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Pulmonary Rehabilitation in the Intensive Care Unit

Mini Review

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Author Details

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Abstract

Pulmonary rehabilitation in the intensive care unit (ICU) has been shown to reduce hospitalization-related complications, facilitate the weaning process from mechanical ventilation, reduce the length of ICU and hospital stay, prevent readmission, and reduce health-related expenses. Pulmonary rehabilitation in ICU patients, as in every patient group, requires a multidisciplinary structure. Patients should be evaluated in every aspect, and optimal treatment should be planned.

Keywords: Pulmonary Rehabilitation; Intensive Care; Physical Therapy; Respiratory Therapy; Ventilator Weaning; Critical Ill

Introduction

Pulmonary rehabilitation (PR) is an evidence-based, multidisciplinary, and personalized treatment approach for symptomatic patients with chronic respiratory disease who often have reduced activities of daily living. The main goals of pulmonary rehabilitation in the intensive care unit (ICU) are to significantly reduce hospitalization-related complications, facilitate the weaning process from the mechanical ventilator (Mv), notably reduce the duration of ICU and hospital stay, prevent readmission, and substantially reduce health-related expenses [1-3]. Pulmonary rehabilitation has become a part of standard treatment in addition to medical treatment in obstructive and restrictive lung diseases, lung malignancies, ventilator-dependent patients, and patients in the preoperative and postoperative periods.

Pulmonary Rehabilitation Practices in ICU

In parallel with technological advances and developments in intensive care, there has been an increase in the number of patients monitored and treated in ICUs. Although follow-up and treatment of patients with various diagnoses are carried out in ICUs with a multidisciplinary approach, significant rates of morbidity and mortality are reported [4-6]. Physiotherapists are also an important part of this team. It is possible to classify pulmonary rehabilitation practices performed in the ICU as mobilization or ambulation, chest physiotherapy and peripheral muscle exercises [7].

Mobilization

Evaluation of ICU mobilization begins with the patient's admission to the ICU, like weaning. Early mobilization of patients reduces the need for MV, length of hospital stay, and mortality. Therefore, every patient in the ICU should be mobilized as early as possible to their current clinical condition. Especially in intubated patients, mobilization may be limited due to respiratory, hemodynamic, and medical problems. It has been reported that the one-year survival rate in patients receiving prolonged Mv support is higher in mobilized patients than in those not mobilized [8]. One of the critical factors determining the mobilization process is the patient's state of consciousness.

Mobilization should be started immediately in conscious patients whose hemodynamic parameters are within normal limits. In-bed exercise programs should be applied to awake patients who need to stay in bed for patient safety reasons. However, active mobilization can be performed with appropriate equipment even in patients undergoing invasive MV [9]. Mobilization should be carried out within a plan, together with pharmacological support such as analgesics and bronchodilators. Adequate analgesia should be provided to every patient, especially postoperative patients. Patient safety should be ensured during mobilization, and accessories such as portable monitors, belts, and walkers should be ready. A healthcare professional should be next to the patient who will direct mobilization and be responsible for ventilator connections.

In-Bed Positioning

In addition to being beneficial in preventing decubitus ulcers, changing in-bed position is a physiological necessity. It is recommended that the patient's position be changed every two hours in the ICU [10]. The patient should regularly be placed in supine, high, side, and prone positions.

Passive-Active Joint Movement Exercises

Passive and active extremity exercises preserve muscle length and strength and reduce the risk of thromboembolism. Several devices are also available as alternatives to manually implementing passive limb exercises. Thanks to these devices, movements such as flexion and extension can be made to the joints at a set time, speed, and angle.

Chest Physiotherapy

Chest physiotherapy is a set of techniques for cleaning secretions and foreign bodies accumulated in the airways. Accumulated secretions increase airway resistance, impaired ventilation, and ventilation-perfusion disorder. Impairment of ventilation can lead to hyperinflation and atelectasis while also increasing the work of breathing. Chest physiotherapy aims to remove secretions accumulated in the airways and prevent atelectasis with appropriate technique.

Respiratory Exercises

Rehabilitation practices, including education and breathing exercises, are as crucial as pharmacological treatment for long-term symptom control in patients with respiratory diseases. These methods are also effective in improving quality of life. One of the most common breathing exercises is inspiratory muscle training through deep breathing. Inspiratory muscle training is a method of expanding and exercising the lungs by maximally moving the rib cage and diaphragm. It has positive effects such as breathing, cough control, and increased lung capacity [11].

