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SURGERY



When good operations go bad: The additive effect of comorbidity and postoperative complications on readmission after pulmonary lobectomy[☆]

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ARTICLE INFO

Article history:

Accepted 12 March 2018

Available online xxx

ABSTRACT

Background: Hospital readmission after major thoracic surgery has a marked effect on health care delivery, particularly in the era of value-based reimbursement. We sought to investigate the additive impact of comorbidity and postoperative complications on the risk of readmission after thoracic lobectomy.

Methods: We queried the Nationwide Readmission Database of the Healthcare Cost and Utilization Project between 2010 and 2014 for discharges after pulmonary lobectomy with a primary diagnosis of lung cancer. We compared 90-day all-cause readmission rates across the presence of Elixhauser comorbidities and postoperative complications. Adjusted logistic and linear regression, accounting for patient and hospital factors were used to calculate the mean change in readmission rate by the number of comorbidities and postoperative complications.

Results: A total of 87,894 patients undergoing pulmonary lobectomies were identified during the study period, of whom 15,858 (18.0%) were readmitted for any cause within 90 days of discharge. After adjusting for other factors, each additional comorbidity and postoperative complication were associated with a 2.0% and 2.7% increased probability of readmission, respectively (both $P < .0001$). Patients with a low burden of low comorbidities were readmitted more frequently for postoperative complications, while those with a high burden of comorbidities were readmitted more frequently for chronic disease.

Conclusion: Among patients with the lowest risk profile, there was an 11.7% readmission rate. Adjusting for other factors, each additional comorbidity and complication increased this rate by approximately 2.0% and 2.7%, respectively. These results demonstrate that the avoidance of postoperative complications may represent an effective mechanism for decreasing readmissions after thoracic surgery.

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Introduction

Lung cancer remains the second most commonly diagnosed cancer among Americans, with more than 200,000 new diagnoses per year and accounting for more than \$100 billion in health care expenditures annually.^{1,2} With the increased use of minimally

invasive thoracoscopic surgery, there have been substantial decreases in the morbidity and mortality after thoracic resections, such that even patients with substantial serious comorbidities can be considered operative candidates. As a result, postoperative readmission after oncologic surgery, including pulmonary lobectomy, has become an increasingly important marker of the quality of health care. Currently, no quality measure addresses readmission after lung resection; however, the National Quality Forum has endorsed the risk-adjusted readmission rate after coronary artery bypass grafting as a quality measure for adult, cardiothoracic surgery programs.³ Markers of surgical quality such as this have become important factors in the delivery of cardiothoracic care, particularly within the current age of bundled payments and value-based reimbursement.^{4,5}

[☆] Presented at the 13th Annual Academic Surgical Congress.

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¹ Raymond A Jean is supported by CTSA Grant Number TL1 TR001864 from the National Center for Advancing Translational Science, a component of the National Institutes of Health.

Several studies have shown that preoperative comorbidity is associated not only with the development of postoperative complications but also with the risk of readmission within 90 days.^{6–8} However, uncertainty remains about whether the selection of low-comorbidity patients versus the avoidance of postoperative complications has a greater effect on decreasing postoperative readmission rates. We hypothesized that because of this unique cohort, even among patients without comorbidities or complications, there will be a high rate of all-cause readmission. Furthermore, we hypothesized that although there will be an incremental increase in readmission risk with additional comorbidity and complications, complications may be the stronger mediator of this association. We sought to investigate this incremental effect of preoperative comorbidity and postoperative complications in a large national dataset.

Methods

The Nationwide Readmission Database (NRD), a part of the Healthcare Cost and Utilization Project (HCUP) between 2010 and 2014 was the data source for this study. Developed by the Agency for Healthcare Research and Quality (AHRQ), the NRD is a nationally representative sample of millions of discharges at acute care hospitals within the United States, and is the largest publicly available, all-payer, readmission database in the United States. The NRD allows researchers to track deidentified readmissions across multiple hospitals within a given calendar year.⁹

