of Surgeons National Surgical Quality Improvement Program database, video-assisted thoroscopic surgery and thoracotomy lung resections (lobectomy, wedge resection, segmentectomy, bilobectomy, pneumonectomy) were analyzed by Common Procedural Terminology codes from the years 2007 to 2016 in 16,696 patients undergoing thoracic surgery.

Intervention: None.

Measurement and Main Results: The final analysis included 16,696 patients, of whom 593 (3.5%) underwent unplanned reintubation. Among the final study population, 137 (23%) of unplanned intubations occurred within 24 hours postoperatively and the median (25%, 75% quartile) day of reintubation was day 3 (2, 8 days). The final multivariable logistic regression analysis suggested that age, American Society of Anesthesiologists physical status classification score ≥ 4 , dyspnea with moderate exertion and at rest, history of chronic obstructive pulmonary disease, male sex, smoking, functional dependence, steroid use, open thoracotomies, increased operation time, and preoperative laboratory results (albumin and hematocrit) were associated with unplanned intubation after lung resection ($p < 0.05$). Unplanned intubation was associated significantly with 30-day mortality, reoperation, postoperative blood transfusion, and increased hospital length of stay ($p < 0.05$).

Conclusions: Nonmodifiable and modifiable preoperative risk factors were associated with increased odds of unplanned reintubation. Patients who experienced unplanned intubation were at considerable risk for 30-day mortality, reoperation, postoperative blood transfusion, and increased hospital length of stay.

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Key Words: lung resection; intubation; thoracic surgery; perioperative risk factors; preoperative risk factors; postoperative pulmonary complications

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¹Address reprint requests to Rodney A. Gabriel, MD, Department of Anesthesiology, University of California, San Diego, 9500 Gilman Drive, MC 0881, La Jolla, CA 92093-0881.

E-mail address: ragabriel@ucsd.edu (R.A. Gabriel).

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DESPITE ADVANCES in perioperative care, up to 16% of surgical procedures continue to be associated with major complications.^{1,2} With an estimated financial burden of \$3.42 billion in the United States, pulmonary complications are the second leading cause of surgical complications, after surgical site infections. Among pulmonary complications, unplanned postoperative intubation in the surgical population is associated with up to a 4-fold increase in mortality.³⁻⁵ In various surgical populations, postoperative reintubation significantly increases morbidity and mortality⁶⁻⁹; however, the effects of unplanned intubation on adverse postoperative outcomes among adult lung resection patients remain unclear. Recent advances in surgical technique, including the widespread use of video-assisted thoroscopic surgery (VATS), offers surgical options to more patient populations that include the elderly and frail.¹⁰ Although there is a vast body of data of perioperative risk factors and morbidity and mortality after thoracic surgeries, there are few studies assessing perioperative risk factors of unplanned reintubation and postoperative adverse events (AEs) of such events in post-lung resection adult patients. Therefore, the authors performed a retrospective study using the American College of Surgeons National Surgical Quality Improvement Program database, aimed to identify modifiable and nonmodifiable preoperative risk factors and consequences of postoperative reintubations after lung resections. The authors hypothesized that comorbidities, demographic factors, and postoperative outcomes are associated with unplanned 30-day intubation.

Materials and Methods

Data Collection

Data were obtained from the publicly available dataset, American College of Surgeons (ACS) National Surgical Quality Improvement Program (NSQIP) for the years 2007 to 2013. This is a multicenter, prospective, outcome-oriented database. The database is deidentified and therefore meets the criteria of the HIPAA to protect personal information and was exempt from the consent requirement by the authors' institutional review board. This database contains > 150 variables, including preoperative risk factors and 30-day postoperative mortality and morbidity outcomes from > 200 participating hospitals for patients undergoing major inpatient and outpatient surgical procedures. A site-specific surgical clinical reviewer collected the data from medical charts. Inter-rater reliability audits of chosen participating sites and other training methods were in place to ensure high-quality data abstraction. NSQIP undergoes a systemic sampling process called the 8-day cycle, developed to make certain cases have an equal chance of being selected from each day of the week, thereby preventing bias in choosing cases for assessment.¹¹ All VATS and thoracotomy wedge resections and lobectomies were identified and extracted from the ACS NSQIP database by primary surgical Common Procedural Terminology (CPT) code. Table 1 lists the CPT codes used to extract patient population.

Table 1
Current Procedural Terminology Used to Extract the Medical History

Thoracic Surgery Procedure	CPT Code
VATS	
Lobectomy	32663
Wedge resection	32666
Segmentectomy	32669
Bilobectomy	32670
Pneumonectomy	32671
Thoracotomy	
Lobectomy	32480
Wedge resection	32505
Segmentectomy	32484
Bilobectomy	32482
Pneumonectomy	32440

Abbreviations: CPT, Current Procedural Terminology; VATS, video-assisted thoroscopic surgery

In this retrospective observational study, the authors explored the odds of 30-day postoperative unplanned reintubation for several preoperative independent variables in patients who underwent lung resection. NSQIP defined postoperative 30-day unplanned reintubation as the patient requiring placement of an endotracheal tube and ventilator support from day 0 (day of surgery) up to 30 days after surgery. All-cause intubation was collected (ie, intubation after hypotension, cardiac arrest, inability to protect the airway, accidental self-extubation, and emergency tracheostomy). The following clinical situations were not regarded as postoperative unplanned reintubation: failed weaning trials where the patient was placed back on ventilator support, intubations for unplanned return to the operating room, and conversion to general anesthesia requiring ventilator support in patients unable to tolerate local or monitored anesthesia care. Preoperative independent variables included body mass index (BMI), functional status, diabetes mellitus, dyspnea, steroid use (ie, requiring oral or parenteral corticosteroids 30 days before the surgical procedure), emergency surgery, sex, ethnicity, race, history of congestive heart failure (CHF), bleeding disorder, disseminated cancer, hypertension, smoking history (ie, smoke cigarettes within the year before surgery), American Society of Anesthesiology Physical Status (ASA PS) classification, age, history of chronic obstructive pulmonary disease (COPD), renal failure, and type of surgical exposure (ie, VATS v thoracotomy). BMI is classified as the following: > 20 kg/m² (underweight), 20 to 25 kg/m² (normal weight), ≥ 25 to < 30 kg/m² (overweight), ≥ 30 to < 40 (obese), and ≥ 40 kg/m² (morbid obesity). Functional status captures the patient's ability to perform activities of daily living (ADLs) in the 30 days before surgery, which include bathing, feeding, dressing, toileting, and mobility. The variable contains 3 categories: independent (patient does not require assistance from another person for any ADLs), partially dependent (patient requires some assistance from another person for ADLs), and totally dependent (patient requires total assistance for all ADLs). Bleeding disorder is defined as patients at increased risk for bleeding secondary to vitamin K deficiency, hemophilia, thrombocytopenia, and chronic

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