Original Article

Evaluation of nutritional status in lung transplant recipients and its correlation with post-transplant short-term prognosis: a retrospective study

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Background: Lung transplantation is an effective treatment for saving the lives of patients with end-stage lung disease (ESLD). Lung transplant-related morbidity and mortality has significantly higher than other solid organ transplants. Among the pre-transplant variables that affect the survival rate after transplantation, nutritional status are associated with poor survival rate. In order to provide basis for formulating nutritional evaluations for lung transplant recipients in the future, we retrospectively analyzed the nutritional status of lung transplantation recipients and explore its correlation with the short-term prognosis.

Methods: This retrospective cohort study included patients who were hospitalized in 2020 and underwent lung transplant surgery at Shanghai Pulmonary Hospital. Inclusion criteria: (I) aged ≥18 years; (II) have been diagnosed with ESLD; (III) have received no other effective treatments; (IV) have undergone a transplantation at Shanghai Pulmonary Hospital. We summarized the patients' general information, including their sex, age, major lung disease etc. And we also collected nutritional status, such as Nutritional Risk Screening 2002 (NRS 2002), subjective global assessment (SGA) and nutritional-related indicators, including albumin, prealbumin, retinol-binding protein etc. before surgery and 1 month after surgery. In addition, we collected postoperative drainage volume, length of stay in intensive care unit (ICU), total hospital days, and hospitalization costs to evaluate the short-term prognosis.

Results: A total of 33 lung transplant recipients were included and successfully underwent surgery. Of the patients, 16 had preoperative NRS 2002 scores ≥3 points, of whom 7 were assessed by the SGA as having mild-moderate malnutrition and 9 as having severe malnutrition. The albumin indexes of these 16 patients, including their prealbumin, and calcium contents, were significantly lower than those of patients with NRS scores <3. Patients with preoperative NRS scores ≥3 had higher drainage volumes, longer hospitalization times, and higher total hospitalization costs than those with NRS scores <3.

Conclusions: Lung transplant recipients have a higher incidence of nutritional risk and malnutrition, which seriously affects their short-term prognosis. Thus, in clinical practice, lung transplant recipients should be screened for nutritional risk and provided preoperative nutritional support to maintain a good preoperative status to improve their prognosis.

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Keywords: Lung transplant recipients; Nutritional Risk Screening (NRS); nutritional evaluation; malnutrition; prognosis

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Introduction

Lung transplantation is an effective treatment for saving the lives of patients with end-stage lung disease (ESLD) (1,2). Although advances in medical technology, pre- and post-operative management have improved overall survival of lung-transplanted patients over the past decades. Despite these developments, lung transplant-related morbidity and mortality has still significantly higher than other solid organ transplants such as kidney and liver (3). Because of this situation, identifying risk factors associated with poor prognosis in lung transplantation may reduce the occurrence of transplant-related risks. Patients with ESLD have a complete or substantial loss of lung function and severe clinical symptoms, such as respiratory failure. They mostly present with decreased appetite and gastrointestinal dysfunction caused by illness, repeated infections, hypoxia, and depression (4). Insufficient energy and nutrient intake in patients may lead to malnutrition and even cachexia (5,6). Studies have shown that if chronic wasting disease patients suffer from malnutrition, their complication and mortality rates increase, as do their hospitalization costs, and their hospitalization times (7,8). Additionally, among the pretransplant variables that affect the survival rate after transplantation, nutritional status-related biomarkers (e.g., hypoproteinaemia and underweight status) are associated with poor recipient survival rates (9-11).

Thus, assessments of the preoperative nutritional status of lung transplant recipients can facilitate the detection of nutritional risk in a timely manner, and malnourished patients can be provided with individualized nutritional support to maintain their best preoperative state and maximize benefits (12,13). Although a previous study on the impact of nutrition on postoperative outcomes have explored the risk and potential benefit of reducing malnutrition-related disease and mortality by correcting malnutrition (14), the relationship between malnutrition and outcomes after lung transplantation is unclear, and there are few studies in China to investigate the effect of preoperative nutritional status on the prognosis of transplant patients.

