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Respiratory and physical therapy in the intensive care unit after liver transplantation for acute-on-chronic liver failure: a case report

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Abstract

Acute-on-chronic liver failure (ACLF) is a severe clinical condition for which liver transplantation (LT) is the only curative option. Due to the recipients' generally poor pre-operative clinical conditions and extensive surgery, post-LT respiratory disorders are very common and significantly contribute to related morbidity and mortality.

We report the case of a 49-year-old patient with ACLF grade 3 who has been taken care of by the Respiratory Physiotherapy Team since hospital admission. After the extubation, the patient was supported with non-invasive ventilation and mechanical in-exsufflation; meanwhile, early resistance and functional training were started. No adverse events occurred during physiotherapy sessions, and the patient returned home without respiratory support.

Respiratory and physical therapy in the intensive care unit after LT were safe and feasible interventions for this patient. Given the high incidence of postoperative pulmonary complications and the high rehabilitation needs, we suggest that physiotherapy should be provided for ACLF recipients.

Key words: case report, liver transplantation, acute on chronic liver failure, intensive care unit, physiotherapy, extubation failure, non-invasive ventilation.

Introduction

Acute-on-Chronic Liver Failure (ACLF) is a clinical syndrome defined by an acute deterioration of the liver function associated with extrahepatic organ failures often requiring intensive care support and associated with a high rate of short-term mortality [1]. The global prevalence of ACLF among patients admitted with decompensated cirrhosis is estimated 35% [2]. Liver transplantation (LT) is considered the only life-saving treatment, which can potentially change the long-term prognosis of patients with ACLF [3]. Due to recipients' generally poor pre-

operative clinical conditions and to the extensive surgery, post-LT respiratory disorders are very common and significantly contribute to the related morbidity and mortality, with lung failure being itself an independent predictor of in-hospital mortality in ACLF patients [4,5]. It is also acknowledged that healthcare resource utilization after LT was greater among recipients with ACLF compared with patients without ACLF. They experienced longer median post-LT length of hospital stay (9 vs. 39 days), longer intensive care unit (ICU) stay (5 vs. 11 days) and higher rate of discharge to a rehabilitation centre (16% vs. 30%) [6,7]. Currently, despite the relevance of the topic, no evidence exists about the efficacy and modalities of rehabilitation intervention in ACLF patients receiving transplantation. We present the case of a 49-year-old patient with ACLF grade 3 admitted to our LT centre for evaluation, who was taken care of by the respiratory physiotherapy team since day one until his discharge from the hospital.
The aim of this paper, which follows the Case Report (CARE) Guidelines [8], is to describe the Respiratory and Physical Therapy interventions in the ICU setting after LT in this ACLF patient.

Case Report

We report the case of a 49-years-old patient with ACLF grade 3 who was admitted to our ICU for evaluation for Liver Transplantation after 26 days of hospitalization (of which 14 in ICU) (Figure 1). At the admission the patient had an ACLF grade 3 with four organ failures (brain, circulation, liver and kidney), a Chronic-Liver Failure C (CLIF-C ACLF) score of 73 (30-days mortality 90%, 3-month mortality 97%) and a model for end-stage liver disease (MELD-Na) score of 40. The past clinical history was mute, except for a former ultrasound documented liver steatosis. The patient was an active smoker and active drinker. Harmful alcohol consumption was identified as precipitant of ACLF.
As soon as the patient arrived in our transplantation centre (where physiotherapy referral is automatic), the physiotherapist on duty instantly placed the patient's limbs in neutral position with anti-decubitus devices and verified the patient's bed position to prevent the worsening of pre-existing pressure injuries and neuromuscular disorders. In the pre-transplantation phase, preventive respiratory physiotherapy interventions were provided, including continuous active humidification (at 37°C) of the airways, changing patient's decubitus (on the lateral decubitus and "in-bed" sitting position) and airway clearance techniques (such as lung expansion and recruitment techniques and expiratory rib cage compressions) in order to prevent mucus encumbrance and atelectasis and to improve gas exchange.
After surgery, patient's unstable clinical conditions (hepatic encephalopathy, kidney failure, need of vasoactive drugs) led to a slow-paced weaning from mechanical ventilation and cardiovascular support. From day 0 to post-operative day 5 (POD 5), the physiotherapist regularly evaluated the patient's neuromotor and respiratory functions and, eventually, his

