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Characteristics and Outcomes of Patients With Lung Transplantation Requiring Admission to the Medical ICU

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BACKGROUND: There are few data on characteristics and outcomes among patients with lung transplantation (LT) requiring admission to the medical ICU (MICU) beyond the perioperative period.

METHODS: We interrogated the registry database of all admissions to the MICU at Cleveland Clinic (a 53-bed closed unit) to identify patients with history of LT done > 30 days ago (n = 101; mean age, 55.4 ± 12.6 years; 53 men, 48 women). We collected data regarding demographics, history of bronchiolitis obliterans syndrome, preadmission FEV_1, clinical and laboratory variables at admission, MICU course, length of stay, hospital survival, and 6-month survival.

RESULTS: The most common indication for MICU admission was acute respiratory failure (n = 51, 50.5%). Infections were most frequently responsible for respiratory failure, whereas acute rejection (cellular or humoral) was less likely (16%). Nearly one-fourth of the patients required hemodialysis (24.1%), and more than one-half required invasive mechanical ventilation (53.5%). Despite excellent hospital survival (88 of 101), 6-month survival was modest (56.4%). APACHE (Acute Physiology and Chronic Health Evaluation) III score at admission and single LT were independent predictors of hospital survival but did not predict outcome at 6 months. Functional status at discharge was the only independent predictor of 6-month survival (adjusted OR, 5.1; 95% CI, 1.1-22.7; $P = .035$).

CONCLUSIONS: Acute rejection is an infrequent cause of decompensation among patients with LT requiring MICU admission. For patients admitted to the MICU, 6-month survival is modest. Functional status at the time of discharge is an independent predictor of survival at 6 months.

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ABBREVIATIONS: ACR = acute cellular rejection; APACHE = Acute Physiology and Chronic Health Evaluation; ARF = acute respiratory failure; LHI = lung hyperinflation; LT = lung transplantation; MICU = medical ICU; RRT = renal replacement therapy

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Increasing numbers of lung transplantations (LTs) are being performed every year,[1] with > 3,500 patients undergoing LT in 2010. Furthermore, with advent of effective immunosuppressive regimens for graft preservation, patients with LT may be living longer. Yet, long-term survival remains poor when compared with other solid organ transplantation.[2] It is reported that as many as 55% of patients will develop an episode of acute cellular rejection (ACR) or antibody-mediated rejection during the first year following transplantation.[3] Infection and/or rejection can result in respiratory decompensation, leading to the need for admission to medical ICUs (MICUs). Few data exist on the characteristics of such patients with LT who require MICU admission beyond their initial perioperative period.[4,5] Earlier studies on this subject have been small and have reported highly variable outcomes,[4-7] with only a single study describing variables that predict outcome in these patients.[5] Furthermore, no study has reported outcomes after hospital discharge among these patients.

The current study aims to describe the profile of patients with LT who require admission to MICU beyond 30 days after transplantation. We also report the incidence, risk factors, and outcomes of common complications, including requirement of invasive ventilator support and renal failure requiring renal replacement therapy (RRT). Finally, we report outcomes at hospital discharge and at 6 months after MICU admission and describe predictors of those outcomes.

Materials and Methods

Study Site

This is a single-center observational study conducted at the Cleveland Clinic, a tertiary care, high-volume center for LT. The MICU at the Cleveland Clinic Foundation is a 53-bed closed unit managed by board-certified intensivists, with 24-h on-site coverage.

Subject Selection

Between July 2011 and July 2012, there were 3,129 admissions to the MICU. Among these, 101 LT recipients > 30 days from transplant surgery were included in the study (mean age, 55.4 ± 12.6 years; 53 men, 48 women). A large majority of these patients were admitted to the ICU after being discharged from the hospital after the LT surgery (90 of 101).

Data Collection

This study was approved by the Cleveland Clinic institutional review board (#12-1135). Data collected included baseline demographics, reason for admission to the MICU, pulmonary function testing, organ failure in the ICU, and the need for RRT or mechanical ventilation. In addition, baseline immunosuppressive regimen, most recent preadmission lung function measures, and survival after discharge were collected.

Although many patients were treated empirically for both infection and rejection, charts/discharge summaries were reviewed to identify the actual cause of decompensation. Charts were reviewed by two investigators independently (A. B. and D. S.), with concordance among 42 of 51 patients for the cause of acute respiratory failure (ARF). All nine discordant assessments were reconciled by the two investigators. Diagnosis of ACR was based upon presence of rejection seen on transbronchial biopsy (n = 1) and/or presence of lymphocytic BAL with negative cultures and response to pulse steroids (n = 1). Cause for respiratory failure was determined to be antibody-mediated rejection when patients had donor-specific antibodies and allograft dysfunction in absence of other causes and negative cultures (n = 6). Presence of positive cultures from blood or body fluids with or without clinical signs of sepsis was considered to be consistent with infection as the cause for ARF. Among patients surviving to hospital discharge (n = 88), functional status at discharge, as determined by the APACHE (Acute Physiology and Chronic Health Evaluation) registry assessments (patient classified as independent, partially dependent, or fully dependent as described in Table 1), discharge disposition, and outcome at 6 months were recorded.

Outcome Variables

Hospital mortality was analyzed as the primary outcome variable. In addition, several other variables were evaluated, including need of RRT, need of ventilator support, and 6-month outcome as secondary outcome variables.

Statistical Analysis

The study group was divided into two groups based upon the presence or absence of outcome variables. Categorical variables were compared using Pearson χ^2 test, whereas continuous variables were compared using the two-sample independent *t* test. Along with the demographic parameters, variables significant at $P < .1$ on univariate analysis were identified as potential predictor variables and entered into a multivariate logistic regression model. Stepwise variable selection procedure was then performed to select a significant subset of predictors. For all outcome variables, regression equations were constructed with significant predictors, respectively. Survival analysis was done using Kaplan-Meier analysis. All analyses were performed by using the SPSS statistical package, version 17.0 for Windows (IBM). The level of statistical significance was set at $P < .05$ (two tailed).

TABLE 1] Definition for Functional Status at Discharge as Determined by the APACHE Registry Assessments

Functional Status	Definition
Independent	The patient is discharged to home requiring no assistance in completing activities of daily living
Partially dependent	The patient is discharged to home, to a group home, or to a care facility and requires SOME assistance in completing the activities of daily living; the limitation or limitations requiring assistance may be physical or mental
Fully dependent	The patient is discharged to home or to a care facility and is unable to perform activities of daily living; must be cared for by others; the limitation or limitations requiring assistance may be physical or mental

APACHE = Acute Physiology and Chronic Health Evaluation