This study sought to evaluate the nutritional status of lung transplant recipients and explore its correlation with the prognosis of transplantation patients. The goal of this work was to provide a scientific basis for future research and to develop strategies for evaluating and improving the preoperative nutritional status of lung transplant recipients to guide the further formulation of nutritional support plans. We present the following article in accordance with the STROBE reporting checklist (available at https://atm.amegroups.com/article/view/10.21037/atm-22-3125/rc).

Methods

This retrospective study was approved by the Ethics Committee of Shanghai Pulmonary Hospital (ethical approval No. K22-262), and was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Signed informed consent was obtained from all the patients.

Patients

This is a retrospective cohort study and used PASS to calculate sample size. A total of 50 lung transplantation recipients admitted to Shanghai Pulmonary Hospital from January 2020 to December 2020 were selected for this retrospective analysis. To be eligible for inclusion in this study, patients had to meet the following selection criteria: (I) aged ≥18 years; (II) have been diagnosed with ESLD; (III) have received no other effective treatments; and (IV) have undergone a transplantation at Shanghai Pulmonary Hospital. A total of 33 patients (28 male and 5 female), with an age range of 40 to 71 years, and an average age of 63.12±7.79 years, were included in the study.

Nutritional Risk Screening 2002 (NRS 2002)

At our hospital, the NRS 2002 (15) score of each admitted

patients are assessed by professional nutrition nurses within 24 hours. The purpose of this assessment is to determine whether a patient has a nutritional risk or a risk of malnutrition to further evaluate and formulate nutritional support plans. The NRS 2002 mainly includes 3 items; that is, the nutritional status impairment score, the disease severity score, and the age score. The first 2 items are given a score of 1 to 3 points and have 3 grades; the highest score is taken for each item according to the scoring standard. For the 3rd item, those aged ≥70 years are given a score of 1 point, and those aged <70 years are given a score of 0 points. The final score is the sum of the 3 items. A NRS score ≥3 points indicates nutritional risk.

Subjective Global Assessment (SGA)

For patients with NRS 2002 scores ≥3 points, a dietician conducts a further nutritional assessment with the SGA tool (16). The SGA comprises 8 items related to dietary changes, any recent (i.e., within the last 2 weeks) decline in body mass, digestive symptoms (mainly including diarrhoea, nausea, and vomiting, with a duration ≥2 weeks), physiological function status, disease, changes in nutritional requirements, fluid balance (the presence and severity of oedema and ascites), muscle wasting, and the degree of lipid consumption. These items are divided into 3 levels; that is, good nutrition (level A), mild to moderate malnutrition (level B), and severe malnutrition (level C). Evaluation criteria: among the above 8 items, if ≥5 items are classified as grade B after the evaluation, the patient is regarded as having mild-moderate malnutrition; if ≥5 items are classified as grade C, the patient is regarded as having severe malnutrition; otherwise, the patient is deemed to be nutritionally acceptable.

Observation indicators

General patient information was collected, including name, sex, age, primary disease, body mass index, NRS score, SGA nutritional assessment grade, blood biochemistry and routine blood indicators at first admission (before transplantation) and 1 month after surgery, and drainage 24 hours after transplantation, length of stay in the ICU, total hospitalization days, and hospitalization costs.

Statistical analysis

The statistical analyses were carried out using SPSS 21.0 (Chicago, USA). For the continuous variables, the normally distributed data are expressed as the mean ± standard deviation (SD) and were evaluated for normality using the Kolmogorov-Smirnov test. The categorical variables are presented as frequencies with percentages and were analysed by the Chi-square test or Fisher's exact test as appropriate. The Student's *t*-test and a 2-way analysis of variance was used for the normally distributed variables. A 2-tailed P value of <0.05 was considered statistically significant.

