Nutritional profile of lung transplant candidates*

Perfil nutricional de pacientes candidatos ao transplante de pulmão

Sabrina Monteiro Pereira de Souza, Miyoko Nakasato,
Maria Lúcia Mendes Bruno, Alessandra Macedo

Abstract

Objective: To determine the nutritional profile of lung transplant candidates. **Methods:** A retrospective cross-sectional study involving lung transplant candidates at a public hospital in the city of São Paulo, Brazil. Data related to gender, age and underlying lung disease were compiled for the participants. For the assessment of the nutritional profile of the patients, body mass index (BMI), mid-arm muscle circumference (MAMC), waist circumference and triceps skinfold thickness (TST) were determined during the first outpatient visit. **Results:** We included 117 patients, 69 of which (59%) were male. The mean age of the participants was 42.5 ± 15.2 years. The most prevalent underlying disease, seen in 29 patients (24.8%), was pulmonary emphysema. The nutritional profile was considered normal in 48.3% of the patients with pulmonary emphysema, 55% of those with cystic fibrosis, 56% of those with bronchiectasis and 50% of those with other lung diseases. The majority (51.7%) of the patients with pulmonary fibrosis were classified as overweight. The TSTs indicated that the risk of depletion was highest (64.7%) among the patients with cystic fibrosis, followed by those with bronchiectasis (52.6%). **Conclusions:** Patients with pulmonary fibrosis presented the highest BMIs, although the corresponding TSTs and MAMCs were normal. Patients with cystic fibrosis and bronchiectasis presented the highest prevalence of nutritional depletion, based on TST and MAMC.

Keywords: Lung transplantation; Nutritional status; Body mass index.

Resumo

Objetivo: Verificar o perfil nutricional dos pacientes candidatos ao transplante de pulmão. **Métodos:** Estudo transversal, retrospectivo com pacientes candidatos ao transplante de pulmão em um hospital público da cidade de São Paulo. O gênero, a idade e a doença pulmonar de base dos participantes foram compilados. Para a avaliação do perfil nutricional dos pacientes, o índice de massa corporal (IMC), a circunferência muscular do braço (CMB), a circunferência da cintura (CC) e a prega cutânea tricipital (PCT) foram determinados durante o primeiro atendimento ambulatorial. **Resultados:** Foram incluídos 117 pacientes, sendo 69 (59%) do gênero masculino. A média de idade dos participantes foi de 42,5 ± 15,2 anos. A doença de base de maior prevalência foi o enfisema pulmonar, em 29 pacientes (24,8%). O perfil nutricional de 48,3% dos pacientes com enfisema pulmonar, de 55% dos com fibrose cística, 56% dos com bronquiectasias e de 50% dos com outras doenças pulmonares foi considerado normal. A maior parte dos pacientes com fibrose pulmonar (51,7%) foi classificada com excesso de peso. A PCT indicou que os pacientes com fibrose cística apresentaram um elevado risco de depleção (64,7%), seguidos pelos pacientes com bronquiectasias (52,6%). **Conclusões:** Os pacientes com fibrose pulmonar foram os que obtiveram maiores valores de IMC, mas com PCT e CMB correspondentes a eutrofia. Pacientes com fibrose cística e bronquiectasias apresentaram maior prevalência de depleção nutricional, baseado na PCT e CMB.

Descritores: Transplante de pulmão; Estado nutricional; Índice de massa corporal.

Introduction

The term end-stage lung disease refers to disorders that lead to progressive deterioration of pulmonary function, physical activity limitation, inability to perform activities of daily living and premature death.[1] Therefore, lung transplantation, either unilateral or bilateral, is a recommended alternative for treating patients at with such diseases.

