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Motor physiotherapy in intensive care adult patients

Fisioterapia motora em pacientes adultos em terapia intensiva

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ABSTRACT

This study aimed to review the literature addressing motor physical therapy for intensive care unit adult patients. A literature search was conducted in the databases, PubMed, MedLine (International Literature and Health), LILACS (Latin American and Caribbean Health Sciences) and Cochrane between 1995 and December 2008 using the keywords: physical therapy, mobilization and intensive care unit. For comparison purposes we selected randomized controlled trials and prospective studies, addressing the subject motor physical therapy for intensive care unit adult patients. Pediatric and experimental studies, systematic reviews and meta-analysis were excluded. Of the 121 articles identified, only 4 met the inclusion criteria. Among these, three focused early motor physical therapy in patients with a range of diagnoses, showing that these patients left the bed and walked earlier, and stayed shorter both in the intensive care unit and hospital. Furthermore, patients on early motor physical therapy had shorter mechanical ventilation duration. Another paper compares the use of electrical stimulation associated with physical therapy in chronic obstructive pulmonary disease patients, showing increased muscle strength and shorter time for these patients bed to chair transference as compared with those only receiving physiotherapy. The risks of immobilization in mechanically ventilated critically ill patients are not fully understood. However, it is clear that the survivors show impaired quality of life due to persistent weakness and fatigue. Early mobilization is a new area, with little evidence so far. However, recent studies have confirmed that mechanically ventilated patients mobilization is safe and feasible, reducing both the intensive care unit and hospital stay. However, more studies are warranted to identify the exercise type, duration, intensity and impact for of early motor therapy in specific groups of patients.

Keywords: Physical therapy modalities; Adult; Intensive care

INTRODUCTION

In many developed countries' hospitals, physiotherapy is considered a relevant portion of intensive care unit (ICU) patients' care.[1] Immobilization, physical deconditioning, and weakness are common issues in acute respiratory failure mechanic ventilation (MV) patients.[2]

These complications inherent to long stay MV have multiple causes. The bed detention, clinical disorders such as sepsis and systemic inflam-

matory response syndrome (SIRS), nutritional deficit and exposure to pharmacologic agents such as neuromuscular blockers and corticosteroids translate all factors affecting adversely the functional status and resulting in longer intubation and hospital stay.[3]

Herridge et al., evaluated 109 patients one year after acute respiratory distress syndrome recovery, identified that all of them reported poor function attributed to of muscle mass loss, proximal muscle weakness and fatigue. Only half of these cohort patients were employed 1 year after the recovery, and the reasons reported for continued unemployment were persistent fatigue and poor functional status (e.g. equinus foot and severe joint stiffness).[4] Jonghe et al. described a 25% prevalence of ICU-acquired weakness in a 95 MV patients cohort. The study described independent ICU-acquired weakness predictors, which included MV duration, multi-organ failure days, steroids administration and the female gender.[5]

For 30 years early mobilization has shown reduced ventilation weaning time, and is the basement for functional recovery. Recently, more attention has been given to (early) physical activity as a safe and feasible intervention for neurological and cardio-respiratory stable patients.[6] Early mobilization includes progressive therapeutic activities such as motor bed exercises, bedside sedestation, orthostasis, chair transference and walking.[7]

ICU patients appropriate bed positioning may be used with a physiological target to oxygen transportation optimization by improved ventilation-perfusion ratio (V/Q), increased pulmonary volumes, reduced respiratory load, reduced heart load, and improved mucociliary clearance. In addition to oxygen transportation optimization, mobilization reduces the immobilization and rest effects. Passive, active-assisted and resisted exertion aim the maintenance of joint movement, muscle tissue length, force and function, and to reduce thromboembolic risk.[1,6]

Little information is available so far on the best type of activity for critically ill patients benefit during hospitalization. Few published studies are available detailing the exercise benefits, duration and frequency for ICU patients.[1] Griffiths et al. described the effects of one leg continued passive mobilization in respiratory failure patients during neuromuscular blockade, the other leg being used as control. This intervention prevented muscle fibers atrophy in very severely ill patients.[8] Other trials described the inconveniences of prolonged immobilization in mechanically ventilated ICU patients, and may speculated on the possible benefits of physical activity in these patients.[9]

This study objective was to perform a literature review addressing the motor physical therapy for adult ICU patients subject.