Results

Preoperative nutritional status of lung transplant recipients

A total of 33 patients (28 male and 5 female), with an age range of 40 to 71 years, and an average age of 63.12±7.79 years, were included in the study. Candidate primary diseases included interstitial lung disease (20 cases), chronic obstructive pulmonary disease (9 cases), idiopathic pulmonary fibrosis (2 cases), severe pulmonary hypertension (1 case), and silicosis (1 case). Of the 33 patients, 16 had NRS 2002 scores ≥3 points, and 17 had NRS scores <3. There was no significant difference between the two groups in terms of baseline data such as sex, age, primary disease, operation method, operation time and uses of extracorporeal membrane oxygenation (ECMO). The two groups were comparable (p>0.05), specific data see *Table 1*. As *Figure 1* shows, the rate of nutritional risk in lung transplant recipients was 48.5% (16/33); the rate of mild to moderate malnutrition according to the SGA assessment was 43.8% (7/16), and the rate of severe malnutrition according to the NRS was 56.2% (9/16).

Comparison of nutrition-related indicators between the 2 groups after surgery

The albumin, prealbumin, retinol-binding protein, total lymphocyte count, and calcium content of the nutritional risk group after surgery were significantly lower than those of the normal nutritional group (P<0.05; *Table 2*). Compared to the normal group, the nutritional risk group had a significantly higher postoperative 24-hour drainage volume, a significantly longer total hospitalization duration, and significantly higher medical costs (P<0.05; *Table 3*). In addition, the length of the ICU stay of the nutrition risk group was significantly longer than that of the normal nutrition group (*Table 3*).

Table 1 Comparison of general data between the 2 groups of lung transplant recipients

General data	Nutritional risk (n=16)	Normal nutrition (n=17)	t/χ^2	P
Sex (n)			0.31	0.58
Male	13	15		
Female	3	2		
Age (years), mean ± SD	60.3±2.52	64.0±1.83	1.20	0.24
Primary disease (n)			8.55	0.07
ILD	7	13		
COPD	7	2		
IPF	0	2		
PAH	1	0		
Silicosis	1	0		
Operation methods (n)			0.25	0.62
Unilateral	5	4		
Bilateral	11	13		
Operation time (h), mean ± SD	4.06±0.34	3.79±0.29	0.60	0.56
ECMO (n)			2.43	0.12
Yes	9	5		
No	7	12		

ILD, interstitial lung disease; COPD, chronic obstructive pulmonary disease; IPF, idiopathic fibrosis; PAH, pulmonary arterial hypertension; ECMO, extracorporeal membrane oxygenation.

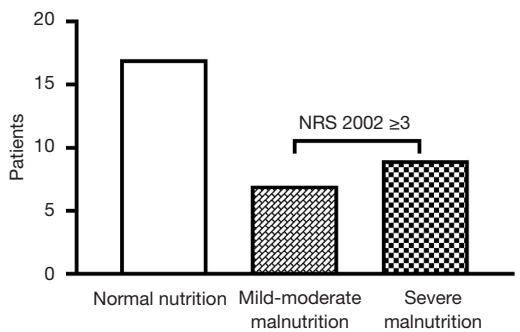

Figure 1 Preoperative nutritional status of the lung transplant recipients. NRS, Nutritional Risk Screening.

Discussion

Most lung transplant recipients have ESLD, and their complex conditions may lead to malnutrition (17). Malnutrition can increase the risk of respiratory infections, affect the immune system, and even worsen the function of respiratory muscles (18), which can affect the incidence of postoperative complications and mortality (19). However, in the scoring standards recognized for recipient selection among patients with ESLD worldwide, there is a lack of focus on nutritional status (20-22). Due to the high incidence of malnutrition among lung transplant recipients and the increasing number of ESLD patients choosing lung transplantation, the relationship between preoperative malnutrition and lung transplant outcomes has received increasing attention (23). Thus, patients need to undergo a comprehensive nutritional assessment before transplantation, as the results of such assessments can be used to better guide clinical nutritional support treatments (24,25).

