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EARLY MOBILIZATION AND THE ELASTIC BAND, AN EFFICIENT SOLUTION FOR AN INTUBATED SUBJECT: A CASE STUDY

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ABSTRACT. Introduction: In severely ill patients, weakness acquired in the intensive care unit is a frequent consequence. The advantages of early mobilization for adult intensive care unit patients include shorter stays in the intensive care unit and hospitals, a shorter need for mechanical ventilation, fewer days of harmful bedrest, fewer negative or dangerous occurrences, and increased walking distance. Early mobilization and rehabilitation programs using elastic bands for patients with severe illnesses in intensive care units enhance the weaning success and shorten ventilation times while also enhancing arm muscular power. **Objective:** This study case aimed to present the fact that early mobilization and elastic band exercises were efficient solutions for an intubated subject from the intensive care unit. **Methods:** A mechanically ventilated subject postoperatively for hiatal hernia and suspected phrenic nerve paresis, benefited from early mobilization and elastic band exercises and was assessed for the state of consciousness with the Richmond Agitation Scale, and muscle strength for the upper limb with the EH101 digital dynamometer. **Results:** Muscle strength at the level of the upper limbs increased from weak to normal and the subject was successfully extubated. **Conclusions:** In this case study we consider that early mobilization and the elastic band exercises program were effective, safe, inexpensive, and suitable for an intensive care unit, and it was the right solution for the success of weaning from the ventilator.

Keywords**:** *early mobilization, elastic band, handgrip, ventilated subject, intensive care unit.*

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REZUMAT. ***Mobilizarea precoce și banda elastică, o soluție eficientă pentru un subiect intubat: studiu de caz.*** **Introducere**: Slăbiciunea musculară dobândită în unitatea de terapie intensivă este o complicație frecventă la subiecții în stare critică. Beneficiile mobilizării precoce sunt: durata redusă în unitatea de terapie intensivă și a spitalizării, a ventilației mecanice, a zilelor de repaus la pat, efecte adverse minime și o distanță parcursă la mers mai mare. Mobilizarea precoce și exercițiile cu banda elastică îmbunătățesc succesul extubării subiecților și reduc durata ventilației mecanice, de asemenea îmbunătățesc forța musculară la nivelul membrelor superioare. **Obiective**: Obiectivul acestui studiu de caz a fost, de a prezenta faptul că, mobilizarea precoce și exercițiile cu banda elastică au fost soluții eficiente pentru un subiect intubat din secția de terapie intensivă. **Metode:** Un subiect ventilat mecanic post-operator pentru hernie hiatală și suspect de pareza de nerv frenic a beneficiat de mobilizare precoce și exerciții cu banda elastică, fiind evaluat pentru starea de conștientă cu Richmand Agitation Scale și forță musculară pentru membrele superioare cu dinamometrul digital EH101. **Rezultate:** Forța musculară la nivelul membrelor superioare a crescut de la nivel slab la normal iar subiectul a fost extubat cu succes. **Concluzii**: În acest studiu de caz considerăm că, mobilizarea precoce și programul de exerciții cu bandă elastică au fost eficiente, sigure, necostisitoare și potrivite pentru o unitate de terapie intensivă, si a fost soluția potrivită pentru succesul extubării subiectului.

Cuvinte cheie: *mobilizare precoce, bandă elastică, dinamometru digital, subiect ventilat, unitate de terapie intensivă.*

INTRODUCTION

Every year, between 13 and 20 million individuals around the world need treatment in intensive care units (Wang, T., 2020). Subjects who have been on mechanical breathing for longer than 48 hours experience rapid skeletal muscle atrophy (Hodgson, C. L., et al., 2022). The muscle force decreases by about 20–27% after two weeks of immobility, making it harder to wean off of ventilatory support and causing functional loss (Skals, S., 2018). A combination of muscle and nerve injuries that developed during an intensive care unit stay in 25% to 63% of mechanically ventilated participants is what causes intensive care unit-acquired muscle weakness (Cottereau, G., et al., 2021). Muscle weakness acquired in the intensive care unit is a common complication affecting critically ill subjects' prognosis. The hand-held dynamometer was found to be sensitive in detecting muscle strength reduction in the critically ill (Samosawala, N. R., Vaishali, K., & Kalyana, B. C., 2016).