Some lung diseases, such as cystic fibrosis (CF), silicosis, pulmonary emphysema (PE) and bronchiectasis, increase the energy requirements of individuals, whereas other pathologies, such as pulmonary fibrosis (PF), are associated with states of lower energy expenditure.[2,3]

Therefore, it is important to include data regarding nutritional status and body composition in the pretransplant evaluation, since these factors can be related to complications that affect quality of life and life expectancy of recipients, as well as contributing to the increase in morbidity and mortality.[2-6]

In Brazil, there have been no studies including the assessment of different anthropometric measurements in the evaluation of the nutritional status of lung transplant candidates and relating these measurements to lung diseases at more advance stages. Therefore, the objective of the present study was to determine the pretransplant nutritional profile of lung transplant candidates at a public hospital specializing in cardiology and pulmonology.

Methods

This was a retrospective cross-sectional study involving lung transplant candidates evaluated at a public hospital, located in the city of São Paulo, Brazil, between August of 2003 and August of 2007.

The variables collected from the medical charts of the patients included gender, age and underlying lung disease.

The variables used for the assessment of the nutritional profile of the patients were as follows: weight (kg); height (m); arm circumference (AC; cm); mid-arm muscle circumference (MAMC; cm); waist circumference (WC; cm); and triceps skinfold thickness (TST; mm).

Data related to body mass index (BMI), TST, MAMC and WC, as determined in the first outpatient visit, were used in order to characterize the population.

The criteria for BMI and WC classification were those recommended by the World Health Organization (WHO) in 1997,[7] whereas the criteria for TST and MAMC classification were those devised by Frisancho.[8] Pre-obesity and the various degrees of obesity were grouped into the same classification category, designated *overweight*. The BMI classification systems applied for elderly patients (≥ 65 years) and for children/adolescents (< 18 years), respectively, were those proposed in two previous studies.[9,10]

Absolute and relative frequencies, as well as the mean and the standard deviation of the variables analyzed, were calculated using the Statistical Package for the Social Sciences program, version 12.0 (SPSS Inc., Chicago, IL, USA). One-way ANOVA was used in the comparison between the BMI means and the different lung diseases. The level of statistical significance was set at $p < 0.01$.

The present study was approved by the Ethics in Research Projects Committee of the Clinical Board of the University of São Paulo School of Medicine *Hospital das Clínicas*.

Table 1 – Distribution of patients by classification of nutritional status, based on body mass index, and by underlying lung disease.

BMI classification	Underlying disease									
	Pulmonary emphysema		Cystic fibrosis		Pulmonary fibrosis		Bronchiectasis		Other	
	n	%	n	%	n	%	n	%	n	%
Underweight	5	17.2	8	40	3	11.1	8	32	4	25
Normal weight	14	48.3	11	55	10	37	14	56	8	50
Overweight	10	34.5	1	5	14	51.7	3	12	4	25
Total	29	100	20	100	27	100	25	100	16	100

BMI: body mass index.

Table 2 – Body mass index by underlying lung disease.

Underlying disease	BMI, kg/m²		
	Minimum	Maximum	Mean ± SD
Pulmonary emphysema	16.1	36.1	23.8 ± 5.1
Cystic fibrosis	15.7	28.2	19.4 ± 3.2
Pulmonary fibrosis	15.9	35.2	25.3 ± 4.8
Bronchiectasis	14.4	29.4	21.1 ± 3.7
Other	13.2	27.7	21.7 ± 4.6

BMI: body mass index.

Results

We studied 117 patients, 48 of whom (41%) were female and 69 of whom (59%) were male. The mean age was 42.5 ± 15.2 years (range, 6-68 years).

Of the underlying diseases studied, the most prevalent was PE, seen in 29 patients (24.8%), followed by PF, seen in 27 (23%), and bronchiectasis, seen in 25 (21.4%).

As can be seen in Table 1, the BMI was considered normal in 48.3% of the patients with PE, in 55% of those with CF, in 56% of those with bronchiectasis and in 50% of those with other lung diseases. In contrast, the majority (51.7%) of the patients with PF were classified as overweight.

The category "other" included less prevalent diseases, such as pulmonary hypertension, sarcoidosis, silicosis, microlithiasis and pulmonary lymphangioleiomyomatosis.

