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Effects of motor physical therapy in critically ill patients: literature review

Efeitos da fisioterapia motora em pacientes críticos: revisão de literatura

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ABSTRACT

The development of critical patient-related generalized weakness is a common complication in patients admitted to an intensive care unit. The reduced muscle strength increases the time for weaning, hospitalization, the risk of infections and consequent mortality. Physiotherapy is used in these patients as a resource for the prevention of muscle weakness, atrophy and functional capacity recovery. The aim of this study was to review the literature regarding the use of exercise alone in intensive care units staying patients. Literature searches were performed using the electronic databases Medline, LILACS, CINAHL, Cochrane, High Wire Press and SciELO, from January 1998 to July 2009 and book chapters, using keywords including “critical illness”, “cinesiotherapy”, “physical therapy”, “physiotherapy”, “exercises”, “training”, “force”, “active mobilization”, “mobilization”, “ICU”, “rehabilitation”, “mobility”, “muscle strength” and “weakness”. Despite the lack of studies and methodological diversity of studies found, confirming the use of exercise alone as a therapeutic resource, its use, including early seems an alternative to prevent and reverse muscle weakness intensive care unit ICU-acquired.

Keywords: Cinesiotherapy; Physical therapy modalities; Muscle weakness/rehabilitation

INTRODUCTION

Therapeutic exercise is considered central for most physiotherapy schedules aimed to improve physical function and reduce disabilities. They include a wide range of activities aimed to prevent complications such as shortenings, muscle weaknesses and bone/joint deformities, reducing health care resources use during hospitalization or following a surgery. These exercises improve or preserve healthy subjects’ physical function or health status, and prevent or minimize their future impairments, functional loss or disability.(1)

The development of critical patient-related generalized weakness is a major complication common to may patients admitted to an intensive care unit (ICU).(2) Its incidence is between 30% and 60% of the ICU patients.(3) Additionally to their previous conditions, several factors may contribute to weakness such as: systemic inflammation, use of drugs such as corticoids, sedatives and neuromuscular blockers, uncontrolled blood glucose, malnutrition, hyperosmolarity, parenteral nutrition, mechanic ventilation duration, and prolonged immobility.(4-6)

Immobilization affects the musculoskeletal, gastrointestinal, urinary, cardiovascular, respiratory and skin systems.[7] Disuse, such as during rest, inactivity or limbs or body immobilization and nervous losses in diseases or injuries promote muscle mass, strength and endurance decline. With total immobilization, muscle mass may be reduced by one half in less than two weeks, and when associated with sepsis, decline daily up to 1.5 kg.[7,8] Experimental trials in healthy subjects showed weekly up to 4% - 5% muscle strength loss.[9] In cases with destroyed nerve to muscle connection, muscle atrophy is even faster.[7] The connection between hypoglycemia and weakness may be related to its toxic effects, which is counteracted by the neuro-protective and anti-inflammatory insulin effects.[10]

All these factors associated contribute for prolonging the ICU stay, result in increased risks of complication, mortality and costs.[2,11-15] Emotional disorders such as anxiety and depression increase the hospital stay, physical deficits, and may affect the function and consequently the one to seven years after the event patient's quality of life, entailing social impairment.[13,14,16]

Early intervention is required to prevent both physical and psychological issues. Therapeutic activity should be started early to prevent prolonged hospitalization and associated immobilization risks,[17] and may be one of the keys for patient's recovery.[14]

The critically ill ICU patient bears severe motor restrictions. The appropriate positioning in bed and early mobilization may mean unique opportunities for the subject's interaction with the environment, and should be considered as sensorial-motor stimulation sources, and prevention of complications secondary to immobilization.[11,14,17]

There are few studies approaching the role of kinesiotherapy role in critically ill patients, initially seen as "too ill" or "too clinically unstable" for mobilization interventions.[18] Nevertheless, therapeutic exertion show benefits, specially when started early, although approaches diversity.[15] Postponing start of exercises only worsens the patient's disability.[18]