According to some data, starting rehabilitation two or three days after being admitted to an intensive care unit may be preferable to starting it later (Hodgson, C. L., et al., 2021). The advantages of early mobilization in the intensive care unit include shorter intensive care unit and hospital stays, shorter periods of mechanical ventilation, fewer days of harmful bedrest, fewer negative or dangerous occurrences, and increased walking distance (Perme, C., et al., 2014). Additionally, early mobilization offers many advantages, such as enhanced perfusion, muscle strength, and functional capacity (Decha, P., et al., 2020).

The handgrip can reveal limb weakness and reveal whether a patient is dependent on a ventilator or may struggle to wean off one (Wang, T., 2020). Using a dynamometer to determine the greatest static force that a hand can squeeze, handgrip strength is an established, non-invasive, and practical bedside approach for the assessment of muscular strength in clinical practice (Pucci, G., et al., 2022). By using a straightforward handhold command without the need for specific equipment, handgrip strength looks to be a simple, quick technique to assess expiratory muscular strength. Strong handholds might be related to powerful expiratory muscles. (Grigoriadis, K., et al., 2022). The participant's highest voluntary effort is recorded by the grip dynamometer (Paramasivan, M., et al., 2019). The participant's highest voluntary effort is recorded by the grip dynamometer. (Lupton-Smith, A., et al., 2022). The EH101 dynamometer offers outstanding validity and dependability (Huang, L., et al., 2022). In mechanically ventilated patients, handgrip strength can predict whether weaning will be challenging or take a long time. Low strength was associated with a considerably higher reintubation rate (Saiphoklang, N., & Keawon, T., 2021).

Elastic resistance bands are a great cheaper alternative to other pricey equipment because they appear to be a genuine and trustworthy tool for the direct measurement of maximum muscle strength and endurance (Haraldsson, B.T., et al., 2021). The weaning rate can be increased by 78% using elastic band resistance training, which is simple to learn and does not have any physical space restrictions. This is especially true for people requiring mechanical ventilation (Chang, Y. J., 2020). It is quite enticing to use elastic band workouts as a cheap, straightforward technique in a "protected environment" like the intensive care unit (Aboodarda, S. J., Page, P. A., & Behm, D. G., 2016). An acceptable, safe, and effective therapeutic approach to retain remaining upper limb motor activities and enhance trunk control was an elastic band exercise program in a critically sick patient recovering from intensive care unit-acquired weakness (Polastri, M., et al., 2018). Elastic band exercise is a fascinating technique since it is helpful for maintaining muscle mass and enhancing muscle strength in a variety of medical problems (Skals, S., 2018). According to Decha P., et al., 2020, rehabilitation programs for critical illness in the intensive care unit that include

early mobilization with elastic band exercises increase weaning success and shorten ventilation duration while also enhancing arm muscular strength. Due to the motor supply to the primary respiratory muscles of the diaphragm, phrenic nerve injury can cause transient dyspnea, diaphragmatic paralysis, and gradually decrease respiratory function (Lee, J.H., et., al. 2021).

CASE DESCRIPTION

Subject History

The subject described in this case report was a 65-year-old man admitted to the post-operative intensive care unit with a diagnosis of axial hiatal hernia, for which the hiatal hernia was treated. Relatedly, the subject has a coronary disease, a triple aortocoronary bypass in 2010, old previous myocardial infarction, degenerative mitral regurgitation, mild tricuspid insufficiency, atrial fibrillation converted to sinus rhythm by medication in 2010, New York Heart Association II, heart failure, ankylosing spondylitis. The subject has a deformed, kyphoscoliosis chest and a postoperative scar at the chest level. On admission, the subject is sedated, with a Richmond Agitation Scale score of -3 points. From a respiratory point of view, the subject, orotracheal intubated and mechanically ventilated. The sedation window was performed for neurological evaluation, with respiratory and ventilatory parameters within normal limits. Was safely extubated, but shortly after extubation, the subject complains of dyspnea, and becomes tachypneic, and polygenic, with increased respiratory effort with the activation of accessory muscles, with hemodynamic impact and developing respiratory acidosis, followed by neurological alteration, which is why reintubate, with monitoring of ventilatory parameters. A decrease in the function of the diaphragm was suspected in the context of the subject's pathology and the surgical intervention that occurred. In this sense, physical therapy intervention was considered necessary for weaning from the ventilatory. On the fourth day of the intensive care unit, the decision was made to extubate the subject with non-invasive ventilation and physical therapy. He remains extubated for four days, after which the subject progressively changes, shows respiratory acidosis with increasing dioxide carbon, and is reintubated. A neurological consultation is requested, what does he recommend for a brain magnetic resonance imaging examination. A rheumatological consultation is also carried out, which concludes that ankylosing spondylitis does not per se, cause diaphragm dysfunction. Abdominal ultrasound detects the mobility of the right hemidiaphragm within normal limits, with very low mobility of the left hemidiaphragm, so the suspicion

