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CRITICAL REVIEW

Physiotherapy in a Burn Patient Admitted in Intensive Care Unit

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KEY WORDS: *Burn patient, Intensive Care Unit, Rehabilitation, Physiotherapy*

Abbreviation List:
HO: Heterotopic Ossification
ICU: Intensive Care Unit
IMT: Inspiratory Muscle Training
MRC: Medical Research Council

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ABSTRACT

BACKGROUND: Early physiotherapy in critically ill patients is a key component to their functional recovery. Burn patients are presented with severe complications that lead to reduced functional ability.

OBJECTIVE: The aim of this paper is to present the effect of physiotherapy in a 22 year old critically ill male patient with a 45% burn of total body surface area, since limited data are presented in the literature regarding the physiotherapy that these patients need during their ICU stay.

METHODS: Early physiotherapy commenced from the early stages of acute illness and involved respiratory and musculoskeletal interventions in order to prevent and address complications from prolonged immobilization and mechanical ventilation.

RESULTS: Significant clinical improvements were noted in the patient during his stay in the ICU. He was successfully liberated from mechanical ventilation and decannulated from tracheostomy tube. Improvements in muscle strength and functional ability was noted once discharged from the ICU to a High Dependence Unit.

CONCLUSION: In the current case study physiotherapy was a vital and effective component of the therapeutic plan of severe burn patient being admitted in a acute care facility and positioning of the upper and lower limbs is of huge importance, in order to minimize and avoid contractures.

INTRODUCTION

Patients with severe burns are often presented with very poor outcomes and survival rates. They are considered to be a major challenge for the Intensive Care Unit (ICU) team and often require a prolonged ICU stay with serious complications. Due to their prolonged ICU stay, burn survivors present with significant physical limitations and reduced function.[1-3] The identification of specific rehabilitation need at each stage of patient recovery is essential in order to reach an optimum independence level. These patients need intensive physical rehabilitation from the early stages of acute illness. Physical pain is being identified as a significant factor that negatively influences survivors' rehabilitation.[4]

PATIENT HISTORY

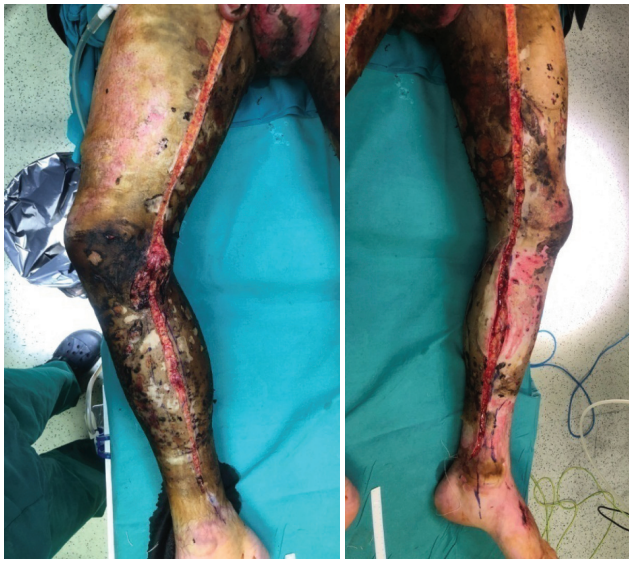
We present the case of a 22 year old male patient with a 45% full thickness burn of total body surface area, who was admitted in the ICU. Burn injury was caused by an explosion. The patient stayed in the ICU for more than 5 months. The burn area was located in the lower limbs, both hands, head and genitals. The patient had a trauma at his right eye. Foreign objects were removed from his face, left eye and right thigh. The objects were removed during the first surgery two hours after the terrorist attack during the escharotomies in the lower extremities.

Burn injuries and skin drafts were carefully handled by plastic surgeons, who also performed the overall care. On the second day after the explosion the patient was operated on and eschatectomy of the full thickness burns was performed. The revealed subcutaneous fat was covered with artificial dermis (integra).

Tracheal broncheal tree was free from smoke as indicated by bronchoscopy. Tracheotomy was performed on the 19th day of ICU admittance and weaning process commenced. On the third surgery, necrosis of the anterior/extensor compartment of the right leg was revealed, followed by an exclusion of all the necrotized muscles. Artificial dermis was used to cover the gap.

Drop foot deformity was present on the right lower extremity. Skin graft covering was performed in six different operative procedures according to the availability of skin on the thorax and abdomen of the patient, and all the grafts were successfully taken.

During his long ICU stay the patient often developed infections primarily from the respiratory system that interrupted the weaning process. Clinical improvement through the administration of a wide range of antibiotics enhanced his withdrawal from control to support ventilation and tracheotomy mask. An intensive physiotherapy program involving both the respiratory



FIGURES 1 and 2. Right and left foot after escharotomies.

FIGURE 3. Necrosis of the anterior/extensor compartment of the right leg.