Incentive Spirometer

Incentive spirometry is widely used in medical and surgical ICU patients to prevent pulmonary complications. Usually, patients perform 5-10 repetitions of the sequence of slowly breathing deeply, holding the breath for 2 to 3 seconds, and then slowly exhaling. Combining this with coughing is beneficial in clearing lung secretions [12].

Inspiratory Muscle Training

Inspiratory muscle training is a resistance exercise designed to strengthen the inspiratory muscles by providing resistance during inspiration. It is an integral part of the rehabilitation program to facilitate weaning from mechanical ventilation and strengthen respiratory muscles. Inspiratory muscle training uses volume-sensitive devices of different size diameters to provide flow or pressure resistance. Patients may want to wean themselves from mechanical ventilation due to physical discomfort during prolonged intubation. Additionally, improper positioning of the tube may result in the need for increased doses of sedative/hypnotic and opioids. For these reasons, early tracheostomy may be considered in critically ill patients in the ICU to facilitate mobilization. Performing early tracheostomy can reduce the length of ICU and MV stay and reduce ventilator-associated pneumonia and mortality rates. The general benefit of tracheostomy is that it facilitates rehabilitation and improves the quality of life by improving comfort, mobility, and speech [13].

Airway Clearing Techniques

Many invasive and non-invasive methods ensure lung hygiene and airway cleaning. Percussion and vibration are non-invasive methods frequently used for this purpose. It is performed in gravity-assisted positions to assist in secretion clearance. Mechanical energy generated by chest wall manipulations is transmitted to the airways, supporting the loosening and mobilization of secretions. These techniques, combined with endotracheal suctioning, increase airway clearance. Percussions increase blood gas and lung complement without any significant change in mucosal clearance in patients with MV who can cough [14]. Another method used to ensure airway clearance is intrapulmonary percussive ventilation. This mechanical device creates a pulsating effect on the airways. Mucus clearance becomes more accessible through direct high-frequency oscillation at the alveolar level [15]. It has been reported to be beneficial in both acute and chronic phases in patients with respiratory distress, neuromuscular diseases, and pulmonary atelectasis [16,17]. Therapeutic bronchoscopy has also been frequently used in ICUs in recent years, both for sampling and cleaning airway secretions and for guiding percutaneous tracheostomy procedures [18].

Peripheral Muscle Exercises

It has been reported that muscle weakness and atrophy symptoms were observed in half of the patients who stayed in the ICU for more than seven days and underwent MV [19]. The most significant risk for muscle weakness is in patients treated with MV under the influence of sedative and neuromuscular blocking agents. Sepsis, shock, and renal failure are frequently observed in these patients. Atrophy was also detected in the diaphragm biopsy samples of patients who underwent Mv [20].

In another study, it was reported that patients who received controlled MV experienced a 32% decrease in diaphragmatic muscle strength in the first week [21]. Upper extremity exercises aim to replace or slow down functional upper extremity losses in daily living activities during long ICU stays. For this purpose, each exercise should be performed 4-10 times every two days, with 1-3 sets of repetitions, for 6-8 weeks, using free hand weights and lever systems [22]. Contracture is the shortening of periarticular connective tissues and muscles. Despite the early initiation of physiotherapy in the ICU, contractures may develop. Arterial/venous catheters and pressure ulcers can cause contractures and limit movement depending on the site where they occur. When contracture occurs, splinting is the right choice. A dorsi flexion splint should be used for the foot, and a suitably positioned hand splint or glove should be used for the hand [23].

In case of muscle weakness in the ICU, functional activity should be increased to form the basis for long-term treatment. This period can consist of strength, flexibility exercises, functional work, and bedside bicycle ergometers. Analgesia is also crucial in muscle physiotherapy, especially in postoperative patients. Physiotherapy becomes easier with or after pain treatment. TENS (transcuteneal electrical nerve stimulation) is the most well-known method in this group. It has been reported to be beneficial in treating airway obstruction when applied with analgesics [24]. This highlights the pivotal role of physiotherapy in mitigating the effects of muscle weakness and atrophy, empowering healthcare professionals with this knowledge.

Conclusion

In conclusion, pulmonary rehabilitation in ICUs is as crucial as pharmacological treatment and should be planned according to the patient's clinical conditions. In patients followed in the ICU, skeletal muscle loss, respiratory problems, and some psychosocial problems can develop very quickly. Therefore, individualized rehabilitation plans, tailored to the patients' ages, disease processes, and expected recovery rates, can lead to significant improvements. With an individually prepared rehabilitation plan, the length of stay in the ICU and the hospital readmission rate can be reduced, inspiring confidence in the effectiveness of this approach. A multidisciplinary team should be formed, structured quality improvement processes should be used, the necessary equipment should be acquired, and the results should be evaluated holistically.

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