



Determining the most important factors in hospital readmission following surgery for lung cancer

Masayuki Nakao, Junji Ichinose, Yosuke Matsuura, Sakae Okumura, Mingyon Mun

Department of Thoracic Surgical Oncology, Cancer Institute Hospital, The Japanese Foundation for Cancer Research, Tokyo, Japan

Correspondence to: Masayuki Nakao, MD. Cancer Institute Hospital, 3-10-6 Ariake, Koto-ku, Tokyo 135-8550, Japan. Email: masayuki.nakao@jfcrr.or.jp.

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With the recent development of novel drugs and the improvement in surgical instruments, the increase in medical care related expenses has become a social issue in several developed countries. Although the present medical oncology is represented by expensive immune-checkpoint inhibitors and robot-assisted surgery, reducing medical expenses is one of the crucial tasks for national health policy. In the field of surgery for lung cancer, one of the most effective ways of reducing medical expenses is preventing postoperative complications. In Japan, for example, the prospective payment system, known as the Diagnosis Procedure Combination (DPC), introduced by the Ministry of Health, Labour and Welfare, has been applied in major medical institutes since 2003 (1). In the DPC system, inpatient medical care-related expenses are calculated based on the diagnosis-related group and not on the actual expenses. In the case of surgical intervention, medical institutes accrue less benefit as postoperative complications occur in this system. It is, thus, important for medical institutes to prevent postoperative complications not only to reduce patient mortality but also to obtain reasonable gain.

Recently, hospital readmission following surgery has become a major point of concern because it has been identified as a marker for the quality of hospital treatment, as it is strongly associated with postoperative complications and patient outcomes. So many previous studies have reported the evaluated factors associated with readmission (2-5). Brown *et al.* provided detailed information regarding the risk factors associated with the readmission of patients

with lung cancer (2). They have considered about the problems of readmission in patient outcomes and medical expenses and have conducted this unique retrospective study. Most previous studies concerning readmission following surgery for lung cancer have focused on patient characteristics and have not given enough consideration to the perioperative courses. The present study determines that postoperative complications are important predictors of readmission within 30 days of discharge for patients undergoing lobectomy for lung cancer. These results have provided crucial information regarding patient care following surgery for lung cancer, and may be used to reduce hospital readmission in our clinical practice. Subsequently, this study will contribute to reduction in patient mortality and associated medical expenses.

The design of this study includes some unique and convincing points. First, the authors used the Society of Thoracic Surgeons (STS) General Thoracic Surgery Database (GTSD), which is the largest clinical thoracic surgical database in North America, and it covers not only detailed preoperative and intraoperative but also postoperative data. The authors included from this database 39,734 patients from 277 centers who had undergone elective lobectomy for lung cancer between January 2, 2012 and June 30, 2017. This is one of the biggest study scales in this field. They collected detailed information regarding the enrolled patients, such as age, sex, race, insurance status, smoking status, clinical stage of the disease, several comorbidities, operative procedure, antibiotics use, individual postoperative complications, and so on. These

results were obtained on the basis of the high quality of the basic database. Among the patients, 3,237 (8.1%) were readmitted within 30 days of discharge. This is a reliable value, which is similar to that present in other recently published data, with a range of 6.2–10.5% (3-5).

Second, the authors generated three models of multivariate logistic regression for determining independent predictors of readmission given that they considered it important to separate several perioperative variables into the following three groups: preoperative, intraoperative and postoperative. This method was unique and reasonable to determining whether preoperative, intraoperative, or postoperative factors were the most predictive of readmission. They also calculated a c statistic, which is a measure of discrimination for each model, and determined that the last multivariable model was the most reliable, with 0.736 of the c statistic. In this model, including the addition of postoperative to preoperative and intraoperative characteristics, postoperative pulmonary embolus [adjusted odds ratio (OR) 12.34] and empyema (OR 11.66) were associated with the greatest odds of readmission, followed by pleural effusion (OR 7.52), pneumothorax (OR 5.08), central neurological event (OR 3.67), pneumonia (OR 3.13), and myocardial infarction (OR 3.16). Although some preoperative and intraoperative variables were also determined as independent predictors of readmission, their effect diminished when they were analyzed with postoperative variables in the last model. Of the 15 preoperative independent predictors of readmission in the first model, including only preoperative variables, only 10 remained independent predictors in the last model. Five factors, including being male sex and a current smoker, were independent predictors in the first model but not in the last one. These factors are possible predictors of postoperative complications, but they were not proven to be predictors of readmission. Regarding intraoperative variables including operative approach, reoperation, and blood transfusion, lower lobe resection was the only independent predictor (OR 1.18) in the last model.

Some findings that were challenging to interpret should also be mentioned. Among seven of the main factors for readmission described above, there was a broad range in the frequency of each factor. The frequencies of pulmonary embolus, empyema, central neurological event, and myocardial infarction were extremely low, approximately 0.2–0.4% of the entire cohort. Indeed, they were strongly associated with readmission with statistical significance, but these complications were incidental events and rarely

encountered in clinical practice. If these infrequent variables are eliminated or separately analyzed, major complications, such as prolonged air leak (frequency 11.1%) or atrial arrhythmia (frequency 10.6%) possibly have more impact on readmission. For reference, another study regarding readmission following surgery for lung cancer, using the same data source, the STS GTSD, was recently published by Attaar *et al.* (5). They conducted a retrospective study that included 2,280 patients undergoing lung resection. They concluded that postoperative prolonged air leak was strongly associated with increased risk of readmission. It is important to be aware of the fact that the results of these studies can differ according to study design or statistical methods. In terms of the purpose of reducing mortality, data regarding patient outcome would be additionally important. We can obtain more helpful information for the purpose if the most effective factor on postoperative mortality is determined among several independent predictors of readmission in this study.

This article provides valuable information regarding perioperative factors that affect readmission within 30 days of discharge following lobectomy for lung cancer. We should note, however, the methodological differences effect on the results. As mentioned in the discussion section, the importance in the application of the results of this study is how to reduce hospital readmission by appropriate interventions for high-risk patients. This will contribute to reduction in the mortality of patients with lung cancer and in medical expenses.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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