Relevant Literature for Critical Care– Evidence Library

Contents

Early exercise in critically ill patients enhances short-term functional recovery.

Burtin C.; Clerckx B.; Robbeets C.; Ferdinande P.; Lander D.; Troosters T.; Hermans G.; Decramer M.; Gosselink R. (2009).

Critical Care Medicine, 37(9): 2499-2505.

Abstract

Objectives: To investigate whether a daily exercise session, using a bedside cycle ergometer, is a safe and effective intervention in preventing or attenuating the decrease in functional exercise capacity, functional status, and quadriceps force that is associated with prolonged intensive care unit stay. A prolonged stay in the intensive care unit is associated with muscle dysfunction, which may contribute to an impaired functional status up to 1 yr after hospital discharge. No evidence is available concerning the effectiveness of an early exercise training intervention to prevent these detrimental complications.

Design: Randomized controlled trial.

Setting: Medical and surgical intensive care unit at University Hospital Gasthuisberg.

Patients: Ninety critically ill patients were included as soon as their cardiorespiratory condition allowed bedside cycling exercise (starting from day 5), given they still had an expected prolonged intensive care unit stay of at least 7 more days.

Interventions: Both groups received respiratory physiotherapy and a daily standardized passive or active motion session of upper and lower limbs. In addition, the treatment group performed a passive or active exercise training session for 20 mins/day, using a bedside ergometer.

Measurements and Main Results: All outcome data are reflective for survivors. Quadriceps force and functional status were assessed at intensive care unit discharge and hospital discharge. Six-minute walking distance was measured at hospital discharge. No adverse events were identified during and immediately after the exercise training. At intensive care unit discharge, quadriceps force and functional status were not different between groups. At hospital discharge, 6-min walking distance, isometric quadriceps force, and the subjective feeling of functional well-being (as measured with "Physical Functioning" item of the Short Form 36 Health Survey questionnaire) were significantly higher in the treatment group ($p < .05$).

Conclusions: Early exercise training in critically ill intensive care unit survivors enhanced recovery of functional exercise capacity, self-perceived functional status, and muscle force at hospital discharge.

In-Bed Mobilization in Critically Ill Children: A Safety and Feasibility Trial.

Choong, K., Chacon, M.D.P., Walker, R.G., Al-Harbi, S., Clark, H., Al-Mahr, G., Timmons, B.W. & Thabane, L. (2015).

Journal of Pediatric Intensive Care, 04(04):225-234.

Abstract

The objective of this study was to evaluate the feasibility and safety of implementing two methods of in-bed mobilization in critically ill children. This prospective cohort trial was conducted at McMaster Children's Hospital, Pediatric Critical Care Unit (PCCU). Hemodynamically stable patients aged 3 to 17 years with a longer than 24-hour PCCU stay were eligible to participate in the study. Children with cardiorespiratory instability, already mobilizing well or at their baseline mobility, anticipated death during this PCCU admission, and those with contraindications to mobilization were excluded. Two methods of mobilization were applied for a maximum of 2 days, respectively, depending on the level of consciousness and cognitive ability of the participant. In-bed cycling was used for passive mobilization and interactive video games (VG) were used for active mobilization. The primary outcomes were safety and feasibility. Secondary outcomes were physical activity during the study period, as reflected by accelerometer measurements. A total of 406 patients were screened over 1 year, 35 of who were eligible and 31 (89%) consented to participate. Median age of participants was 11 years (quartile 1 is 6 years and quartile 3 is 14 years), and 15 (48%) were male. Twenty-five (81%) participants received the study intervention, 22 (88%) of who received the intervention within 24 hours of consent.

Twenty-one (84%) participants received in-bed cycling, five (20%) received VG, and only one received both. Fifteen (60%) completed the prescribed 2-day intervention, while in 11 (44%) the intervention was interrupted or not applied, most commonly because the patient was transferred out of the PCCU. Physical activity was greater during the intervention compared with nonintervention times with in-bed cycling, but not with VG. There were no adverse events attributable to the intervention. This pilot reveals that in-bed cycling can enhance physical activity, and appears to be safe and feasible in this group of critically ill children. VG was feasible only in a minority of patients who were cooperative and age appropriate. Further research is necessary to evaluate the efficacy and most appropriate methods of enhancing mobility and rehabilitation in this population.