The scientific papers search was performed on the databases PubMed, MedLine (International Literature and Health), LILACS (Latin American and Caribbean Health Sciences) and Cochrane between 1995 and December 2008. The keywords used were: physical therapy, mobilization and intensive care unit. For comparison purposes, controlled, randomized and prospective studies were selected addressing the use of motor physical therapy in 18 years or older ICU patients, being all the publications selected by two authors (LRO and VMB). For each selected study, data as sample characteristics, method, intervention and results were extracted.

Additional studies were identified by manual search of the references in the articles. Presentations abstracts, dissertations or academic thesis were not included. Pediatric and experimental studies, systematic reviews and metanalysis were excluded. After in each database search, the articles were manually excluded. The studies language was not a limiting factor.

The search strategy initially identified 121 articles, being 93 excluded for lack of relevance, involving pediatric patients, or for addressing respiratory physiotherapy. Of the 28 remaining articles, 15 were excluded for being reviews, 4 for being case report/study, 3 for being observational, 1 for being descriptive exploratory and 1 for being on outpatient rehabilitation. Thus, the 4 included studies are controlled, randomized and prospective trials addressing ICU motor physical therapy.

Although the early physiotherapy benefits in critically ill patients were described for longer than a decade, our search identified few controlled and randomized trials describing this intervention benefits. From the 4 identified articles, three are regarding early motor physical therapy, and one is on electrical stimulation in ICU adult patients, being two cohort prospective studies,[2,10] and two randomized and controlled trials.[11,12]

Chiang et al., in 2006 tested the effect of a 6-week physical training program in longer than 14 days mechanically ventilated patients who had no physical therapy before ICU admission. The program consisted in peripheral and respiratory muscles training. The peripheral muscle training followed the order: 1) upper

and lower extremities exercises, focusing on passive and light weight active movements while the patient remained in bed; 2) functional bedside training, focusing moving and out-of-bed transferences; 3) walking. The respiratory training focused on diaphragm respiratory exercises during spontaneous respiration testing. As a result, at 6 weeks the test group had improved peripheral and respiratory muscle strength, while the control group had peripheral muscle function loss. The out-of-MV time improved in the test group. An improvement was reported on the Barthel Daily Life Activity (DLA) score, and in all Functional Independency Measure (FIM) sub-items which include daily life activities, sphincter control, mobility and tasks performance. Both DLA and functional independence scores were able to identify the physical training changes results for long term MV patients. By the test end, if the patient was able to breath with no MV support for at least one hours, a 2-minutes walk test was performed with oxygen supplementation and/or a walker aid. While 53% of the test group patients were able to complete the 2-minutes walk test within 6 weeks, all control-group patients were in bed for 6 weeks and were not able to walk. The control (no physiotherapy intervention) group reduced muscle strength by 3 weeks, is a strong evidence of physiotherapy benefits. However, this group non-intervention is not ethically appropriate.[11] This study results are shown in table 1.

Bailey et al., performed in 2007 a prospective cohort study focusing the safety and feasibility of early walking in longer than 4 days mechanically ventilated patients admitted to a respiratory ICU. The activity was started early when the patient appropriately complied with neurological (verbal stimulation response), respiratory (oxygen inspired fraction (FiO_2) < 0.6 and positive end-expiratory pressure (PEEP) < 10 cmH_2O) and circulatory (no orthostatic hypotension and cathecolamines use) criteria. The aim was allowing the patients to walk longer than 100 meters until the respiratory ICU discharge. From the 1,449 recorded activities, more than 50% were walking. By the respiratory ICU discharge, the patients were able to walk 212 ± 178 meters. Patients discharged from the ICU to home walked longer as compared to those discharged to the ward and to long-term acute care facilities.[10] This study also shows that a multi-disciplinary team was able to conduct the trial with no head count increase.

