ORIGINAL CLINICAL SCIENCE

Clinical predictors and outcome implications of early readmission in lung transplant recipients

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BACKGROUND: The purpose of this study was to identify risk factors and outcome implications for 30-day hospital readmission in lung transplant recipients.
METHODS: We conducted a retrospective cohort study of lung transplant cases from a single, high-volume lung transplant program between January 2000 and March 2012. Demographic and health data were reviewed for all patients. Risk factors for 30-day readmission (defined as readmission within 30 days of discharge from index lung transplant hospitalization) were modeled using logistic regression, with selection of parameters by backward elimination.
RESULTS: The sample comprised 795 patients after excluding scheduled readmissions and in-hospital deaths. Overall 30-day readmission rate was 45.4% ($n = 361$). Readmission rates were similar across different diagnosis categories and procedure types. By univariate analysis, post-operative complications that predisposed to 30-day readmission included pneumonia, any infection, and atrial fibrillation (all $p < 0.05$). In the final multivariate model, occurrence of any post-transplant complication was the most significant risk factor for 30-day readmission (odds ratio = 1.764; 95% confidence interval, 1.259–2.470). Even for patients with no documented perioperative complication, readmission rates were still >35%. Kaplan-Meier analysis and multi-variate regression modeling to assess readmission as a predictor of long-term outcomes showed that 30-day readmission was not a significant predictor of worse survival in lung recipients.
CONCLUSIONS: Occurrence of at least 1 post-transplant complication increases risk for 30-day readmission in lung transplant recipients. In this patient population, 30-day readmission does not predispose to adverse long-term survival. Quality indicators other than 30-day readmission may be needed to assess hospitals that perform lung transplantation.
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It is estimated that overall hospital 30-day readmission rates are 20% to 25%, with associated costs of nearly $17.4 billion annually.[1–3] The US Centers for Medicare and Medicaid Services has identified 30-day readmission as a major indicator of clinical quality and cost-effectiveness, and readmission rates have become a major target for health care improvement under the Patient Protection and Affordable Care Act.[2] In October 2012, the first set of 30-day readmission benchmarks were established for 3 conditions with an estimated average penalty of up to $125,000 to be levied on hospitals within the first year.[4] Data on 30-day

readmission rates suggest that typical readmission rates vary considerably by condition and by medical specialty. In a 2012 study looking at readmission rates after percutaneous coronary intervention, the authors noted 30-day readmission rates of 4.6%.[5] Studies have described readmission rates of 18% after treatment for acute myocardial infarction, 23% after complex vascular surgery procedures, and 16.5% after revascularization procedures for coronary artery disease.[6–8] These differing readmission rates reflect the varying characteristics and clinical needs of patients with different medical conditions. As benchmark rates for 30-day readmission are extended to hospitalization for other medical conditions, it will be imperative that expectations reflect the realities of clinical care to ensure that clinicians are not inappropriately incentivized or penalized when assessing patients for readmission.

Lung transplant recipients represent a unique patient population, and several important factors affect the clinical course and discharge considerations in these patients. First, the considerable degree of functional disability of many of these patients and the complexity of the surgical procedure required for treatment complicate the postoperative management of lung transplant recipients. Additionally, the intricacies involved with optimizing immunosuppression regimens—along with the accompanying susceptibility to infection—mean that management of these patients often requires prolonged and/or repeated trials to ensure adequate pharmacologic protection. Considering these factors, lung transplant recipients are bound to have readmission rates that differ from observed rates after other surgical procedures. The purpose of this study was to identify the rate, risk factors, and outcome implications for 30-day hospital readmission in lung transplant recipients.

Methods

Study design and patient population

This study was designed as a retrospective cohort analysis of lung transplant cases at a single high-volume center from January 1, 2000, to March 1, 2012. The study protocol was approved by the institutional review board. Records were included in the study based on receipt of lung allografts before March 2012 and on availability of demographic and outcome data in the perioperative period. As demonstrated in Figure 1, exclusion criteria included retransplantation, multi-organ transplantation, and in-hospital death during the initial hospitalization. Patients were excluded from final risk factor analysis if readmission was planned as part of post-operative management (e.g., readmission for fundoplication after lung transplant).

Data sources

Our institution maintains an enterprise data warehouse containing patient-specific and encounter-specific information that is accessible to investigators. Available data include clinical and administrative information generated during patient care.[9] Data on comorbidities existing at the time of transplant were obtained, along with information on patient demographics,
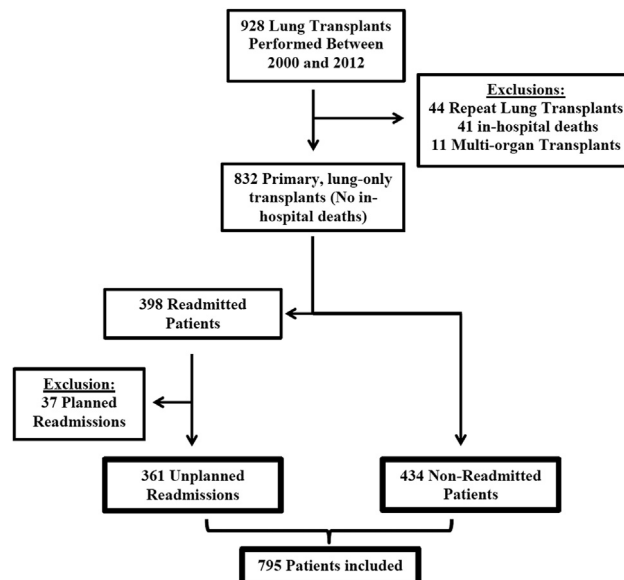

Figure 1   STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) diagram of the study population—patients who were discharged after primary lung-only transplant without scheduled readmission.

operative characteristics, and post-operative complications. We also collected survival and other outcome data related to individual patient records. Finally, we collected data on total encounter charges and on International Classification of Diseases, Ninth Revision, codes associated with readmission episodes to characterize the financial costs of readmission as well as the reasons for rehospitalization. These data were validated, supplemented, and cross-referenced with manual chart review and with data obtained from our institutional database for cardiovascular disease. Additional information was obtained from site-specific reports provided through the United Network for Organ Sharing. Survival data were cross-referenced with tumor registries and with the Social Security Death Index, providing for increased reliability of outcome data, particularly in situations where patients may have been lost to follow-up at our center.

Identification of readmission in administrative data

To identify the index readmission episode, each patient record was linked to our institutional data warehouse to search for readmissions that occurred within 30 days of post-transplant discharge. Records were excluded if readmission was planned—for example, as follow up for performance of a fundoplication procedure. Any available information on reason for admission was obtained from the associated readmission encounter record. Additionally, charge data reflecting the total dollars associated with each readmission encounter were obtained from our hospital system financial analysts.

Statistical analysis

All statistical analyses were carried out using SAS version 9.2 (SAS Institute Inc., Cary, NC). Unadjusted analysis of associations between study variables and early readmission was performed using the chi-square test if the variable was categorical and using Student's t-test if the variable was continuous. Logistic regression models were employed for multi-variate analysis of