Bangladesh Crit Care J September 2015; 3 (2): 63-66

Review Article

Physical Rehabilitation in the ICU

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Abstract :

Intensive care unit (ICU) based rehabilitation has become an important evidence-based component in the management of patients with critical illness. In addition to critical illness, prolonged bed rest and immobility may lead to severe physical deconditioning and loss of muscle mass and muscle weakness. Intensive care unit acquired weakness is associated with increased duration of mechanical ventilation and weaning, longer ICU and hospital stay, and increased mortality. These physical impairments may last for years after ICU discharge. Early Physical Medicine and Rehabilitation (PM&R) interventions in the ICU may attenuate or prevent the weakness and physical impairments occurring during critical illness. This article reviews the effects of prolong bed rest and inactivity, early PM&R interventions, their safety, feasibility, benefits and future directions for early PM&R in the ICU.

Introduction :

Advances in critical care have resulted in reduction of intensive care unit (ICU) mortality. As a consequence, there are a growing number of ICU survivors living with long-term sequelae of critical illness, such as impaired physical function and quality of life[1]. In addition to critical illness, prolonged bed rest and immobility lead to a loss of muscle mass and muscle weakness[2]. At complete bed rest, muscle lose 10 to 15% of strength per week, and 50% in 3-5 weeks. In two months, muscle bulk may shrink to half the original size[2]. The histological changes seen in muscle by electron microscopy after six weeks of immobilization are fiber degeneration and an increased proportion of fat and fibrous tissue[2]. Reduced capacity of the musculoskeletal system will produce weakness and disuse atrophy, which will eventually affects on cardiovascular and respiratory function[2]. The assessment and treatment of these patients should include a focus on prevention and treatment of deconditioning (muscle weakness, joint stiffness, impaired functional performance) and weaning failure (respiratory muscle weakness).ICU based rehabilitation has become an important evidence-based component in the management of patients with critical illness[3]. Early Physical Medicine and Rehabilitation interventions may attenuate or prevent the weakness and physical impairments occurring during critical illness[4].

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Effect of prolong bed rest and inactivity

Skin : Pressure sore.

Musculoskeletal : Muscle weakness, atrophy, contractures, osteoporosis

CVS : cardiovascular deconditioning, postular hypotension and thromboembolic phenomena.

Respiratory : ventilatory dysfunction, URTI, hypostatic pneumonia

Genito urinary : calculi and UTI

Nervous system : intellectual dysfunction, anxiety, depression

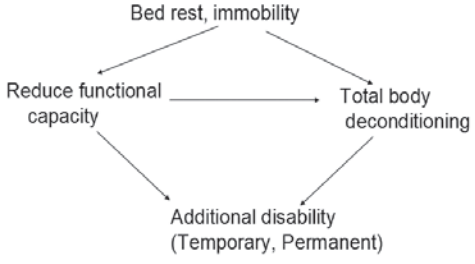

Figure 1: Effect of prolong bed rest and inactivity

PM & R interventions for bed ridden patients

1. Bed positoning
2. ROM (Range of Motion) exercise
3. Therapeutic exercises
4. Respiratory care
5. Prevention of pressure ulcers
6. Prevention of DVT

Bed positioning:

The prevention and treatment of contractures through an effective bed positioning program is contingent upon proper equipment, a well trained and well motivated nursing stuff and appropriate physicians order[5].

It is the physician's duty to see that these bed positioning orders are carried out routinely on a daily basis by nursing personnel[6] .

In the supine position the feet are positioned with the entire planter surface firmly against the foot board. Contact with the posterior heel is avoided by placing it in the space between the mattress and the footboard. The legs are placed in a neutral position with the toes pointed towards the ceiling. A trochanter roll placed under the greater trochanter (figure 2). The knee and hip are positioned in extension.

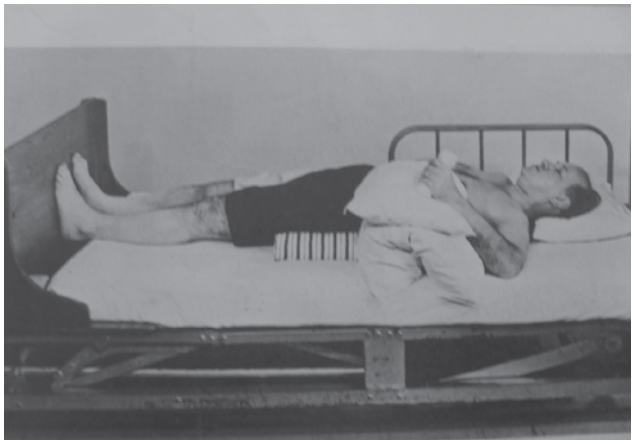

Figure 2: Routine positioning of lower extremities plus one possible arm position

Upper extremities, nurses should be cautioned to position only within the painless or nonresistive range of motion. Spasticity must be differentiated from other forms of resistance to joint motion.