We retrospectively analysed 33 patients at our hospital who had undergone lung transplantation in 2020 and found that the preoperative nutritional risk rate was 48.5%, of which SGA assessed mild to moderate malnutrition accounted for 43.8% and severe malnutrition accounted for 56.2%. We also found that the postoperative albumin, prealbumin, total lymphocyte count, and calcium contents

Table 2 Comparison of indicators after lung transplantation between the 2 groups

Indicators	Nutritional risk (n=16), mean ± SD	Normal nutrition (n=17), mean ± SD	t/χ^2	P
Serum albumin (g/L)	34.4±1.21	39.7*±1.64	2.53	0.02
Serum prealbumin (g/L)	169±16	225*±17	2.39	0.02
Retinol-binding protein (mg/L)	20.1±1.96	25.7*±1.50	2.32	0.03
Total lymphocyte count ($\times10^9$/L)	0.97±0.11	1.56*±0.23	2.30	0.03
Calcium (mmol/L)	2.16±0.04	2.30*±0.04	2.50	0.02

*, the difference is statistically significant compared to the nutritional risk group, P<0.05.

Table 3 Comparison of clinical outcome-related indicators after lung transplantation between the 2 groups

Indicators	Nutritional risk (n=16), mean ± SD	Normal nutrition (n=17), mean ± SD	t/χ^2	P
24 h drainage (mL)	750.0±94.1	521.1*±54.2	2.14	0.04
ICU stay (d)	23.4±2.32	21.8±2.30	0.48	0.64
Hospital stay (d)	57.56±6.78	40.59*±4.61	2.09	0.04
Hospital costs (RMB) (ten thousands)	46.9±1.76	41.1*±1.14	2.80	0.01

*, the difference is statistically significant compared to the nutritional risk group, P<0.05. ICU, intensive care unit.

of the recipients with nutritional risk were significantly lower than those of the recipients with a normal nutritional status. Additionally, the drainage volume 24 hours after surgery, hospitalization duration and total costs of the recipients with nutritional risk were significantly increased, which may be because malnourished patients experience a decline in immune function. Plasma protein levels can reflect the nutritional status of the body's visceral proteins (26,27).

Albumin and prealbumin, which are synthesized in the liver, serve as important indicators in the assessment of nutritional status (28,29). The half-life of albumin is 20 days, which can reflect the loss of visceral protein in the human body (30). The half-life of serum prealbumin is only 1.9 days, so it fluctuates quickly when malnutrition occurs (31). Studies have shown that prealbumin levels change before body mass, subcutaneous fat, and other anthropometric indicators change, which can reflect the body's early and subclinical nutritional deficiencies (32,33). Thus, patients with poor preoperative nutritional status may have more severe nutritional problems after surgery, which may seriously affect their immune function and thus increase the length of their ICU stay and hospitalization expenses.

Lung transplant recipients should cooperate with nutritionists and complete comprehensive nutritional assessments before surgery, including a preoperative medical history, a physical examination, laboratory examinations, and a body composition analysis, to assess their nutritional status so that nutritional support can be provided in a timely and standardized manner. This would allow the nutrient reserves in the patient's body to be optimized to the greatest extent possible to provide a nutritional basis for a successful operation and improve patients' nutritional status and clinical outcomes.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://atm.amegroups.com/article/view/10.21037/atm-22-3125/rc

Data Sharing Statement: Available at https://atm.amegroups.com/article/view/10.21037/atm-22-3125/dss

Conflicts of Interest: All authors have completed the

ICMJE uniform disclosure form (available at https://atm.amegroups.com/article/view/10.21037/atm-22-3125/coif). 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. This study was approved by the Ethics Committee of Shanghai Pulmonary Hospital (ethical approval No. K22-262), and was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Signed informed consent was obtained from all the patients.

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