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Improvement of Physical Capacity and Quality of Life After Liver Transplantation: A Longitudinal Study

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1. Introduction

Individuals in the post-operative period immediately after liver transplantation (LxT) may experience a decline in their physical capacity (PC), life quality (LQ), and respiratory capacity (RC). These complications may be due to reduced muscle strength, weakness, malnutrition, and fatigue as the consequences of surgical procedures and hospitalization (1).

In the presence of a new organ, the function tends to return to normal, but the PC, RC, and LQ seem to act differently. The pulmonary function and respiratory muscle strength tend to match the expected values by one month after LxT (2). The LQ results, measured by short form-36 questionnaire (SF-36), are different because life capacity is dynamic and recovers quickly in the first six months after surgery. This may be influenced by many factors such as comorbidity, disease progression, and the clinical conditions after surgery (3).

The "status of PC" information can contribute to better planning, recovery, and improvement of life expectancy of patients. Typically, after surgery, patients have a low level of physical activity as recorded in the six-minute walk test (6MWT) and the six-minute step test (6MST) (1). In a study, these values were lower than those predicted for the normal Brazilian adult population (1). This may be explained by the occurrence of chronic muscular fatigue after surgery causing a decline in daily activity. However, no study focused on the long-term examination of physical activity levels or the correlation between physical activity and LQ a long time after transplantation.

Given the need for understanding PC and LQ in early stages after LxT and because the long-term effects of LxT are unknown in patients, this study aimed to verify the improvement of PC and LQ one to six months after LxT and assess the correlation between physical activity and LQ of patients.

2. Methods

It was a pilot observational longitudinal study approved by the Ethics and Research Committee (922/2009). The PC and the LQ were evaluated using 6MST and SF-36, respectively, one month, three months, and six months after LxT.

2.1. Subjects

The inclusion criteria included patients adults, after one month of hospitalization for transplantation or major lung surgery and no major heart problems. The exclusion criteria included patients with the sequel of motor function or cognitive issues, as they could not endure the physical tests, the signs of organ rejection, and hemodynamic instability.

2.2. Data Collection and Measurements

Information about clinical and surgical characteristics included respiratory muscle strength (Muscle Inspiratory Pressure (MIP) and Muscle Expiratory Pressure (MEP) (4) and spirometry (the expected percentage of Forced Vital

Capacity (FVC) and forced expiratory volume in the first second (VEF_1) (5).

Six-min step test (2): The numbers of steps were recorded along with the physiological parameters. The values obtained in three evaluations were compared with each other and with expected (predictive) values (6).

2.3. Statistical Analysis

Shapiro-Wilk test was used for checking the normality of the data. The comparison of groups was done using the Tukey test for data with normal distribution and Kruskal-Wallis test for data with non-normal distribution. Paired Wilcox test was used to determine which of the three stages of the evaluation was statistically different from others. Student *t*-test was used to compare the expected values and the actual number of steps in 6MST (with normal distribution). To verify the correlation between the number of steps and LQ, we employed a simple linear regression. SPSS V. 21.0 was used and the alpha value was set at 0.05.

3. Results

We used specific inclusion criteria to restrict the number of participants and seek complex cases for the study. Initially, 30 participants were selected of whom 12 were excluded as they did not meet the inclusion criteria. The data of 18 patients were collected in the first stage of the evaluation. In the second stage, five patients developed complications of organ transplantation (three died).

The majority of the sample was male (72%) with an average age of 54.50 and a MELD score of 24.50 before LxT. The most common cause of the liver disease was hepatitis C virus (61%) infection, followed by alcohol consumption (33.3%). The median waiting time for transplantation was six months. Piggy Back technique and Orthotopic LxT were used.

Pulmonary functional test results showed the VEF_1 of $75.1 \pm 22.56\%$ and the CVF of $74.7 \pm 20.22\%$; the respiratory muscle strength was 81.7 ± 35.06 cm H_2O in MIP and 100 cm H_2O in MEP.

Supplementary file appendix 1 shows the results of PC as evaluated by 6MST (number of steps) in the three stages of evaluation. We found a statistically significant difference between the stages (P = 0.00007), specifically between the first and third months after surgery (P = 0.01). The average numbers of expected steps were 141 steps for each patient. The significance is highlighted in Supplementary file appendix 2 for all the stages of evaluation.