Neuromuscular electrical stimulation in mechanically ventilated patients: A randomized, sham-controlled pilot trial with blinded outcome assessment.

Kho, M.E., Truong, A.D., Zanni, J.M., Ciesla, N.D., Brower, R.G. Palmer, J.B. & Needham, D.M. (2015).

Journal of Critical Care, 30(1): 32–39. doi:10.1016/j.jcrc.2014.09.014.

Abstract

PURPOSE: The purpose of the study is to compare neuromuscular electrical stimulation (NMES) vs sham on leg strength at hospital discharge in mechanically ventilated patients.
MATERIALS AND METHODS: We conducted a randomized pilot study of NMES vs sham applied to 3 bilateral lower extremity muscle groups for 60 minutes daily in the intensive care unit (ICU). Between June 2008 and March 2013, we enrolled adults who were receiving mechanical ventilation within the first week of ICU stay and who could transfer independently from bed to chair before hospital admission. The primary outcome was lower extremity muscle strength at hospital discharge using Medical Research Council score (maximum, 30). Secondary outcomes at hospital discharge included walking distance and change in lower extremity strength from ICU awakening. Clinicaltrials.gov: NCT00709124.
RESULTS: We stopped enrollment early after 36 patients due to slow patient accrual and the end of research funding. For NMES vs sham, mean (SD) lower extremity strength was 28 (2) vs 27 (3), P = .072. Among secondary outcomes, NMES vs sham patients had a greater mean (SD) walking distance (514 [389] vs 251 [210] ft, P = .050) and increase in muscle strength (5.7 [5.1] vs 1.8 [2.7], P = .019).
CONCLUSIONS: In this pilot randomized trial, NMES did not significantly improve leg strength at hospital discharge. Significant improvements in secondary outcomes require investigation in future research.

CYCLE pilot: a protocol for a pilot randomised study of early cycle ergometry versus routine physiotherapy in mechanically ventilated patients

Kho, M.E., Molloy, A.J., Clarke, F., Herridge, M.S., Koo, K.K.J., Rudkowski, J., Seely, A.J.E., Pellizzari, J.R. Tarride, J.-E., Mourtzakis, M., Karachi, T. & Cook, D.J. (the Canadian Critical Care Trials Group) (2016).

BMJ Open, 6:e011659. doi:10.1136/bmjopen-2016-011659

Abstract

Introduction Early exercise with in-bed cycling as part of an intensive care unit (ICU) rehabilitation programme has the potential to improve physical and functional outcomes following critical illness. The objective of this study is to determine the feasibility of enrolling adults in a multicentre pilot randomised clinical trial (RCT) of early in-bed cycling versus routine physiotherapy to inform a larger RCT.
Methods and analysis 60-patient parallel group pilot RCT in 7 Canadian medical-surgical ICUs. We will include all previously ambulatory adult patients within the first 0–4 days of mechanical ventilation, without exclusion criteria. After informed consent, patients will be randomised using a web-based, centralised electronic system, to 30 min of in-bed leg cycling in addition to routine physiotherapy, 5 days per week, for the duration of their ICU stay (28 days maximum)

or routine physiotherapy alone. We will measure patients' muscle strength (Medical Research Council Sum Score, quadriceps force) and function (Physical Function in ICU Test (scored), 30 s sit-to-stand, 2 min walk test) at ICU awakening, ICU discharge and hospital discharge. Our 4 feasibility outcomes are: (1) patient accrual of 1–2 patients per month per centre, (2) protocol violation rate <20%, (3) outcome measure ascertainment >80% at the 3 time points and (4) blinded outcomes ascertainment >80% at hospital discharge. Hospital outcome assessors are blinded to group assignment, whereas participants, ICU physiotherapists, ICU caregivers, research coordinators and ICU outcome assessors are not blinded to group assignment. We will analyse feasibility outcomes with descriptive statistics.
Ethics and dissemination Each participating centre will obtain local ethics approval, and results of the study will be published to inform the design and conduct of a future multicentre RCT of in-bed cycling to improve physical outcomes in ICU survivors.