In a second prospect cohort study, Morris et al., in 2008, prepared a physical activity protocol aiming to provide a standard mechanism and frequency for physical therapy administration in acute respiratory failure patients intubated longer than 48 hours and with more than 72 hours ICU admission.[2]

The protocol had 4 activity levels. Unconscious patients underwent passive upper and lower extremities mobilization 3 times daily by Auxiliary (Level I),

Table 1 - Peripheral and Respiratory muscle strength comparison from Admission to the 6th Rehabilitation Week between control and test groups, according to Chiang et al. [11]

	Start		3rd week		6th week	
	Control	Test	Control	Test	Control	Test
Shoulder flexors (Kg)	2.0 (1.4–4.5)	3.2 (2.2–4.2)	0.9 (0.7-3.1)[b]	4.1 (3.2-5.6)[b,c]	0.9 (0-1.8)[b,d]	4.5 (4.0-5.8)[b,c,d]
Elbow flexors (Kg)	4.5 (2.1–6.0)	4.3 (3.2–6.0)	1.8 (1.2-3.2)[b]	6.6 (4.5-8.0)[b c]	1.1 (0.7-3.2)[b]	7.3 (5.4-7.8)[b,c,d]
Knee extensors (Kg)	4.1 (2.3–6.0)	4.1 (3.1–7.5)	2.0 (1.1-4.5)b	6.6 (4.0-8.7)[b,c]	1.8 (0.7-3.0)[b,d]	7.3 (4.4-8.9)[b,c]
Pimax (cmH_2O)	38.0 (29.0–59.3)	46.0 (30.0–60.0)	34.0 (27.0-45.0)	58.0 (35.0-63.5)[b]	30.0 (25.0-42.0)[b]	60.0 (40.5-71.5)[b,c,d]
Pemax (cmH_2O)	42.0 (30.5–56.5)	45.0 (37.0–64.5)	32.0 (27.0-47.0)	58.0 (45.0-71.0)[b,c]	35.0 (18.0-45.0)	62.0 (49.5-72.0)[b,c,d]
MV free time (hours)	0 (0-0)	0 (0-0)	0 (0-21)[b]	6 (1-12)[b]	0 (0-0)	6 (3-13)

Pimax – Maximal Inspiratory Pressure; Pemax – Maximal Expiratory Pressure; MV – mechanic ventilation.

[b]: $P<0.05$ versus start; [c]: $P<0.05$, versus control; [d]: $P<0.05$, versus third week. Results expressed as median values with 25%-75% quartiles in parentheses.

(11) Chiang LL, Wang LY, Wu CP, Wu HD, Wu YT. Effects of physical training on functional status in with prolonged mechanical ventilation. Phys Ther. 2006;86(9):1271-81.

with 5 series for joint. Physiotherapy was started on Level II, where the patient would be able to participate if answering correctly 3 of 5 following orders: "Open (close) your eyes.", "Look at me", "Open your mouth and put your tongue out", "Move your head" and "Raise your eye brown after I counted to 5". The progression to the next levels was based on the muscle strength during exertion, 3/5 strength biceps to Level III to Level IV progression, 5 series per exercise. The exercises progression was always focused on functional activities such as transference to the bedside, from the bed to a chair, balance sedestation activities, orthostasis exercises and walking. The protocol was finished when the patient was transferred to the ward. The control group received daily passive mobilization and decubitus change every 2 hours, if unconscious.[2]

In the control group, 64 of 135 (47.4%) patients received at least once physical therapy during their hospital stay compared to 116 of the 145 (80%) patients in the test group (P<0.001). Of the 64 control group patients receiving physiotherapy, in 8 (12.5%) it was started during the ICU care, in comparison with 106 of 116 patients in the test group (91.4%) (P<0.001). In the subgroup of those receiving at least one physiotherapy session during the hospital stay, the control group patients had fewer sessions as compared with the test group, 4.1 versus 5.5 sessions per patient (P=0.037). After adjusting for body mass index (BMI), Acute Physiologic Chronic Evaluation II (APACHE II) and vasopressor use, the test group patients left the bed within 5 days while those in the control group in 11.3 days (P<0.001). Another statistical difference for both groups was the ICU and hospital stay length. The ICU stay length in the control group was 6.9 days, while in the test group 5.5 days. The hospital stay was 14.5 days for the control group (n=135) and 11.2 days for the test group (n=145).[2]