readiness to manage spontaneous breathing. Firstly, to evaluate the neurologic status, Richmond Agitation Sedation Scale (RASS), Confusion Assessment Method for the ICU (CAM-ICU) and ability to follow simple orders were considered, while motor function was assessed by using the Medical Research Council Sum Score (MRC-SS). Secondly, to evaluate patient's respiratory function, tidal volume, respiratory rate, respiratory kinematics, P0.1, Pmusc,index (PMI), Rapid Shallow Breathing Index (RSBI), arterial blood gas, presence of voluntary cough and cough reflex, bronchial secretions quality and quantity and Negative Inspiratory Force (NIF) where considered and a Spontaneous Breathing Trial (SBT) was performed. On POD 6, after successfully passing the SBT and the cuff-leak test, the patient was extubated. Since the high risk of extubation failure due to the presence of copious bronchial secretions, pleural effusion and atelectasis, and to the severe muscle weakness (clinical picture of severe Intensive Care Unit - Acquired Weakness with MRC-SS 34/60 and inspiratory muscles and cough weakness with NIF -22 cmH2O) the patient was supported with Non-Invasive Ventilation (NIV), High Flow Nasal Cannula and Mechanical In-Exsufflation (MI-E). Non invasive respiratory supports were primarily managed by the physiotherapist, who was responsible for the initial settings (along with the physician), choice of the most appropriate NIV mask and ventilator and monitoring of patient response (along with the nurse). MI-E was set and firstly administered by the physiotherapist too, then on demand by physiotherapists or nurses. To do al this task and to monitor patient response, the physiotherapist was present all day-shift long (ICU dedicated) and 10-hours on-call. On POD 8 patients suffered for a massive secretion encumbrance causing respiratory distress, nonresponsive to MI-E (probably due to the high respiratory rate and patient-device asynchrony) or tracheal aspirations (which unfortunately led to an upper airway bleeding); therefore, patient needed to be reintubated. On POD 12, the second extubation attempt took place: even this time the patient was supported with NIV (especially during night rest), High Flow Nasal Cannula (HFNC) during NIV breaks and MI-E. On POD 13 swallowing function was assessed for screening using the Gugging Swallowing Screen for the ICU (GUSS-ICU) test which tested positive; therefore, a speech and language therapy consult was requested for formal evaluation and rehabilitation. The feeding tube was kept in place as a parallel nutritional support until the patient re-acquired a proper swallowing ability. On the same day, resistance and functional training was started (initially with in-bed cycle ergometer) (Figure 2) while functional outcome as sitting in wheelchair has been reached on POD 14. On POD 22 the patient was transferred to the High Dependency Unit, where the Respiratory and Physical Therapy program was carried out by the same physiotherapy team (NIV at night, MI-E for airway clearance, continuing of exercise training).

No adverse events occurred during physiotherapy sessions, which continued after the discharge from the hospital (POD 97). Finally, the patient returned home without respiratory support, walking with assistive devices.

Discussion

This Case Report fully describes the physiotherapy care of a frail ACLF recipient in the ICU setting.

One of the main goals of the respiratory physiotherapist in this setting is to prevent and treat respiratory complications and lung failure, which is known to be an independent predictor of in-hospital mortality in ACLF recipients [5]. In critically ill subjects, the worsening of the respiratory function can be often related to pulmonary secretion retention and/or atelectasis. In fact, in the mechanically ventilated patient, due to the presence of the artificial airway, poor humidification of inspired gases and relative immobility, the primary mechanisms of secretion clearance are impaired [9]. Since adequate conditioning of inhaled gasses can improve mucociliary clearance function and mucus rheology, active humidification was adopted as the first-line treatment for obstructive atelectasis prevention. Expiratory Ribe Cage Compressions were also used as an add-on airway clearance technique on account of lung auscultation and ventilatory waveforms analysis [9]. Decubitus changing and positional therapy, which are essential to prevent the formation of bedsores or promote their treatment when already present, in this specific case were implemented primarily as an adjuvant in strategies for airway clearance and lung recruitment [9]. It is well known that the recumbent position in critical patients affects ventilation, causing decreased lung volume and increased airway resistance, contributing to hypoxemia; early mobilization, instead, reduces the negative effects associated with bed rest [10,11]. In fact, it has been observed that in critically ill subjects the sitting position leads to an increase in Functional Residual Capacity and an improvement in oxygenation [10]. Early mobilization is a safe intervention that can decrease the incidence of ICU-AW, increase the number of ventilator-free days and the discharged-to-home rate for patients with a critical illness [11]. In this population early mobilization and rehabilitation are strongly recommended by the ERAS guidelines, which states that they should be encouraged with early-goal-directed interventions, from the morning after LT until hospital discharge [12]. Unfortunately, in this specific case, due to recipient's poor neurological and respiratory function, it was possible to start active mobilisation only on POD 13 (27 days after the first ICU admission), when he had already developed an acquired weakness. Despite this, it can be said that the rehabilitation intervention was successful, as the patient returned home without respiratory support, walking independently with an assistive device.

Along with exercise therapy, an accurate nutritional intervention was carried out; the feeding tube was kept in place as a parallel nutritional support until the patient re-acquired a proper swallowing ability. This aspect too was fundamental for patient's rehabilitation.