After discharge from the ICU, the patients have disabilities lasting for up to one year, being unable to go back work due to persistent fatigue, weakness and poor functional status.[19] Rehabilitation has a potential to restore functional status, but sometimes is only started after discharge from the unit, that is, too late.[11] Early ICU kinesiotherapy has been shown to be safe and feasible, and can be either passive or active, according to the patient's interaction, hemodynamic stability, ventilatory support level, inspired oxygen fraction (FiO_2) and response to therapy.[11,15,20,21]

Physical training in an ICU is a logical rehabilitation extension, and has been shown a key critical care component.[13] Exercises offer well-established physical and psychological benefits, and additionally reduce the oxidative stress and inflammation, due to increased anti-inflammatory cytokines production.[6] Previous studies have shown that in most times, after discharge from the hospital, patients with reduced body function will need a training schedule.[22]

This study aims to review the publications on kinesiotherapy and its effects in ICU staying patients, analyzing the methodologies and their results in ICU immobilized subjects.

METHODS

The literature research was performed in the electronic databases MedLine, LILACS, CINAHL, Cochrane, High Wire Press and SciELO, for the period between January 1998 and July 2009.

The key works used, in different combinations, were: "critical illness", "cinesiotherapy", "physical therapy", "physiotherapy", "exercises", "training", "force", "active mobilization", "mobilization", "ICU", "rehabilitation", "mobility", "muscle strength" and "weakness".

The search was limited to English, Spanish and Portuguese languages, with studies in 19 years or older adult humans, and published in the last 10 years. Academic publications abstracts were not included.

The titles and abstracts were analyzed to identify articles potentially relevant for the review.

RESULTS

Ten studies considered relevant for the review were identified. These are chronologically shown in Chart 1.

Martin et al.[23] evaluated in a retrospective analysis the weakness prevalence and magnitude in prolonged mechanic ventilation patients, and the impact of a rehabilitation schedule on the variables weaning, muscle strength and functional status. This schedule included trunk control, passive, active, active-resisted, with thera-band and weight exercises,

Chart 1- Studies summary

Author/Year	Type of study	Sample	Intervention	Main analyzed variables	Relevant results
Nava (1998)[24]	Prospective, randomized, controlled	Exacerbated COPD n=60 (intervention group); n=20 (control group)	Passive movements, early walking, respiratory muscle (threshold) and lower limbs training. Lower limbs training in ergometric bicycle, stair climbing and treadmill.	ICU stay time, TC6 walk distance, dyspnea and inspiratory muscle power.	TC6 improvement, Pimax increase, reduced dyspnea by VAS.
Zanotti et al. (2003)[28]	Randomized, controlled	Bed restricted COPD n=12 (intervention group), n=12 (control group)	Control = kinesiotherapy and Intervention group = kinesiotherapy + 30 min FES	Muscle strength, cardio-respiratory function, nr days for bed to chair transference.	Improved peripheral muscle strength in both groups, and less days for transfer from bed to chair in intervention group
Martin et al. (2005)[23]	Retrospective analysis	Various diagnosis patients, n=49 MV 14 days or more, 2 consecutive weaning failures	Progressive physiotherapic exercise, from trunk control to walking, going up and down stairs, TMR with threshold	Limbs and respiratory muscles strength, function (transference, locomotion, up/down stairs FIM) and weaning time.	Increased peripheral muscle strength, improved FIM and reduced weaning time. Gain of 1 score point in upper limbs muscle strength lead to 7 days reduction on weaning time.
Porta et al. (2005)[25]	Prospective, randomized, controlled	Various diagnosis, weaned 46-96 hours, n=32 (intervention group) and n=34 (control group)	Control group = kinesiotherapy and intervention group = kinesiotherapy + upper limbs cycloergometer training	Inspiratory muscle strength, dyspnea degree, muscle fatigue perception.	Reduced dyspnea and muscle fatigue, improved inspiratory muscle strength
Chiang et al. (2006)[22]	Randomized, controlled	Various diagnosis patients, n=17 (intervention group) and n=15 (control group), MV for more than 14 days	Kinesiotherapic exercises for upper and lower limbs; functional training on bed, walking, TMR with spontaneous respiration evolution.	Respiratory and limbs muscle strength, function (FIM and Barthel) and MV-free time	Increased peripheral muscle strength, improved FIM and Barthel, increased MV-free time.
Vitacca et al. (2006)[26]	Prospective, controlled	COPD patients with difficult weaning (n=8 (tracheostomized) and MV for 15 or more days	Aerobic training with upper limbs cycloergometer (incremental and endurance) in T piece and PSF	Cardio-respiratory ability (SpO2, dyspnea, tidal volume, respiratory and heart rate) and intrinsic PEEP	The dyspnea for both groups (PSF and T piece) was similar. Other variables had better values in VSP
Bailey et al. (2007)[21]	Prospective cohort	Various diagnosis patients, n=103 under MV for more than 4 days	Progressive activities, since trunk control to walking, early started	Seating by bed side without support, seating in chair after transference from bed and walking with or without assistance.	4.7% patients seated by the bed side, 15.3% seated on chair, 8.2% walked less than 100 feet (3048 cm) and 70% were able to walk more than 100 feet (3048 cm) before discharge.