of left phrenic nerve paresis is raised, with the mention that the phrenic nerve paralysis/injury cannot be objectified on the territory of our country, due to the lack of logistics. The subject was conscious and cooperative, but respiratory and hemodynamically unstable. With the consent of the subject, a tracheostomy was performed on the fifteenth day of the intensive care unit.

OBJECTIVE

The aim of this study case was to present the fact that early mobilization and elastic band exercises were solutions for an intubated subject from the intensive care unit.

MATERIAL AND METHOD

The case study was conducted in the Intensive Care Unit of Cluj-Napoca "The Regional Institute of Gastroenterology and Hepatology Prof. Dr. Octavian Fodor", from September to October 2022, to present the fact that early mobilization and elastic band exercises were solutions for an intubated subject from the intensive care unit.

The procedure was explained to the subject, and informed consent was signed. The baseline data was noted before starting the protocol.

The subject's state of consciousness was assessed with the Richmond Agitation Scale (RASS) to describe his level of alertness, agitation, and sedation. This scale ranged from -5 to +4 which means: with a score of 0 to +4 the subject is alert, restless, or agitated (Sessler et al., 2002). In our case, the subject has 0, which means he was awake, alert, and calm.

Muscle force of the upper limb was tested with an electronic hand dynamometer EH101**,** which is one of the latest released products. High-precision power gauging, giving momentary digital read-out of gripping power. Auto capturing of maximum achieved grip power and display value. Assessment of results according to age and gender group - weak/normal/strong, provides gripping up to 90 kg. The digital handgrip dynamometer EH101 is a valid tool for assessing grip strength in hospitalized adult patients (Lupton-Smith, A., et al., 2022). The EH101 dynamometer provides excellent reliability and validity (Huang, L., et al., 2022). The indication for the subject was to use the dominant hand and was asked to squeeze the handle with maximal effort, three times and the best result was registered. Upper limb exercises were performed using an elastic band, a blue band with reduced resistance of 2 kg.

The subject has 37 days in the intensive care unit and 30 days of physical therapy. He has had one session of physical therapy per day from Monday to Friday and two times on Saturday too since the first day of intensive care.

Intervention

Below, in the table is the description of the physical therapy program by day.

Table 1. The schedule of the physical therapy program by day

Physical therapy/ Day	Assessment	Exercise/ Exercise with an elastic band	Transfer/ Gait
1	Clinical: Subject intubated, conscious, cooperative Informed consent signed Richmond Agitation Scale 0 The handgrip of the upper limbs was 27.6kg – weak At the level of the cervical spine, welding of the vertebrae with the impossibility of flexion, extension, rotation, or tilting of the head	Global analytical exercise, 10 repetitions in bed Diaphragmatic breathing exercise, 10 repetitions	Transfer to the edge of the bed, standing, steps next to the bed
2 – 3		Global analytical exercise, 10 repetitions in dorsal decubitus Diaphragmatic breathing exercise, 10 repetitions For the upper part specific exercise with the elastic band (2kg - of resistance) in bed, 10 repetition	Transfer to the edge of the bed, standing, steps next to the bed, armchair - 2 hours
4	The subject was extubated with high oxygen flow	Global analytical exercise, 10 repetitions in bed Diaphragmatic breathing exercise, 10 repetitions For the upper part specific exercise with the elastic band in the armchair, 10 repetition	Transfer to the edge of the bed, standing, steps next to the bed, armchair- 3 hours