The trial results (Table 2) showed that a activities protocol is feasible, safe and doesn't increase costs, and is associated with shorter hospital and ICU survivors stay, however decreased mortality was not evaluated in this trial.[2]

Zanotti et al. (2003) studied the benefits of electric stimulation in addition to active exercises in chronic obstructive pulmonary disease (COPD) who were in bed and mechanically ventilated for longer than 30 days. Patients receiving systemic corticosteroids or neuromuscular blockers longer than 5 days were excluded from the control due to drug induced neuromuscular weakness. Electric stimulation was used in patients in bed with superficial bilateral electrodes on quadriceps at rectum femoralis and vastus lateralis regions. Each electric stimulation session involved 5 minutes F 8 Hz and T 250 μs and followed by 25 minutes with F 35 Hz and T 350 μs. Once the equipment was turned on, the physiotherapist started active limb mobilization. Thus, muscle contraction occurred both by electric stimulation and the limb movement. The activity, in both groups, was performed 5 days/week for 4 weeks, and the cardio-respiratory parameters were recorded (respiratory and heart rate, and oxygen saturation) and the days to bed to chair transference. After the 4 weeks, the patients receiving electric stimulation had a large muscle strength score increase, and need less days for bed to chair transference as compared to those receiving plain physiotherapy (Table 3 and 4).[12]

Table 2 – Results (survivors), according to Morris et al.[2]

	Control group (N = 135)	Test group (N = 145)	P value
Days to first leaving bed	13.7	8.5	<0.001
Days to first leaving bed*	11.3	5.0	<0.001
MV days	9	7.9	0.298
MV days*	10.2	8.8	0.163
ICU days	8.1	7.6	0.084
ICU days*	6.9	5.5	0.025
Hospital stay days	17.2	14.9	0.048
Hospital stay days*	14.5	11.2	0.006

MV – mechanic ventilation; ICU – intensive care unit. *: Data adjusted for the body mass index, Acute Physiologic Chronic Health Evaluation II (APACHE II) score and vasopressors.

(2) Morris PE, Goad A, Thompson C, Taylor K, Harry B, Passmore L, et al. Early intensive care unit mobility therapy in treatment of acute respiratory failure. Crit Care Med. 2008;36(8):2238-43.

Table 3 – Muscle strength and vital data by treatment start and end - Zanotti et al.[12]

Variables	Physiotherapy + electric stimulation			Physiotherapy		
	Start	End	P value	Start	End	P value
Muscle Strength	1.66±0.77	3.83±0.57	0.0001	1.83±0.71	3.08±0.51	0.0006
HR	95.9±7.51	92±6.96	NS	91.58±5.24	88.83±4.52	NS
RR	21.75±2.89	19.83±2.62	NS	22.5±2.31	22.91±2.67	NS
SatO2	92.16±3.73	94.58±1.44	0.04	93.66±2.87	94.33±1.37	NS

RR – respiratory rate; HR – heart rate; SatO2 – arterial oxygen saturation; NS – non-significant.

(12) Zanotti E, Felicetti G, Maini M, Fracchia C. Peripheral muscle strength training in bed-oound with COPD receiving mechanical ventilation: effect of electrical stimulation. Chest. 2003;124(1):292-6.

Table 4 – Comparison of change in muscle strength and other variables between the groups - Zanotti et al. [12]

Variables	Physiotherapy + electric stimulation	Physiotherapy	P value
Muscle Strength	2.16±1.02	1.255±0.75	0.02
HR	-3.83±2.55	-2.75±4.90	NS
RR	-1.91±1.72	0.41±1.88	0.0004
SatO2	2.41±2.92	3.13±3.31	NS

HR – heart rate; RR – respiratory rate; SatO2 – arterial oxygen saturation, NS – non-significant.

(12) Zanotti E, Felicetti G, Maini M, Fracchia C. Peripheral muscle strength training in bed-oound with COPD receiving mechanical ventilation: effect of electrical stimulation. Chest. 2003;124(1):292-6.