FIGURE 4. Covered loss of the anterior/extensor compartment of the right leg with artificial dermis.

and musculoskeletal system assisted his gradual rehabilitation that led to his discharge from the Intensive Care Unit.

PHYSIOTHERAPY INTERVENTION

Physiotherapy commenced once the patient was medically stable and following written medical referral.

1. PATIENT IN THE ICU UNDER MECHANICAL VENTILATION

ASSESSMENT

Once the patient was referred for physiotherapy, a thorough and detailed assessment was carried out in order to identify the main problems and risks, set the appropriate goals and decide on the most suitable interventions. Physiotherapy assessment of the respiratory and cardiovascular system was performed regularly due to his critical condition whilst, neuromuscular assessment was performed in a weekly basis according to the plastic surgeon's instructions.

RESPIRATORY SYSTEM

During the acute stage the patient was sedated and under mechanical ventilation. Tracheotomy was performed at the 19th day of ICU admittance. His trunk, abdominal and lower limbs were covered with bandages due to extensive burn injuries, or due to the collection of skin grafts.

Aims of physiotherapy

During the acute stage of illness caution was given in:

- The maintenance of clear airways.
- Prevention and management of atelectasis .
- Improvement of pulmonary ventilation.

Once sedation was minimized and patient was awake and co-operative, attention was given to:

- Minimizing the effects of control ventilation on respiratory muscles.
- Assisted cough and re-education.

Physiotherapy interventions included:

- Patient positioning and postural drainage in order to mobilize secretions from the tracheal bronchial tree and maintain clear airways.
- Chest percussions were performed only to areas of the trunk with intact skin with great caution.
- Nebulazition and humidification.
- Manual hyperinflation
- Inspiratory Muscle Training(IMT) in order to assist weaning from mechanical ventilation[5] (Fig. 6)

MUSCULOSKELETAL SYSTEM

During the acute phase, upper limb range of motion was assessed passively and there were no restrictions. Regarding the lower limbs which were wrapped with bandages, reduced joint mobility was recorded. However, according to the patient's pre morbid history, there were no functional restrictions.

Once the patient was awake and co-operative, active range of motion and muscle strength was assessed. The ongoing physical pain is a significant factor that often limits the rehabilitative interventions, especially those of passive mobility that

FIGURE 5. Loss of the anterior/extensor compartment of the right leg with artificial dermis completely covered by artificial dermis and scar tissue.

FIGURE 6. Inspiratory muscle training performed with the Threshold IMT inspiratory muscle trainer (Threshold IMT device HS730; Respironics). The patient commenced with a load of 30% of Maximum Inspiratory Pressure (MIP) and increasing it daily by 10% of MIP. They performed 5 sets of 10 breaths (with one to two minutes of rest with ventilation support between each set).

are essential for the prevention of contractures. Williams et al (2003) indicated that patients with severe burns experience pain in different ways. Although passive range of motion was restricted due to severe physical pain, it was noted that both shoulder abduction and flexion along with elbow flexion were restricted in both arms (20˚ shoulder abduction/30˚ shoulder flexion and 20˚ elbow flexion). Regarding lower limbs, once plastic surgeons requested mobilization, significant joint restrictions were noted in both active and passive range of motion, without accurate measurements due to the graft immobilization and extensive applied pressure bandaging. Muscle strength was severely reduced both in the upper and lower limbs, possibly due to the physical pain of the patient was experiencing during movement.

Aims of physiotherapy:

During the acute phase, while the patient was sedated:

- Maintenance of range of motion.
- Prevention of skin and tendon contractions along with long term deformities
- Reduction of oedema
- Prevention of deep venous thrombosis

Once patient was awake and co-operative, caution was placed in minimizing muscle atrophy and weakness.

Physiotherapy innervations included:

- Patient and limb positioning
- Passive range of motion and safe stretching along with elongation of the affected areas
- Limb elevation
- Assistive exercises

Although positioning of the upper and lower limbs is of huge importance, in order to minimize and avoid contractures, it was not fully applied as described by clinical guidelines[6] since the general ICU where the patient was admitted didn't have the appropriate bed that could allow such techniques to be performed, despite the plastic surgeon's advice. Additionally, splitting was considered once a decreased range of motion was noticed. It has been reported by Richard et al that the practice of splitting was delayed at a 40% of cases and was not routinely used at 21%.[7]

2. PATIENT IN THE ICU WITHOUT MECHANICAL SUPPORT

The patient was gradually switched from control ventilation to pressure support and later on was disconnected and applied tracheostomy venturi mask. Once the patient was weaned from mechanical ventilation, he was transferred to the step down unit where the tracheal tube was removed and tracheostomy closure was achieved.