Continued...

Chart 1 - Continuation

Author/Year	Type of study	Sample	Intervention	Main analyzed variables	Relevant results
Morris et al. (2008)[15]	Prospective cohort	Various diagnosis patients, 3 days from admission and at least 48 hours IOT, n=165 (control group) and n=165 (intervention group)	4 levels protocol. Passive movements, active-assisted and active (functional challenge without weights), seating on bed, seating balance, weight discharge standing, transference from bed to chair (vice-versa) and walking	Number of days stay (ICU and hospital), hospital costs, number of days for leaving bed for the first time.	Reduction of hospital days, reduced hospital costs, and less days for the leaving bed for the first time in the intervention group.
Needham (2008)[9]	Case report	One severe COPD patient	Early walking, from 4^{th} TOT day (patient under MV) for 6 weeks	Sedation level, early mobilization and walking by physiotherapy at ICU and quality of life after discharge	Improved self-esteem, and self perceived function status
Burtin et al. (2009)[27]	Randomized, controlled	Various diagnosis patients, ICU stay expected for 7 or more days, n=45 (control group) and n=45 (treatment group)	Respiratory physiotherapy, passive or active mobilization for lower and upper limbs, both groups. In the treatment group, additionally cycloergometer for the lower limbs|inferiors.	TC6 and SF-36 (by hospital discharge), palmar grip, isometric quadriceps strength (portable dynamometer), functional status (Berg scale), weaning time, ICU and hospital stay time, and mortality at 1 year after discharge	Increased quadriceps strength, improved function and self-perceived function status in the treated group.

COPD – chronic obstructive pulmonary disease; TC6 – 6 minutes walk test; VAS – visual analogic score; FES – functional electrical stimulation; MV – mechanic ventilation; TMR – respiratory muscle training; FIM – functional independence measurement score; SpO_2 – peripheral oxygen saturation; PSV – pressure suport ventilation; TOT – orotracheal tube ; ICU – intensive care unit; SF-36 - Quality of life inventory.

cycloergometer, seating/standing training, stationary march, parallel bars walking and stairs climbing, 5 times weekly, with 30 to 60 minutes duration. After the rehabilitation schedule significant improvements were identified such as increased upper and lower limbs strength, transferences ability, locomotion, going up and down stairs, and the weaning time. This in turn was directly correlated with gain in upper limbs strength. For each point gained in the muscle strength scale (Medical Research Council), a seven days time to weaning reduction was seen.