Immobilization, physical deconditioning and weakness are common issues in respiratory failure mechanically ventilated patients, and may contribute to extended hospital stay.[2] Prolonged MV patients frequently have peripheral and respiratory muscles weakness, impairing their functional status and quality of life.[11] The physiotherapy objective in prolonged MV patients is to minimize the mobility loss and improve the functional independence, making the weaning easer.[13]

The ICU patients' early mobilization is conceptually new. There are few published studies which can be used for supporting the benefit of early motor ICU physical therapy. Of the articles identified, only 4 were selected for being within the inclusion criteria, showing that early mobilization is a safe and feasible procedure which promotes muscle strength, allowing bed to chair transference and walking within few days, and a shortening ICU and hospital stays. Additionally, early mobilization patients had lass MV days.

Bailey et al. reported the first early mobilization trial in mechanic ventilation ICU patients, aiming to show that this is a safe and feasible procedure. Their study was the only showing early start details regarding safety and feasibility. According to them, respiratory failure patients early activity is feasible and didn't require ICU staff increase for its implementation. It only required assembling this multidisciplinary team. Before this team was developed, it was not common that ICU patients were early exercised. Additionally, it was safe, as during the study few adverse events were seen, none of them serious. Early activity had low complication risk (<1%). The adverse events didn't result in extubations, complications needing additional therapy, cost increase or longer hospital stay time.[10]

A multidisciplinary focus on early mobilization is necessary as part of clinical daily routines in ICU. The multidisciplinary team structure, and inclusion on physiatrists, physicians, occupational therapists, physiotherapists, nurses, nutritionists, physiologists, and social assistants may serve as an excellent model for building an early mobilization ICU team. This may be useful for evaluation of the different components of an appropriate training program, including type, frequency, intensity and specific exercises, in addition to psychosocial or behavioral programs used.[14]

Morris et al. conducted the first trial comparing early ICU mobilization with standard care.[15] With an early mobilization protocol use, patients had more physiotherapy sessions (4.1 sessions in the control group versus 5.5 in the protocol group) and had shorter hospital stays (14.5 days for control group versus 11.2 days for the protocol group). This study has shown that an ICU mobility protocol safely increased the rate of respiratory failure patients receiving physiotherapy without adverse events. This study

is similar to previous trials showing that ICU mobility is feasible and safe, ant these previous reports extend relating that early ICU mobility is associated with a statistically significant decrease of survivors' days in bed, ICU and hospital stay, with no cost impact.[2]

Mundy et al. studied community acquired pneumonia patients admitted to ICU beds. The patients randomized to early mobilization (seat out of the bed or walking for 20 minutes, started in the first hospitalization day), showed less hospital stay (5.8 versus 6.9 days). No adverse event was reported in the early mobilization group.[16]

In the Morris' trial, physiotherapy was more frequently used in the protocol group in comparison to the standard care group (7 days compared with 5 days/week) and may have contributed to the shorter hospital stay in these patients.[2] Additionally, among the survivors receiving early mobilization there was a trend to a shorter MV duration (8.8 days versus 10.2 days).[2] Future trials may justify the ICU mobilization benefits.

Chiang et al., in their trial, showed that a 6 weeks training program may improve the functional status in prolonged MV patients by means of improved muscle strength and the out-of-MV days. In comparison to the third week, in the sixth training week the patients had a 0.77 to 1.48 shoulder flexors increase, from 1.36 to 1.82 in elbow flexors, and 0.94 to 1.26 in the knee extensors. This improvement may be observed both by the Barthel DLA and FIM scores. These scores are two of the best overall functional status measures, however were not used so far for evaluating prolonged MV patients functional status. These scores were used for giving quantification of results and psychometric measures of physical and cognitive disabilities.[11]

As previously reported, neuromuscular post critical illness complications are common and may be persistent. For these complications improvement, the interest on early physiotherapy is growing steadily and the use of equipments as electric stimulation may help this rehabilitation.