Physiotherapy Assessment:

- Sedation was discontinued, the patient was under analgesics and anti-depressant treatment
- Occasional lung atelectasis (mostly at the basal lobes)
- Bilateral shoulder and elbow stiffness and reduced range of motion (upper limb: 35˚ shoulder abduction/35˚ shoulder flexion and 30˚ elbow flexion-lower limb: 30˚ hip flexion/ 20˚ hip abduction and 30˚ knee flexion) with intense pain produced at all movements. Pet scan images revealed Heterotopic Ossification (HO) in both shoulder, elbows and ankle joints (Fig. 7).
- Bilateral foot drop.
- Claw hand deformity.
- Reduced muscle strength (Tab. 1).

Aims of physiotherapy:

Regarding the respiratory system, the aims are the same as when the patient was on mechanical ventilation. More effort and work was placed on improvement of pulmonary ventilation and management of the secretions in order to facilitate weaning from mechanical ventilation and removal of the tracheostomy tube.

Regarding the musculoskeletal system:

- Maintenance of functional pain free range of motion in the affected with heterotopic ossification joints.
- Prevention of foot deformities and progressively recovery of foot drop.
- Muscle strengthening.
- Reinforcement of upper limb functional recovery.
- Functional recovery of the hand

Physiotherapy interventions

The rehabilitation program progressed and it was enriched with more techniques including:

- Thoracic expansion exercises.

FIGURE 7. Pet scan examination indicating the formation of heterotopic ossification in both shoulder and elbow joints.

TABLE 1. MRC score for muscle strength measurements

MRC assessment	1st		2nd		3rd	
	Left	Right	Left	Right	Left	Right
Shoulder abductors	1	1	2	2	3	3
Elbow flexors	2	2	3	3	4	4
Wrist extensors	1	1	2	2	2	2
Hip flexors	0	0	2	2	2	2
Knee extensors	0	0	2	2	2	2
Plantar extensors	0	0	0	0	0	0
Total score:	8		22		26	

MRC: Medical Research Council.
1st assessment was performed once patient was fully awake and co-operative. Lower limb assessment was not allowed by physicians due to the incomplete healing process.
2nd assessment once plastic surgeon requested the mobilization of lower limbs.
3rd once patient was transferred from the ICU to the step down Unit. Assessments were performed at the pain free range of motion in order for resistance to be applied when needed.

- Proprioceptive neuromuscular facilitation techniques along with functional exercises in order to enhance functional recovery.
- Ankle mobilization, calf stretching and maintenance of foot in a neutral position with different wedges.
- Transfer to seated position and sitting balance exercises.
- Progression of exercises from assistive to active and resistance in order to enhance muscle strengthening.
- Functional exercises that included grasping, moving and releasing objects.

Early ambulation, although important[8], was not possible in the patient due to his severe burns in the lower limbs.

DISCUSSION

The current case study presents a patient who was hospitalized in the ICU for several months following a serious burn injury and attempts to highlight the significance of early physiotherapy. Burn patients are quite challenging due to their long term physical complications.[9] Although, the patient was not admitted to a specialised Burn Unit, he received intensive respiratory and musculoskeletal physiotherapy in order to minimize complications and augment his recovery.[10] It is well established that early physiotherapy and mobility interventions are important to the recovery of critical ill patients.[11] Once patient was weaned from mechanical ventilation, increased attention was given in his functional rehabilitation, through therapeutic exercises, taking into consideration complications[9] that were present due to the injury and a certain immobility period, at the beginning of his admission. It has been noted that the appliance of mechanical stretch through therapeutic exercises has a positive effect in scar deformities and loss of joint's range of motion.[12] The main barrier to extensively apply such interventions is pain, something that was our biggest obstacle as well.[13]

Additionally, it has been noted that in patients with extensive burns, the rate of neuropathy was found to range from 11% to 41% which could be presented as mononeuropathy or even polyneuropathy.[8,9] These conditions along with a long term disuse of limbs could be responsible for the presence of severe weakness. Thus, a thorough assessment of muscle strength and an early onset of active exercises are of high importance. Taking into consideration how painful are these interventions, it is of no surprise how long it took to our patient to increase his muscle strength. Heterotopic Ossification is another pathology that although it's not common (1,2% in elbow joint[9]) should be considered. Unfortunately, the pathophysiology, incidence and risk factors of HO remain poorly understood in burns. A recent review indicated that burn patients who have prolonged immobilisation, and patients who receive aggressive physical therapy, are both at greater risk for the development of HO,[14] giving rise to severe considerations. A controversy seems to also exist regarding the role of exercises and stretching in treatment of HO.[14,15] Little evidence are presented in order to confirm whether stretching should be limited to the pain free range of motion , or if aggressive range maintenance and stretching techniques can be applied to optimize post-HO functional outcomes.[9]

Although, this is a case study, we believe that it may con-

tribute to clinical physiotherapy practice in patient with burns since publications referring to early rehabilitation of burn patients in the ICU are lacking. This case study also, tried to highlight the numerous complications that a burn patient could face during his/her stay in the ICU and the long period of rehabilitation that is needed. Further research is needed, as most of the published data come from observational studies, in order to establish the importance of early physiotherapy in critically ill patients with extensive burns.

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