Chiang et al,[22] in a prospective, randomized, controlled trial, identified the effects of six weeks exercises for respiratory, upper and lower limbs strength, also in patients under prolonged mechanic ventilation, evaluating the strength with a dynamometer and the function in two scales, Barthel and Functional Independence Measurement (FIM) score. The program was developed five times weekly and consisted in thresholds training respiratory muscle strength, and for the limbs, with active, resisted and using weights movements, functional training and walking. The treatment group strength and functional status improved significantly versus the control group, where both strength and function decline were seen, as no intervention was provided. The intervention group had also reduced mechanic ventilation time.

Nava et al.[24] developed a seven weeks training program consisting in four different progressive difficulty steps. Steps I and II were common to both groups, consisting of a basic walking program. Steps III and IV were applied only for the intervention group, with lower extremities training. After seven weeks training, 87% of the chronic obstructive pulmonary disease (COPD) patients in the intervention group, who were recovering from acute respiratory failure (ARF) were able to walk with or without assistance, versus 70% in the control group, being that by the entry time, all were restricted to bed.

Morris et al.[15] in a prospective cohort study of a kinesiotherapic exercises protocol, among others aimed to compare a group of protocol subjects to a usual care control group. This consisted of passive bed movements and decubitus changes every two hours. The protocol was divided in four levels. Level I was conducted on the still unconscious patient, passively moving all joints but shoulder and hip extension, restricted by the position. On Level II, where the patients were already able to respond to verbal orders, in addition to the passive movements, active-assisted, active or active-resisted movements were performed, according to the strength degree, and also seating in the bed. On Level III, the exercises aimed to strength the upper limbs, and were performed with the patient seating by the bed side. Weights use was not included in the protocol, being added functional challenges according to the development. On the fourth level, were trained transference from bed to chair (and vice-versa), seating balance activities, weight discharge with the patient standing, and walking. No intercurrence was seen during the protocol implementation, being it rated as safe and effective. The intervention group had gains regarding the number of days to the first time leaving bed, hospitalization days and hospital costs.

Two of the studies, Porta et al.[25] and Vitacca et al.,[26] used an upper limbs cycloergometer for cardio-respiratory ability evaluation and treatment. The incremental test, which is symptom-limited, i.e., addition of a load per minute and the patient lead to exhaustion, only stopped before this threshold if heart rate reached the limit, or electrocardiogram changes were seen. The endurance test was performed with 50% of the peak load reached in the incremental test, and was also ended with patient-reported exhaustion.

In the Porta et al.[25] study, the upper limbs cycloergometer was added to kinesiotherapy in the intervention group for 20 minutes daily for 15 days , with 2.5 W/day increases/reductions according to the modified Borg scale and rest pause. The intervention group had a significant improvement versus the control group. Vitacca et al.[26] evaluated the effects of cycloergometer in the upper limbs in with and without pressure support ventilation (PSV) patients, also using the modified Borg scale to quantify the dyspnea and upper limbs discomfort, and concluded that this variable was similar for both groups. Other variables as respiratory rate, peripheral oxygen saturation (SpO_2), tidal volume, heart rate, intrinsic positive end-expiratory pressure, had better values with PSF.

Burtin et al.[27] investigated if daily exercise sessions with lower limbs cycloergometer, still on bet, would be safe and effective for prevention or attenuation of exercise performance, functional status and quadriceps strength. The control group therapy consisted of respiratory physiotherapy and upper and lower limber active or passive movements, depending on the patient's sedation degree, five times weekly. Walking was started as soon as deemed safe and appropriate. The treatment group received, additionally, daily 20 minutes long exercises sessions with increasing resistance levels. Sedated patients had fixed 20 cycles/minute frequency, while those able to help had their sessions divided in two 10 minutes times, plus intervals when needed. Each session the training intensity was evaluated and resistance increase tried, according to the patient's toleration. A statistically significant improvement was seen in treatment versus control groups respecting the evaluated variables, i.e., increase of function recovery, increased quadriceps strength, and improved self-perceived functional status. Independent walking was higher in the treatment group.

