Postlung Transplant Rehospitalization: A Study of Causes, Health Care Burden, and Outcomes

Azizollah Abbasi Dezfooli,1 Katayoun Najafizadeh,1 Tahereh Parsa,1 Mohammad Behgam Shadmehr,1 Shideh Dabir,1 Foruzan Mohammadi,1 Payam Tabarsi,1 Maryam Moghani Lankarani,2 Shervin Assari,2 Majid Marjani,1 Fanak Fahimi,1 Shadi Shafaghi,1 Jamileh Faeghi,1 Mohammad Reza Masjedi1

Abstract

Objectives: Rehospitalization is a significant burden for transplant systems, which use data on hospitalization to monitor practice outcomes. In this study, all rehospitalizations after successful lung transplant performed in our medical center during an 8-year period were assessed for cause, health care resource use, cost, and outcome.

Materials and Methods: We performed a retrospective chart review of all rehospitalizations of lung transplant recipients in Masih Daneshvari Hospital in Darabad, Tehran, between 2000 and 2008. Baseline data (each patient’s age at transplant and rehospitalization, sex, primary lung disease, medications used), cause of rehospitalization (infection, graft rejection, surgical complications, type of infection), health care resources use (length of hospital stay, intensive care unit stay, physician visits, imaging), rehospitalization costs (accommodations, personnel, drugs, paraclinical [ie, laboratory] tests, supplies, procedures) and outcome (death, survival) were noted.

Results: In 69% of patients who were rehospitalized after having received a lung transplant, the cause was infection. Other causes were acute rejection in 31% and surgical complications in 6.9%. In 10.3% of those patients, the primary cause for rehospitalization could not be specified. The mean (SD) duration of rehospitalization was 12.8 ± 10.4 days. Treatment in the intensive care unit was necessary for 93.1% of the study subjects. The mean (SD) number of physician visits was 27.8 ± 27.7, and the fatality rate in the patients studied was 13.8%.

Conclusions: These data may guide the monitoring of the causes, burden, and outcomes of lung transplants performed in our medical center in Iran and in other medical centers.

Key words: Rehospitalization, Transplant, Lung transplant, Costs, Health care use

In-hospital data are generally accurate, and transplantologists often retrospectively review rehospitalization charts to determine the cause and outcome of readmission to the hospital and to evaluate the use of health care resources (1). The information in hospital databases is not skewed by the underdiagnoses and deficiencies that characterize surveillance systems in outpatient settings (2). In-hospital data have been shown to be reliable and to provide useful information about posttransplant morbidity (3). Posttransplant rehospitalization is costly for transplant systems. Data from posttransplant rehospitalization studies can be used to design interventions that can improve the allocation of health care resources (4). Information from a review of posttransplant rehospitalizations can be used to identify the causes of hospital readmissions as well as outcomes (5-8), to determine the risk factors for specific complications (9-12), to define health care practice patterns (13-15), and to indicate the need for the careful monitoring of patients with specific risk factors.

In this study, we investigated the causes, costs, use, and outcomes of rehospitalizations after
lung transplant in the Shaheed Beheshti Medical University in Tehran, Iran.

Materials and Methods

In this retrospective study, which was approved by the Shahid Beheshti University of Medical Sciences, the hospitalization records and charts of all patients who received a lung transplant in the lung transplant center of Masih Daneshvari Hospital between 2000 and 2008 were reviewed. Study protocol was confirmed by the ethical review board of the university. Written informed consent was not needed because of the study was a retrospective chart review. We extracted baseline data (sex, medications, use of health care resources, length of hospital stay, treatment in the intensive care unit, number of physician visits, imaging), costs (total cost and the expense for accommodations, personnel, medications, paraclinical [ie, laboratory] tests, supplies, procedures, and miscellaneous services and items), and outcome (death or survival) from the hospital database. The patients’ charts were also reviewed to determine the cause for admission (infection, graft rejection, surgical complications, type of infection), age at transplant, age at rehospitalization, and the primary lung disease.

Masih Daneshvari Hospital is a university-based hospital and referral center for lung transplant and posttransplant follow-up in northern Tehran. Lung transplants have been performed in our hospital since 2000, and between that year and 2008, 28 such procedures have been performed there. At the time of this writing, Masih Daneshvari Hospital is the most active center for both lung transplants and respiratory disease research in Iran (16-20).

In our study, rehospitalization was defined as a hospital admission that occurred for any medical reason following the patient’s medical discharge after the initial transplant hospitalization (21-24). Hospitalization costs were divided into the following categories: accommodations, medications, surgical procedures, paraclinical tests, health care personnel time, imaging tests, special services (ie, patient transportation by ambulance), and miscellaneous services and items. The costs included direct medical expenses but not indirect costs (such as a loss of productivity due to disease-related absence from work). To facilitate international comparison, the costs in Iranian rials were converted to US dollars (conversion rate, USD $1 = 10 000 Iranian rials).

Statistical analysis

SPSS software (Statistical Product and Service Solutions, version 13, SSPS Inc, Chicago, IL, USA) was used for statistical analysis in this study. Frequency, mean (SD), and median were reported when appropriate.