As shown in Table 2, the lowest mean BMI (19.4 kg/m²) was found among the patients with CF (p < 0.01), whereas the highest (25.3 kg/m²) was found among the patients with PF (p < 0.01).

According to the TSTs, the risk of depletion was highest (64.7%) among the patients with CF, followed by those with bronchiectasis (52.6%). The majority (73.6%) of the patients with PF were classified as being within the range of normality (Table 3).

Through the analysis of MAMC (Table 4) the majority of the patients, considering all of the lung diseases studied, were found to present depletion, which was either moderate or severe.

The WC measurements revealed that the majority of the patients with CF and bronchiectasis were not at risk for cardiovascular diseases. However, 68% of the patients with PF were found to be within the moderate- to high-risk range for the development of such diseases.

Discussion

The mean age of the 117 lung transplant candidates evaluated in the present study was 42.5 ± 15.2 years, which is similar to the 42.9 ± 14.7 years found in 163 lung transplant candidates evaluated in another study.[11] We found that, in our study, the population was younger, probably due to the presence of patients with CF, which is usually diagnosed in childhood.[12] Although early diagnosis of CF is important, disease severity varies and might be related not only to age at diagnosis but also to the phenotypic expression of the patient. In adulthood, CF can vary considerably, presenting a milder pulmonary component and no digestive symptoms.[12,13]

The present study revealed that the most prevalent underlying disease was PE (24.8%), as did the study mentioned above,[11] in which the prevalence of PE was found to be 36.8%. The BMI has proven to be a good indicator of nutritional status due to its practicality. However, this index does not portray individual differences in body composition, such as fat distribution. In patients with chronic diseases, skinfold

Table 3 – Distribution of patients by triceps skinfold thickness classification and underlying lung disease.

TST classification	Underlying disease									
	Pulmonary emphysema		Cystic fibrosis		Pulmonary fibrosis		Bronchiectasis		Other	
	n	%	n	%	n	%	n	%	n	%
Severe depletion/ Risk of depletion	8	40	11	64.7	2	10.6	10	52.6	6	50
Normal	11	55	4	23.5	14	73.6	8	42.1	5	41.7
Excess fat	1	5	2	11.8	3	15.8	1	5.3	1	8.3
Total	20	100	17	100	19	100	19	100	12	100

TST: triceps skinfold thickness.

Table 4 – Distribution of patients by mid-arm muscle circumference classification and underlying lung disease.

MAMC classification	Underlying disease									
	Pulmonary emphysema		Cystic fibrosis		Pulmonary fibrosis		Bronchiectasis		Other	
	n	%	n	%	n	%	n	%	n	%
Moderate or severe depletion	11	55	13	76.5	11	57.9	14	73.7	7	58.3
Good nutrition	9	45	4	23.5	8	42.1	5	26.3	5	41.7
Total	20	100	17	100	19	100	19	100	12	100

MAMC: mid-arm muscle circumference.

thickness measurements can be useful for evaluating the long-term changes that occur in the subcutaneous adipose tissue reserves. The AC satisfactorily reflects the protein reserve.[14]

In the present study, the mean BMI of the patients with PF (25.3 ± 4.8 kg/m^2) was the highest, 51.7% of these patients being classified as overweight. However, 73.6% of such patients were classified as normal according to the TST measurements, and 68% were at some risk of developing cardiovascular diseases based on the WC measurements. Although it has been suggested that WC is the best measure of abdominal obesity, which is strongly correlated with cardiovascular disease, especially atherosclerotic diseases,[15] there have been no studies correlating WC with lung diseases.

One group of authors found that lung transplant candidates with interstitial diseases such as PF presented higher BMIs, higher TSTs and more fat mass than did those with other diseases.[11] According to the authors, patients with PF can have, in part, greater need of continued treatment with steroids than do those with other diseases. This medication has an appetite-stimulating effect and induces mechanisms in the nutrient metabolism that can lead to fat deposition.