Supplementary file appendix 3 shows the results of LQ. The results were statistically significant between the three stages of evaluation for FC, mainly between the first and third stages (P = 0.0001) and between the second and third stages (P = 0.004). For the LPA, a statistically significant difference was observed between the first and second stages (P = 0.035) and between the first and third stages (P = 0.07). It was significant in the domain of vitality when comparing the first and third stages (P = 0.005), the second and third stages (P = 0.020), and finally the first and third stages for EA (P = 0.018). We could not observe any correlation between 6MST and quality in any evaluation stage ($P < 0.05$).

4. Discussion

In this study, we observed that the PC of patients is significantly related to the number of steps from a period of one to six months after LxT. When we compared the actual values with the predictive values, we observed significant differences between all stages of evaluation. This implies that patients had significant differences in PC even six months after surgery, and PC presented continuous damage in this period.

Our results are in alignment with the results by Magalhaes et al. (1), who measured PC in patients one month after LxT using TD6 and 6MST. Their results indicated that patients had impaired physical function with low expected (predictive) values. VanWagner et al. (7) studied PC using 6MWT over a long period (one, three, six, and 12 months) after surgery, and found that patients showed a gradual improvement in each stage of evaluation, but the values were lower than predictive values at all evaluation times. This may be due to some factors. The first factor is the immunosuppression medication used over a long period that may have led to the impairment of the musculoskeletal, cardiovascular, and respiratory systems and metabolic disorders (7). The second factor is that patients with end-stage liver disease present muscle mass loss that may affect peripheral and respiratory muscle, leading to chronic fatigue and protein wasting possibly remaining for up to one year after surgery (1).

In our study, we observed that a month after LxT, the quality of life was low in all aspects measured. However, after long periods (six months), the FC, LPA, vitality, and EA scores improved with significant differences between the three evaluation stages.

There are limited studies of the quality of life after LxT, with controversial results. Bownik et al. (8) showed that patients were poor on all the domains of SF-36 one month after surgery, but they improved gradually during six months. Some authors challenged this assertion. Notably, Burra and Germani (9) concluded that all aspects of SF-36, except for physical aspects, improved six months

post-LxT. This may be explained by several factors that influence LQ after LxT, including the etiology of liver disease, social and demographic factors, immunosuppression therapy, waiting time for LxT, sexual activity, complications of organ rejection, infection, and biliary events (3).

No significant differences were observed in this study when LQ was correlated to the measurements from SF-36 and PC, and measurements from 6MST at six months after LxT in this study. The LQ recovered in most cases within six months after LxT but the PC was low in many cases. Limited research is available to decipher the reasons. We believe that LQ is a subjective measure that may be influenced by several physiological factors while PC is a direct measure.

4.1. Clinical Implication, Strengths and Limitations of the Study

Compared to previous studies, there are two main strengths in the current study. First, this is the first study of evaluating the improvement of PC and LQ in patients after LxT in a long time (six months). Second, there are no previous studies on the correlation between PC and LQ. The main limitation of this study was the small sample size although it can be justified by highlighting the specificity of inclusion criteria, the characteristics of patients in the study, and the long time of monitoring and follow-up.

5. Conclusions

Patients subjected to LxT may experience declined PC within a month after LxT. This condition tends to improve in six months. However, it does not return to predictive values. A month after surgery, the LQ is significantly affected, particularly in the main domains of SF-36. The scores appear to return to the ideal state within six months after surgery. The improvement of these capacities after LxT could be explained by some associated factors such as social and demographic variables, pre-operative situations (muscle mass loss, waiting time for LxT, and etiology of liver disease) and post-operative situation (immunosuppression therapy, complications of organ rejection and infection).

Supplementary Material

Supplementary material(s) is available here [To read supplementary materials, please refer to the journal website and open PDF/HTML].

Footnotes

Conflicts of Interests: The authors declare that there are no conflicts of interest.

Ethical Approval: This study was approved by the Ethics and Research Committee (number 922/2009).

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