Results

The mean age at transplant was 37.1 ± 9.6 years, and the median interval between transplant and rehospitalization was 206 days. Most of the rehospitalizations occurred during the first 12 months after transplant (48.3%) (Table 1).

| Table 1. Data on postlung transplant rehospitalizations in the study subjects. |
|---------------------------------|----------------|
| Interval between transplant and rehospitalization | Percentage of subjects |
| First 12 mo | 48.3 |
| 13-24 mo | 31.0 |
| 25-36 mo | 20.7 |
| Length of hospital stay | |
| < 10 d | 48.3 |
| 10-19 d | 34.5 |
| 20-29 d | 10.3 |
| 30-39 d | 3.4 |
| 40-49 d | 3.4 |
| Cause of rehospitalization | |
| Infection | 69.0 |
| Acute rejection | 31 |
| Surgical | 6.9 |
| Undetermined | 10.3 |
| Site of infection | |
| Lungs | 85 |
| Catheter | 5 |
| Urinary tract | 5 |
| Perianal | 5 |
| Costs | |
| Medication | 35.5 |
| Accommodations | 25.6 |
| Paraclinical tests | 17.3 |
| Personnel | 11.6 |
| Supplies | 7.3 |
| Procedures | 1 |
| Other | 1.7 |

Causes of rehospitalization

The most frequent causes of rehospitalization were infection (69.0% of patients) and acute rejection (31%). In 20.7% of rehospitalized patients, infection and acute rejection occurred concomitantly. The most common site of infection was the lungs (85% of rehospitalized patients). Aspergillosis, which caused membranous tracheobronchitis in 3 rehospitalized patients and pneumonia in 1 (Table 2).
Discussions

The findings of this study showed that admitting hospitals must be prepared to provide a wide range of intensive care services for readmitted lung transplant recipients. The cost of rehospitalization after lung transplant was found to be comparable to the cost of the transplant procedure itself. Although infection was the most frequent cause of postlung transplant hospitalization, most deaths in rehospitalized patients were associated with acute rejection.

Serious complications frequently develop in lung transplant recipients, and the complex care they require increases the cost of readmission. Rigorously treating the pulmonary and nonpulmonary medical complications that develop in lung transplant patients and ensuring that the management of those recipients is undertaken by a multidisciplinary team are among the factors most essential to ensuring optimal long-term results (25).

A review of the literature on data similar to that provided in this study revealed that infection is one of the most common causes of morbidity and mortality after lung transplant (26). It has been reported that 21.2% and 40% of annual deaths after a lung transplant are due to infections that develop during the first 30 days and the first year after transplant, respectively. In the first month after surgery, bacterial pneumonia often caused by gram-negative organisms such as *Pseudomonas* develops in 35% to 70% of lung transplant patients (27). Community-acquired and nosocomial infections are important causes of morbidity in lung transplant recipients (26), and infections can also be transmitted from the donor to the recipient (28).

The high rate of infection in lung transplant patients is due, in part, to the excessive susceptibility of those individuals to infections from environmental microorganisms, the effects of immunosuppressive therapy, and clearance mechanisms damaged by the denervation of the transplanted lung.

A broad spectrum of microorganisms (*Pseudomonas aeruginosa*, *Cytomegalovirus*, community-acquired respiratory viruses, and *Aspergillus*) can infect the allograft after lung transplant (29). In our study, the pathogen identified
most frequently in lung transplant recipients with a respiratory infection was *Aspergillus*, which caused pneumonia in 1 patient and membranous tracheobronchitis in 3 patients.

Some investigators have suggested that prophylactic antimicrobial regimens will reduce the risk of bacterial postlung transplant infections; however, many questions regarding efficacy of those strategies and methods remain unanswered (29). Antiviral medications may prevent infection with *Cytomegalovirus* (30). However, transplant centers use various preventive strategies to reduce infections in their patients.

In our series, most rehospitalizations (especially those due to infections) occurred during the first year after transplant, and that finding was supported in the literature (31-35). Such infections may result from the high doses of immunosuppressive medications that are administered in the early posttransplant period. Some authors have suggested that minimizing treatment with immunosuppressive agents will decrease the incidence of postlung transplant infections (36-38).

The next most frequent cause of rehospitalization in our patients was acute rejection. Early or late graft dysfunction, stenosis of the airway anastomosis, a lymphoproliferative disorder (39), and gastrointestinal complications (40, 41) are cited in the literature as common causes of rehospitalization in lung transplant recipients.

The costs associated with a lung transplant do not end after the transplant has been performed. In addition to the cost of regular follow-up visits and necessary immunosuppressive therapy, the expense of readmission to the hospital for management of complications and diseases can be high. To minimize the posttransplant costs imposed on their system and also to monitor transplant outcomes, health care policy makers should rely on rehospitalization data (1). Because a large proportion of organ transplant system resources are allocated to hospitalization, that information is of significance (42). It is therefore essential to establish an effective system of monitoring the use of resources associated with lung transplant (43). That information should be incorporated into preventive strategies if a reduction in the cost of organ transplant is a goal (44).

The analysis of posttransplant hospitalization is not an easy task for several reasons; for example, not all rehospitalizations are due to transplant-related complications. Although some transplant recipients may be hospitalized repeatedly, others never require rehospitalization (1). Our study provides information on the cause, burden, and outcomes of postlung transplant hospitalizations that may be of significant benefit to health care policy makers who must minimize posttransplant costs.

**References**