This Case Report also highlights the central role physiotherapists played in the respiratory weaning of this frail patient. In our hospital we have a specialized team of respiratory and critical care physiotherapists, which, after attending a university master course and/or post-graduate courses, have an extended knowledge and scope of practice in the cardiorespiratory, surgical and critical care field. They have expertise to assess cough strength, work of breathing, respiratory muscle strength, and respiratory secretion load, which are important factors in the outcome of extubation [13]. Cork and colleagues showed that specialist physiotherapists can detect patients at high risk of extubation failure with a high sensitivity following a thorough assessment [13]. On top of that, Thille and colleagues observed that ICU-AW is associated with ineffective cough and extubation failure [14]. Accurate prediction of extubation outcome and risk stratification can help to inform management plans pre- and post-extubation and therefore reduce the likelihood of extubation failure. Based upon patient assessment, which highlighted severe muscle weakness (MRC-SS 34/60), inspiratory muscles and cough weakness (NIF -22 cmH2O), prolonged intubation and presence of copious bronchial secretions, pleural effusion and atelectasis, extubation was classified as high risk. According to the most recent international clinical practice guidelines, which recommend the use of Non-Invasive Ventilation immediately after extubation to prevent respiratory failure in patients at high risk of reintubation [15], and the use of High Flow Nasal Cannula, especially during NIV breaks [16], this patient was supported with non-invasive respiratory support (NIRS) strategies, which were managed by an experienced team composed by critical care physicians, critical care nurses and respiratory and critical care physiotherapist. As mentioned above, ineffective cough and the inability to clear copious secretions are reasons for extubation and NIV failure. Therefore, the adopted weaning strategy was the bundle of Non-Invasive Ventilation and Airway Clearance Techniques such as Mechanical In-Exsufflation, as the latter was essential for the former's effectiveness [17,18].

Post-extubation dysphagia (PED) is a condition that is becoming a growing concern. This occurs in 3-62% of extubated patients and can be related to mixed aetiologias, such as neuromuscular impairment, critical illness or laryngeal damage. Recent studies recommend the implementation of a standardized swallowing screening to prevent aspiration and decrease pneumonia rate and mortality [19]. In this case, the physiotherapists, along with the nurse in charge, assessed patient's swallowing function using the GUSS-ICU screening toll, which tested positive; this was crucial for aspiration pneumonia prevention and led to an early request of formal speech and language therapy evaluation and related interventions.

Lastly, since no adverse events occurred during physiotherapy sessions, it can be said that respiratory and physical therapy after LT in the ICU setting were safe and feasible interventions in this ACLF recipient. Limitations of our experience are mainly related to the inability to draw robust conclusions exportable to the whole population given the fact that we report experience with a single patient. Further studies are needed to show the safety and feasibility of early rehabilitation in larger cohorts. Lastly, our experience relates to a setting where there is high resource availability, with 10-hour on-call availability of respiratory physiotherapists, that is not necessarily applicable to all ICU settings.

Conclusions

Respiratory and Physical Therapy after Liver Transplantation in the ICU setting were safe and feasible interventions in this ACLF patient and were important components of patient's care. Since the high incidence of post-operative pulmonary complications and the high rehabilitation needs, we suggest that a multidisciplinary approach including physiotherapy should be provided to ACLF recipients, especially for more advanced ACLF grade and in frail patients.

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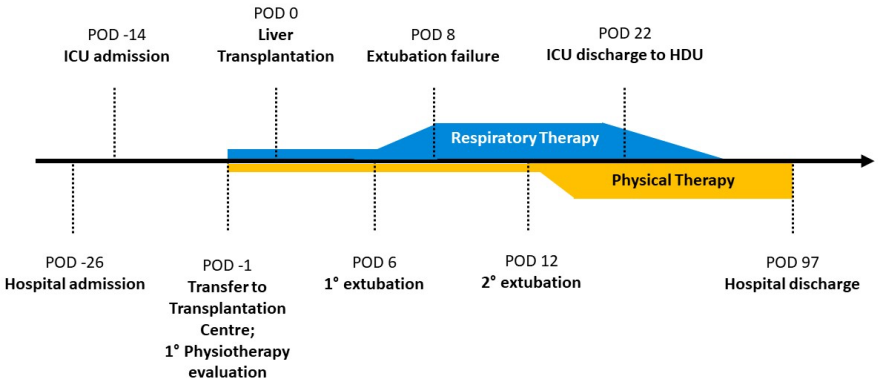

Figure 1. Visual representation of the hospitalization of the patient. Time 0 is considered the day of surgery. The area under the curve visually represents the rehabilitation and assistance needs in terms of respiratory (respiratory therapy - blue) and neuro-motor (physical therapy - yellow) interventions. ICU, intensive care unit; HDU, high dependency unit; POD, post-operative day.

Figure 2. Physiotherapy session in the intensive care unit: the patient is supported with non-invasive ventilation during in-bed cycle ergometry training.