The electric stimulation aim is to improve the exertion ability by improving the peripheral muscle strength.[12] Electric stimulation requires minimal cooperation, produces minimal cardio-respiratory stress and requires less personal involvement than regular physiotherapy.[17] Additionally, it can lead to reduced rest associated complications such as pressure sores, pneumonia and pulmonary embolism.[12]

Electric stimulation use has been constantly associated with increased mass, force and endurance in sport injuries as well as abnormal innervation muscles in a series of disease conditions. Electric stimulation reduces muscle mass loss during denervation/immobilization and promotes muscle strength recovery during rehabilitation. Additionally, has been shown being able to induce increased muscle oxidative capacity, proving to be another mild training form.[18]

Zanotti et al. showed in their study that COPD patients receiving physiotherapy associated with electric stimulation had muscle strength increase (3.83 ± 0.57 versus 3.08 ± 0.51) and were transferred from bed to chair in less days (10.75 ± 2.41 days versus 14.33 ± 2.53 days) than those receiving physiotherapy.[12]

Electric stimulation is well tolerated in chronic diseases, with few adverse effects. Most trials failed to identify and significant change in hear rate and blood pressure, although one trial found a slight statistically significant increase, however non-clinically relevant, in heart rate (4 ± 3 beats/minute). However, electric stimulation was not studied in critical acute disease patients. Based on the available evidence, the American Thorax Association, European Respiratory Society and European Society of Intensive Medicine and Care guidelines state that electric stimulation may be considered as an adjuvant therapy in critically ill patients who are restricted to bed with increased risk of developing skeletal muscles weakness.[7]

COMMENTS

Immobilization risks in mechanically ventilated critically ill patients are not fully understood. However, it is evident that the survivors have persistent weakness and fatigue, impairing their quality of life. Early mobilization is a new area with few evidences so far. However, recent trials confirmed that mobilization in mechanically ventilated patients is a safe and feasible procedure, reducing the stay length both in ICU and hospital. However, more studies are warranted for identification of the exercise type, duration, intensity and early motor physiotherapy repercussion in specific patient groups.

RESUMO

O objetivo desse estudo é realizar uma revisão da literatura abordando o tema fisioterapia motora para pacientes adultos em unidade de terapia intensiva. A busca de artigos científicos foi realizada nas bases de dados PubMed, MedLine (Literatura Internacional em Ciências e Saúde), LILACS (Literatura Latino Americana e do Caribe em Ciências e Saúde) e Cochrane entre 1995 e dezembro de 2008 utilizando as palavras-chaves: *physical therapy, mobilization and intensive care unit*. Para efeito de com-

paração foram selecionados estudos controlados, randomizados e prospectivos, abordando o tema fisioterapia motora para pacientes adultos em unidade de terapia intensiva. Estudos em pediatria, experimentais, revisões sistemáticas e metanálises foram excluídos. Dos 121 artigos encontrados, apenas 4 preencheram aos critérios de inclusão. Dentre estes, três artigos abordavam sobre a aplicação da fisioterapia motora precoce em pacientes com diagnósticos variados, mostrando que estes indivíduos saíram mais cedo da cama, deambularam em menos dias e tiveram um menor tempo de permanência na unidade de terapia intensiva e no hospital. Além disso, os pacientes que receberam fisioterapia motora precoce apresentaram um menor tempo de ventilação mecânica. Já o outro artigo compara a aplicação da eletroestimulação associada à fisioterapia em pacientes com doença pulmonar obstrutiva crônica, mostrando um aumento na força muscular e menor tempo para a transferência destes indivíduos da cama para a cadeira em relação aos que receberam apenas fisioterapia. Os riscos da imobilização em doentes críticos ventilados mecanicamente não são bem esclarecidos. Entretanto, é evidente que os sobreviventes apresentem fraqueza e fadiga persistente, prejudicando sua qualidade de vida. A mobilização precoce é uma área nova e com poucas evidências até o momento. No entanto, recentes estudos têm confirmado que a mobilização em pacientes ventilados mecanicamente é um procedimento seguro e viável, diminuindo o tempo de internação na unidade de terapia intensiva e hospitalar. Porém mais estudos se fazem necessário para se identificar o tipo de exercício, duração, intensidade e a repercussão da fisioterapia motora precoce em grupos específicos de pacientes.

Descritores: Modalidades de fisioterapia; Adulto; Cuidados intensivos

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