Evaluation of Lung Function in Liver Transplant Candidates

L. Roque[a], A.K. Sankarankutty[b], O.C. Silva Jr[b], and E.D. Mente[b,*]

[a]Medical School of Ribeirão Preto, University of São Paulo, Brazil; and [b]Hepatic Transplantation Unit, Department of Surgery and Anatomy, Medical School of Ribeirão Preto, University of São Paulo, Brazil

ABSTRACT

Introduction. A wide variety of pulmonary conditions are found in cirrhotic patients and may compromise the pleura, diaphragm, parenchyma, and pulmonary vasculature, influencing the results of liver transplantation.

Objective. To evaluate the pulmonary function (lung capacities, volumes, and gasometric study) of patients with liver cirrhosis awaiting liver transplantation.

Patients and Methods. Cirrhotic patients, subdivided into 3 groups stratified by liver disease severity using the Child-Pugh-Turcotte score, were compared with a control group of healthy volunteers. In spirometry, the parameters evaluated were total lung capacity, forced volume in the first second, and the relationship between forced volume in the first minute and forced vital capacity. Blood gas analysis was performed. In the control group, arterial oxygenation was evaluated by peripheral oxygen saturation by pulse oximetry.

Results. Of the 55 patients (75% men, 51 ± 12.77 years), 11 were Child A (73% men, 52 ± 14.01 years), 23 were Child B (75% men, 51 ± 12.77 years), and 21 were Child C (95% men, 50 ± 12.09 years). The control group had 20 individuals (50% men, 47 ± 8.15 years). Pulmonary capacities and volumes by the parameters evaluated were within the normal range. Arterial blood gas analysis detected no hypoxemia, but a tendency to low partial gas pressure was noted.

Conclusion. In this population of cirrhotic patients the parameters of spirometry were normal in relation to the lung capacities and volumes in the different groups. No hypoxemia was detected, but a tendency to hypocapnia in the blood gas was noted.

THE NATURAL history of cirrhosis of the liver is invariably progressive with worsening of liver function and appearance of complications resulting from this condition.

A positive correlation has been described between the severity of the liver disease and the worsening functional capacity of cirrhotic patients [1,2]. Among these complications, pulmonary problems are very frequent and may change the prognosis of the disease. Several conditions associated with terminal hepatic disease, such as tense ascites, pleural, interstitial pulmonary edema, and intercostal muscle weakness, contribute to deterioration of lung function [3]. A reduction in pulmonary vascular capacity, obstructive and restrictive problems, problems related to gas diffusion, and pulmonary vascular problems lead to the deterioration of gas exchange and hypoxemia [4,5]. Pulmonary alterations may be present in about one-third of patients with decompensated liver cirrhosis, leading to a decrease in arterial oxygen saturation and sometimes to cyanosis [6,7]. Arterial hypoxemia is a frequent finding in patients with hepatic cirrhosis and may be asymptomatic, detected only in arterial blood gases [8]. Moderate and severe hypoxemia may be associated with hepatopulmonary syndrome [9].

*Address correspondence to Ênio David Mente, Department of Surgery and Anatomy, Medical School of Ribeirão Preto, University of São Paulo, CEP 14040-900, Av Bandeirantes, 3900–USP Campus, Ribeirão Preto, SP, Brazil. Tel: +55 16 36022618. E-mail: eniomente@fmrp.usp.br

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Table 1. Demographic Characteristics of Cirrhotic and Control Groups

Groups	Child A (n = 11)	Child B (n = 23)	Child C (n = 21)	Control (n = 20)	*P* Value
Male, n (%)	8 (73)	17 (74)	20 (95)	10 (50)	.01
Age (y)	52 ± 14.01	51 ± 12.77	50 ± 12.09	47 ± 8.15	.52
Stature (m)	1.66 ± 0.11	1.68 ± 0.09	1.71 ± 0.07	1.67 ± 0.12	.50
Weight (kg)	69.36 ± 0.65	79.65 ± 16.61	76.62 ± 15.81	73.2 ± 13.7	.24
BMI	25.13 ± 3.19	27.95 ± 5.27	26.2 ± 4.29	26.41 ± 4.29	.36
MELD	11.6 ± 5.78	14.46 ± 3.24	17.89 ± 4.61	-	<.01

Statistical significance: $P < .05$.
Abbreviations: BMI, body mass index; MELD, Model End-Stage Liver Disease.