Physical therapy/ Day	Assessment	Exercise/ Exercise with an elastic band	Transfer/ Gait
5	The subject was reintubated	Global analytical exercise, 10 repetitions in bed Diaphragmatic breathing exercise, 10 repetitions Exercise with the elastic band in bed, 5 repetitions	
6 - 7		Global analytical exercise, 10 repetitions in bed Diaphragmatic breathing exercise, 10 repetitions at the edge of the bed For the upper part specific exercise with the elastic band in the armchair, 10 repetition/2 series	Transfer to the edge of the bed, standing, steps next to the bed, armchair- 3 hours
8	Premiere	Global analytical exercise, 10 repetitions in bed Diaphragmatic breathing exercise, 10 repetitions at the edge of the bed For the upper part specific exercise with the elastic band at the edge of the bed, 10 repetition	Transfer to the edge of the bed, standing, steps next to the bed Walked intubated more than 25 meters
9		Global analytical exercise, 10 repetitions in bed Diaphragmatic breathing exercise, 10 repetitions in bed For the upper part specific exercise with the elastic band in bed, 10 repetition/2 series	Transfer to the edge of the bed, standing, steps next to the bed Walked intubated more than 30 meters Armchair 1 hour
10	Handgrip 32,8 kg - normal	Global analytical exercise, 10 repetitions in bed Diaphragmatic breathing exercise, 10 repetitions in bed For the upper part specific exercise with the elastic band in bed, 10 repetition/ 2 series	Transfer to the edge of the bed, standing, steps next to the bed Walked intubated more than 30 meters Armchair 2 hours

Physical therapy/ Day	Assessment	Exercise/ Exercise with an elastic band	Transfer/ Gait
11 - 12		Global analytical exercise, 10 repetitions in bed Diaphragmatic breathing exercise, 10 repetitions in bed For the upper part specific exercise with the elastic band in bed, 10 repetition/2 series	Transfer to the edge of the bed, standing, steps next to the bed Walked intubated more than 30 meters Armchair 2 hours
13 - 27	Tracheostomy Progressive weaning from the ventilator	I continued the therapeutic program adjusting the dosage of the exercises according to the clinical condition of the subject	
28 - 30	Ventilator weaning Handgrip 31,7 kg - normal	I continued the therapeutic program adjusting the dosage of the exercises according to the clinical condition of the subject	Walked without supplemental oxygen

RESULTS

The purpose of this case study was to present the fact that early mobilization and elastic band exercises were efficient solutions for an intubated subject from the intensive care unit. The subject was independent with all functional mobility before his hospitalization, and we managed to keep it. In this study case, the subject has Richmond Agitation Scale 0, which means he was awake, alert, and calm during the whole physical therapy program. He was very cooperative and compliant with the physical therapy program. The communication was greatly facilitated by the fact that the subject was using a smartphone. In this sense, we could start a physical therapy program as soon as the hemodynamic parameters allowed us, and this was since the first day. At the initial evaluation of the muscle force of the upper limb with the dynamometer EH101, the result was 27,6 kg which means weak, after ten days of the physical therapy program we obtained a normal force of 32,8 kg, and the muscle force of the upper limb raised with 5,2 kg. Although at the end of the 30 days of physical therapy, the muscle force of the upper limb tested with the handgrip was a little smaller 31,7 kg. During the 30 days of the physical therapy program, our subject had a lot of difficult periods with hemodynamic and respiratory instability and other complications due to the intensive care unit.

The subject was very cooperative and compliant and with a great communication, we succeed the performance of walking more than one hundred steps with the mechanical ventilation device while the subject was intubated. This was a very important aspect for our intensive care unit because it was the first time when an intubated and mechanically ventilated subject was walking in these conditions. This thing was another important aspect that contributed to the success of weaning from the ventilator in the end. The physical therapy program, the compliance of the subject, and teamwork contributed to the success of weaning from the ventilator.

CONCLUSIONS

In this case study we consider that early mobilization and the elastic band exercises program were effective, safe, inexpensive, and suitable for an intensive care unit**,** and it was the right solution for the success of weaning from the ventilator.

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