Position 1: The shoulder is abducted to 90 degree and slightly internally rotated , the elbow is at 90 degree and forearm is partially pronated (figure 3).

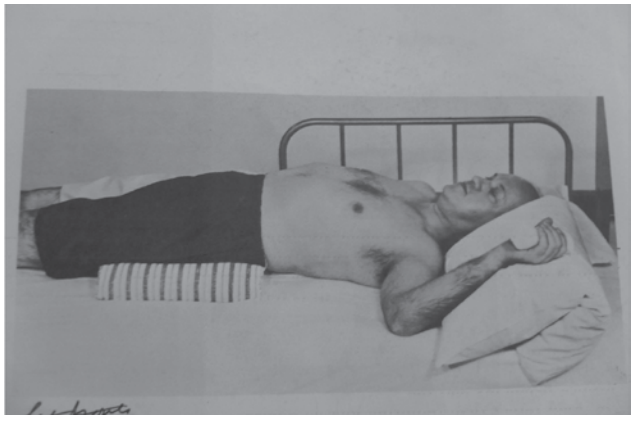

Figure 3 : Use of trochanter roll plus position of upper extremities

Position 2: The shoulder is abducted to 90 degree or more and externally rotated to the greatest degree compatible with comfort .The elbow is flexed at 90 degrees and the forearm is supinated (figure 3).

Position 3: The shoulder is in slight abduction, the elbow extended and the forearm supinated. The wrist is extended, the fingers are partially flexed. Maintenance of these positions are facilitated by the use of a hand roll (figure 4). In another position, fingers are in extended and it is maintained by using a splint. In side lying position: Hemiplegic patients are most comfortable lying on their uninvolved side[5] (figure 5). Paraplegics and quadriplegics should be positioned on either side when they can tolerate it.

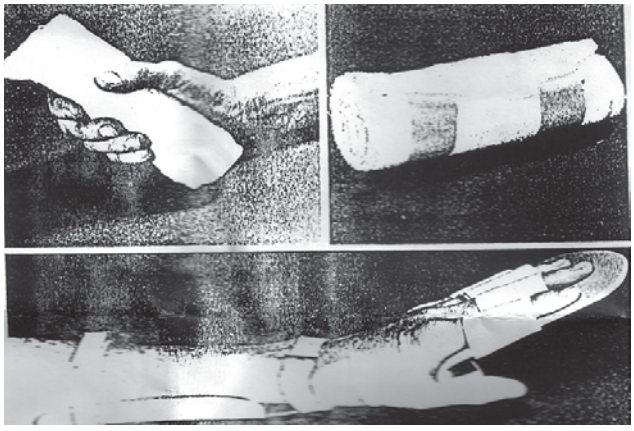

Figure 4: Hand roll and splint

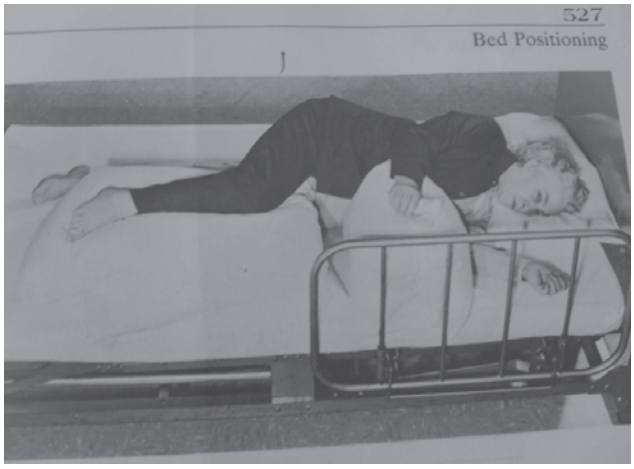

Figure 5: Side-lying position

Range of motion exercise :

It is the duty of nursing personnel to perform passive range of motion exercise to prevent contracture, even though sometimes these exercises may also be carried out by the physical therapist[6]. It is the physician's duty to see that these exercises are ordered to be carried out routinely, on a daily basis by nursing personnel[6]. It should be pointed out that a distinction should be made between passive range-of –motion exercises that are performed by nursing personnel to prevent contractures and the stretching exercises for correction of contractures; the latter are usually performed by trained physical therapist[6]. Dynamic splinting or serial casting is an approach that may be used if prolonged passive stretch does not produce the desired results.

Therapeutic exercises :

Therapeutic exercises for all muscle groups in the extremity: active assistive, active, active against gravity and finally active

resistive exercise. The patient is being ambulated while on mechanical ventilation with the assistance of a physical therapist, nurse and a physical therapy technician[1].Early PM&R interventions are safe, even for mechanically ventilated patients[1]. PM&R has been consistently associated with improvement in patients' mobility and physical function[1].