The evaluation of pulmonary function and the presence of hypoxemia and its relation to the severity of hepatic dysfunction among hepatic transplant candidates may be important to establish a preoperative profile of these patients and to assist in the planning of therapies capable of preventing respiratory complications postoperative.

PATIENTS AND METHODS

Patients in the study group were contacted during the consultation at the liver transplant outpatient clinic of the Hospital das Clínicas of the Medical School of Ribeirão Preto (HCFMRP) from September 25, 2009, to April 11, 2011. The control group volunteers were recruited from the work environment in different sectors of the HCFMRP. Then, subjects were interviewed and medical records were reviewed to fill out an evaluation form with clinical, anthropometric, and biochemical results for the characterization of the MELD (Model for End-Stage Liver Disease) score.

Patients in the study group were divided into 3 groups, according to the severity of the liver disease by the Child-Pugh-Turcotte classification [10]. The study included 57 adults, men and women, aged 18 to 70, who were potential candidates for liver transplantation. The control group consisted of 20 healthy adults.

Systemic problems that could influence the results of evaluations were considered exclusion criteria, such as chronic obstructive pulmonary diseases, asthma, and pulmonary emphysema; heart diseases such as congestive heart failure and myocardial ischemia; renal insufficiency with serum creatinine >3.5 mg/dL; instability of blood pressure at the time of the tests; acute gastrointestinal bleeding; hepatic encephalopathy; and difficulty in collaborating with the evaluation.

Pulmonary function was evaluated by spirometry using the Pulmonet spirometer (Godartnv de Bilt, Ultr, Holland), calibrated daily in ambient conditions, with temperature in degrees centigrade (°C), atmospheric pressure in millimeters of mercury (mm Hg), and relative humidity of the air in percentage (%). The exams were performed in the lung function room of the Pulmonology Section of HCFMRP-USP, using the same device and the examination performed by the same professional. The examination was performed after a detailed orientation of the procedure, with the individual sitting with a straight chest after 10 minutes of rest and at least 3 acceptable curves were considered. Total lung capacity (TLC), forced volume in the first second (FEV1), and the ratio between FEV1 and forced vital capacity (FVC) were classified as mild disorder when >60%, moderate between 41% and 59%, and severe ≤40%.

The arterial blood for the gasometric study was collected in the Pulmonology Section of the HCFMRP-SP, with the individual sitting and chest upright in ambient air. Arterial oxygen partial pressure (PaO_2), carbon dioxide arterial pressure ($PaCO_2$), and arterial oxygen saturation ($SatO_2$) were assessed by arterial gasometry using a gasometer (178 pH/blood gas analyzer, Corning Glass Works, Corning Limited, Halsteld, Essex, England). In the control group, the peripheral oxygen saturation (SpO_2) was evaluated using a pulse oximeter (MOD 1001, JG Moriya, Brazil). This was used in the control group because it is a noninvasive method and has acceptable accuracy when comparing SpO_2 to $SatO_2$ measured by arterial samples.

The data were analyzed using SAS 9.2 software (Foundation SAS, SAS Institute Inc., Cary, NC, USA). The categorical variables were analyzed using the χ^2 test, and analysis of variance was used to compare between the groups in relation to the quantitative variables. The level of significance adopted in this study was $P < .05$.

Patients who agreed to participate signed the Free and Informed Consent Form previously approved by the Research Ethics Committee of HCFMRP-USP (Process no 4168/2009).

RESULTS

Of the 57 patients studied, 2 were excluded because they presented obstructive pulmonary disorder in the pulmonary function test. The patients had the following distribution according to the Child-Pugh-Turcotte: Child A classification: 11 patients, 8 men (73%); Child B: 23 patients, 18 men (75%); and Child C: 21 patients, 20 men (95%). In the control group, 10 patients were men (50%). There was a predominance of male subjects in all groups. The stratification of the groups by the severity of the liver disease corresponded to the MELD score, with the highest values in the Child C group, which were significantly higher than the Child A and B ($P < .01$) groups. The rest of the sample presented homogeneity in relation to age, height, weight, and body mass index (Table 1).

Values of FEV1 were normal in the different groups. However, when the means of the Child B and C groups were compared with those of the control group, there was a significant difference ($P = .02$ and $P < .01$, respectively), with a lower volume for both groups of the study. The other parameters evaluated were normal without significant differences between groups (Table 2).

No hypoxemia was detected; gasometric values observed were within normal range with the partial pressure of oxygen varying from 71.5 to 103.6 mm Hg. A tendency to low partial pressure of carbon dioxide with a mean of 32 mm Hg was observed. There were no significant differences between the study groups (Table 3).