Although COPD, here represented by PE, affects the lungs, it can cause various systemic manifestations, such as malnutrition, which has been associated with higher mortality among COPD patients. However, according to some authors, the mechanisms involved in this weight loss process—mechanisms that can be triggered by an imbalance between energy intake and energy expenditure and by elevated levels of pro-inflammatory cytokines, which can result in the development of hypermetabolism, decreasing the energy intake and contributing to the nutritional alterations seen in patients with COPD—have yet to be fully elucidated.[16] Low BMI and weight loss are risk factors for hospitalization due to exacerbation of the disease, indicating worse prognosis and determining the need for mechanical ventilation.[16]

In the present study, the mean BMI of the patients with PE was 23.8 ± 5.1 kg/m^2, which is within the range of normality according to the WHO criteria[7] and is in agreement with the TST classification, according to which 55% of the patients were classified as normal. Nevertheless, based on MAMC, 55% of the patients with PE presented some degree of depletion, either moderate or severe, and this can indicate a deficit in lean body mass. According to other studies,[17-19] critical patients with COPD at the highest risk of death presented a BMI < 25 kg/m^2. According to two authors,[14] determining body fat reserves in patients with COPD is extremely important, since, without these reserves, the organism begins to mobilize its own protein reserves as an energy source. Therefore, muscle mass depletion is the principal factor responsible for the negative effects attributed to malnutrition.

An important factor in preparing patients with CF for lung transplantation is intensive treatment of malnutrition, which is quite common at the time that these patients—in whom the difficulties of the pancreatic disease are compounded by the deprivation due to chronic infections and to the energy consumption resulting from the increased respiratory effort—are added to a waiting list.[20] The principal causes of malnutrition in these patients include poor absorption, poor digestion, increased energy expenditure, low food intake, glycosuria (in diabetic patients) and chronic respiratory infections.[21]

According to the BMI classification, 55% of the patients with CF were classified as normal and 40% were classified as underweight or malnourished. Regarding TSTs and MAMCs, 64.7% and 76.5% of the patients with CF, respectively, were within the depletion ranges. In addition, according to WCs, the majority (75.0%) were not at risk of developing cardiovascular diseases. Therefore, although the mean BMI of the patients with CF (19.4 ± 3.2 kg/m^2) was within the normality range according to the WHO criteria,[7] the nutritional status of these patients presented more aspects related to malnutrition, such as the high prevalence of depletion in the measurements related to body composition (TST and MAMC). The same was found among the patients with bronchiectasis, in whom the mean BMI (21.1 ± 3.7 kg/m^2) was normal.[7] However, in relation to TSTs and MAMCs, many were classified as depleted or as being at risk of depletion, thereby indicating malnutrition. In one study,[11] the patients with septic diseases, including CF and bronchiectasis, presented the highest prevalence of malnutrition (89.4%). The authors of that study concluded that nutritional status is not an absolute contraindication to lung transplantation. However, patients who are at the extremes are at a higher risk of surgical complications.

In conclusion, according to the anthropometric measurements taken, the patients with PF presented normal BMIs, TSTs and MAMCs more often than did the patients with other diseases. The patient groups with the lowest mean BMIs and the highest prevalence of nutritional depletion, based on TST and MAMC, were those diagnosed with CF and bronchiectasis.

Considering the results of the present study, and since this is a significant and relatively new subject, we propose that measurements, such as TST and AC, in addition to BMI, be taken in order to complement and improve the assessment of the body composition and nutritional profile of lung transplant candidates.

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About the authors

Sabrina Monteiro Pereira de Souza
Nutritionist. Heart Institute, University of São Paulo School of Medicine *Hospital das Clínicas*, São Paulo, Brazil.

Miyoko Nakasato
Head Nutritionist. Heart Institute, University of São Paulo School of Medicine *Hospital das Clínicas*, São Paulo, Brazil.

Maria Lúcia Mendes Bruno
Nutritionist. Heart Institute, University of São Paulo School of Medicine *Hospital das Clínicas*, São Paulo, Brazil.

Alessandra Macedo
Nutritionist. Heart Institute, University of São Paulo School of Medicine *Hospital das Clínicas*, São Paulo, Brazil.