Zanotti et al.[28] compared the effects of active lower limbs mobilization with and without Functional Electrical Stimulation (FES) in 24 COPD subjects with severe peripheral muscle atrophy then depending on mechanic ventilation. The program was four weeks long, and was performed five times weekly. The muscle strength significantly improved in both groups versus baseline. Regarding the number of days for transference from bed to chair, there was a statistically significant improvement in the FES group. The intervention group took in average 10 days to transfer, while the control group an averaged 14 days.

Bailey et al.,[21] in a prospective cohort study evaluated the feasibility and safety of early activities in subjects mechanically ventilated for more than 4 days. The activities were developed twice daily, and included seating by the bed side without support, seating on chair after transferring from the bed, and walking without or with a person or walker assistance. The activities aimed the patient walking more than 100 feet (3048 cm) before discharged from the unit; 2.4% of the subjects had no activity until the discharge, 4.7% seated by the bed side, 15.3% seated on a chair, 8.2% walked less than 100 feet (3048 cm) and 69.4% walked more than 100 feet (3048 cm). It was defined as early the therapy started when the patient was hemodynamically stable, with no amines, $FiO_2 \leq 60\%$ and PEEP ≤ 10 cmH_2O need, able to respond to verbal stimulation according to neurological evaluation criteria. No activity was started during coma and/or less than 4 days in mechanic ventilation patients, justifying that patients needing longer than 4 days mechanic ventilation are more endangered of physical weakness.

One case report was recently published by Needham,[9] where a patient with severe COPD, 56 years-old, acute renal failure, walked on the 4th day following ICU admission, with orotracheal tube and mechanic ventilation installed. The patient walked a total of 140 meters divided in three phases, assisted by a walker and two physiotherapists constantly monitoring heart rate, blood pressure, electrocardiographic track and oxygen saturation. In an interview the patient Mr. E. showed improved self-esteem, and self-perceived muscle strength and functional status. Also reported that it was not uncomfortable to walk with a tube in his mouth, and that this benefited his recovery.

CONCLUSION

Kinesiotherapy, including early started, appears to bring favorable results for muscle weakness reversion in critically ill patients, providing faster return to function, reduced weaning time and hospitalization. Although the evaluated studies suggest its use to be safe and effective, their methodological diversity points to the need of further randomized and controlled studies, with larger cases series and better standardization for appropriate description and comparison of different treatment protocols.

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RESUMO

O desenvolvimento de fraqueza generalizada relacionada ao paciente crítico é uma complicação recorrente em pacientes admitidos em uma unidade de terapia intensiva. A redução da força muscular aumenta o tempo de desmame, internação, o risco de infecções e conseqüentemente morbimortalidade. A fisioterapia é usada nesses pacientes como recurso para prevenção da fraqueza muscular, hipotrofia e recuperação da capacidade funcional. O objetivo deste estudo foi rever a literatura relacionada ao uso da cinesioterapia em pacientes internados em unidades de terapia intensiva. A pesquisa da literatura foi realizada por meio das bases eletrônicas de dados MedLine, LILACS, CINAHL, Cochrane, High Wire Press e SciELO, de janeiro de 1998 a julho de 2009 e capítulos de livros utilizando palavras-chave incluindo: "*critical illness*", "*cinesiotherapy*", "*physical therapy*", "*physiotherapy*", "*exercises*", "*training*", "*force*", "*active mobilization*", "*mobilization*", "ICU", "*rehabilitation*", "*mobility*", "*muscle strength*" e "*weakness*". Apesar da escassez de estudos e da diversidade metodológica dos estudos encontrados demonstrando o uso da cinesioterapia como recurso terapêutico, o seu uso, inclusive precocemente parece uma alternativa à prevenção e reversão da fraqueza muscular adquirida na unidade de terapia intensiva.

Descritores: Cinesioterapia; Modalidades de terapia física; Debilidade muscular/reabilitação

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