The NRD contains up to 30 International Classification of Disease, Ninth Edition Clinical Modification (ICD-9-CM) diagnoses and 15 ICD-9-CM procedural codes for each admission. These descriptors were queried for patients with a primary diagnosis of lung cancer (ICD-9-CM 162.3 – 162.9) undergoing pulmonary lobectomy (ICD-9-CM 32.4). These lobectomies were defined as the index hospitalization. From this index hospitalization, patients surviving to discharge were then tracked for readmissions during the 90 days after discharge. The NRD tracks readmissions for a given patient between January and December of a single calendar year; therefore, to ensure that patients had a full 90 days of follow-up, index hospitalizations between October 1 and December 31 were excluded in all years. Other exclusion criteria included evidence of a second lobectomy in a given year, evidence of metastatic cancer, and the presence of a procedural code for reoperative thoracotomy (ICD-9-CM 34.21) or diagnostic thoracoscopy (ICD-9-CM 34.03) during the index hospitalization.

Variables of interest

The primary outcomes of interest were the unadjusted and risk-adjusted rate of all-cause readmissions modulated by the presence of comorbidities and the occurrence of complications. As a secondary outcome, the most common readmission diagnoses assessed using the first 3 digits of the principal ICD-9-CM diagnosis for the readmission encounter were compared across stratifications for comorbidity and complications. Patient comorbidity was calculated according to the Elixhauser Comorbidity Index (ECI) and grouped as ECI 0, ECI 1, ECI 2, or ECI 3 or more. The ECI is a 29-item comorbidity score developed in 2006 included in the NRD, using AHRQ-developed comorbidity software. The ECI has been shown to be effective in estimating comorbidity among surgical patients.¹⁰ Complications were calculated based on earlier studies and included supraventricular tachycardia and atrial fibrillation, myocardial infarction, stroke, deep vein thrombosis, pulmonary embolism, pneumonia and empyema, acute respiratory failure, sepsis and septic shock, urinary tract infection, and surgical site infection or wound infection.^{11–14} The insurance status of each patient was classified as Medicare, Medicaid, private, uninsured, and other.

Hospital factors of interest included hospital bed size classified as small, medium, or large; hospital control classified as governmental, not-for-profit, or proprietary; hospital teaching status; and urban versus rural location.

Statistical analysis

We conducted our analysis by comparing the number of comorbidities against the number of complications. We compared groups of 0, 1, 2, and 3 or more comorbidities against 0, 1, 2 and 3 or more complications, and then calculated both unadjusted and risk-adjusted readmission rates for the 16 possible comorbidity-complication intersections. Analyses utilized stratified cluster sampling methods consistent with the complex survey design of the NRD and as detailed in the NRD documentation. Means are described with the standard error (SE) or 95% confidence interval (95% CI). Given the use of discharge weights, all frequencies are rounded to the nearest integer to facilitate interpretation. In accordance with the HCUP data-user agreement, values or percentages representing unweighted frequencies less than 11 are not reported. Adjusted hierarchical logistic regression models

Table 1
Unadjusted descriptive statistics of the data set.

	N	(%)
Total	87,894	100.0
Male	41,197	46.9
Female	46,697	53.1
Age (y)		
18–50	4,282	4.9
51–64	25,502	29.0
65–80	51,132	58.2
≥ 81	6,978	7.9
Elixhauser comorbidity		
0	8,935	10.2
1	19,788	22.5
2	23,386	26.6
3 or more	35,786	40.7
Postoperative complications		
0	44,104	50.2
1	24,624	28.0
2	11,652	13.3
3	7,514	8.5
Insurance status		
Medicaid	4,681	5.3
Medicare	56,656	64.5
Other	1,732	2.0
Private	23,564	26.8
Uninsured	1,115	1.3
Admission status		
Urgent	5,856	6.7
Elective	81,917	93.2
Readmission (days)		
30	9,398	10.7
90	15,858	18.0
Hospital characteristics		
Small	7,957	9.1
Medium	15,194	17.3
Large	64,744	73.7
Hospital control		
Government	10,344	11.8
Not-for-profit	68,094	77.5
Proprietary	9,456	10.8
Hospital teaching status		
Nonteaching	28,387	32.3
Teaching	59,507	67.7
Hospital urbanicity		
Rural	3,311	3.8
Urban	84,583	96.2

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