Pressure ulcers :

Pressure ulcers have been challenging societies for centuries. Despite new understanding of wound causation and management, the pressure ulcer problem continues to be a significant health care concern. Pressure ulcers develop in response to a number of factors. These factors can be thought of as primary and secondary. Pressure, shear and friction are the three primary factors. Secondary factors include mobility, status, sensory motor function, nutrition, age, diabetes, faecal and urinary incontinence etc. The most common sites for pressure ulcers are the ischium, sacrum, greater trochanter of the femur and the heel.

Staging of Pressure ulcers:

Stage 1 : Non-blachable erythema.

Stage 2: Partial thickness loss of skin involving epidermis.

Stage3 : Full thickness destruction through dermis into the subcutaneous tissue.

Stage 4: Deep tissue destruction.

Strategies to prevent pressure ulcers:

1. Patient should have their position turned every 2 hours.
2. Patient can be benefited from lying prone.
3. Minimize shearing forces by keeping the head of the bed lower than 45 degree.
4. Air fluidized bed.
5. Pressure relieving cushions of air, foam gel or a combination can be used.
6. Nutritional support.
7. Hygiene and good skin care.
8. Correct positioning.

Treatment Guidelines:

Non-operative for stage1 and stage 2.

Surgical interventions are required for stage 3 & 4.

Respiratory care:

All patents immobilized in bed can benefit from instructions in coughing and breathing exercises (figure 6). The patient with a poor cough and widespread pulmonary secretions who is confined to bed, hourly turning from side to side, coughing may be inadequate to manage secretions.

Airway secretions can precipitate life threatening bronchial mucus plugging and acute respiratory failure. This is also true for intubated or tracheostomized patients. Airway secretions are specially profuse and hazardous after the translaryngeal extubation of patient.

There is over reliance on airway suctioning. Airway suctioning via the nose or mouth is ineffective and poorly tolerated. Suctioning via an endotracheal tube does not mobilize deep secretions and has many potential complications. In adults the suction catheters also usually fails to enter the left main stem bronchus. It irritates airway membranes, induces airway edema and wheezes, and necessitates further bronchial suctioning and cleansing of the tracheostomy site itself. Mucus plugs that adhere to the cuff or the wall of a tube cannot be suctioned and may eventually plug a bronchus causing atelectasis or airway collapse.

Chest percussion and postural drainage are most widely prescribes method used to facilitate airway secretion.

In the acutely ill patient, chest physical therapy may be given as frequently as every two hours[8]. For routine treatment given two to four times daily, the following sequence and procedures are ordered.

1. **Mist inhalation (20 min).** This will moisten the upper airways and help liquefy secretions. The mist may be cold for febrile patients but preferably is heated to deliver more water. Usually the carrier gas is oxygen–enriched air. Administration via a mask or into a tent may be by humidifier or nebulizer. Instruction for breathing exercises and cough control can be given at this time, if it is convenient for the physical therapist.
2. **Intermittent Positive Pressure Breathing (IPPB) (15min)** It results an increase in lung expansion. IPPB also provides an effective means of delivering bronchodilator, decongestant and mucolytic agents to the airways and in addition, continues to add moisture.
3. **Chest Physical Therapy (20 min)** After the mist and IPPB are given, postural drainage, combined with vibration and percussion, usually produces good results in cleaning secretions.

B) Deep breathing and insufflation.

C) Maintenance of respiratory muscle strength and endurance.

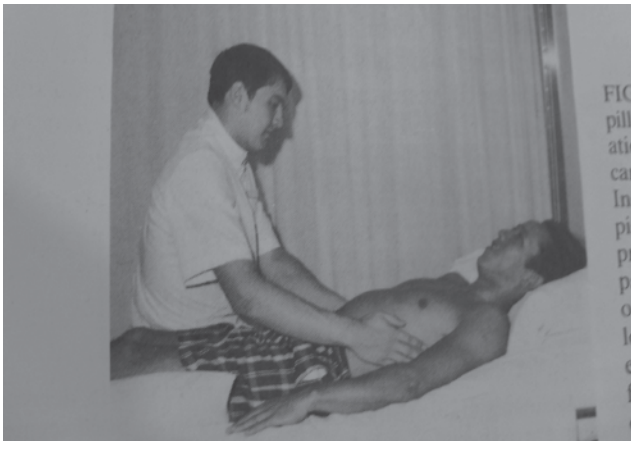

Figure 6 : Costal expansion breathing

Deep vein thrombosis:

Patient undergoing neurosurgical procedures, spine or prosthetic surgery should receive intermittent pneumatic leg

compression devices, low dose heparin, full length elastic stoking, abdominal binders and intermittent active exercises of the calf, thigh and abdominal muscles[2].

PMR appears to confer significant benefit in improving quality of life physical function, peripheral and respiratory muscle strength increasing ventilation free days and decreasing hospital stay [9].

Conclusion :

Muscle weakness and impaired physical function are common and long lasting complications of critical illness. Currently, there are limited interventions to prevent these complications. However, in recent years, there is growing evidence that early PM&R are feasible, safe, and beneficial in critically ill patients. Such early interventions result in better functional outcomes at hospital discharge with further studies needed to evaluate the potential long term benefits.

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