Functional electrical stimulation with cycling in the critically ill: a pilot case-matched control study

Parry S.M., Berney S., Warrillow S., El-Ansary D., Bryant A.L., Hart N., Puthucheary Z., Koopman R. & Denehy L. (2015).

J Crit Care. 2014 Aug;29(4):695.e1-7. doi: 10.1016/j.jcrc.2014.03.017. Epub 2014 Mar 26.

Abstract

PURPOSE:

The purpose was to determine (a) safety and feasibility of functional electrical stimulation (FES)-cycling and (b) compare FES-cycling to case-matched controls in terms of functional recovery and delirium outcomes.

MATERIALS AND METHODS:

Sixteen adult intensive care unit patients with sepsis ventilated for more than 48 hours and in the intensive care unit for at least 4 days were included. Eight subjects underwent FES-cycling in addition to usual care and were compared to 8 case-matched control individuals. Primary outcomes were safety and feasibility of FES-cycling. Secondary outcomes were Physical Function in Intensive Care Test scored on awakening, time to reach functional milestones, and incidence and duration of delirium.

RESULTS:

One minor adverse event was recorded. Sixty-nine out of total possible 95 FES sessions (73%) were completed. A visible or palpable contraction was present 80% of the time. There was an improvement in Physical Function in Intensive Care Test score of 3.9/10 points in the intervention cohort with faster recovery of functional milestones. There was also a shorter duration of delirium in the intervention cohort.

CONCLUSIONS:

The delivery of FES-cycling is both safe and feasible. The preliminary findings suggest that FES-cycling may improve function and reduce delirium. Further research is required to confirm the findings of this study and evaluate the efficacy of FES-cycling.

Functional Electrical Stimulation Cycling Pre- and Post-Bilateral Orthotopic Lung Transplantation: A Case Report

Pastva, A., Kirk, T. & Parry, S.M.

Am J Respir Crit Care Med 191;2015:A1643

Abstract

Introduction: Numerous studies now document acquired functional disabilities in survivors of critical illness. Thus, survivorship has become a defining challenge in critical illness management. Given that skeletal muscle wasting occurs early and rapidly (up to 30% in first ten days), there is growing interest in the use of assistive technologies to assuage muscle wasting. This case report examines the efficacy of functional electrical stimulation (FES)-cycling in a patient pre- and post-bilateral orthotopic lung transplantation (BOLT).

Description: A 30-year-old female with cystic fibrosis and severe obstructive pathophysiology (FEV1<15%) was admitted to medical ICU with severe multiresistant

pneumonia and respiratory failure requiring mechanical ventilation (MV) and veno-venous extracorporeal membranous oxygenation (V-V ECMO, internal jugular) as a bridge to BOLT (day-10). Premorbidly, the subject was independent in all activities of daily living and worked full-time. During the inpatient stay, FES-cycling was performed with stimulation to the quadriceps, hamstrings, and gluteal muscles bilaterally (RT300, Restorative Therapies Ltd, Baltimore). The subject also underwent conventional physical therapy involving progressive mobilization. Ultrasonography was used to quantify changes in muscle quality (echointensity) and quantity.

Discussion: The subject completed 7 FES-cycling sessions (2 pre-, 5 post-transplant) over 18 days. Cycling duration, distance, and power ranged from 20-43 min, 3.62-6.89 miles, and 1.59-8.96 Watts, respectively. Three sessions were undertaken whilst the subject was on V-V ECMO and perfusion rates remained stable. No adverse events occurred during or after training. Muscle thickness of rectus femoris (RF) was stable (1.5-1.6cm) over the hospital stay and then increased to >2.0cm from day-26 (hospital discharge) to outpatient pulmonary rehab completion (day-63). Vastus intermedius (VI) followed a similar pattern with maintenance of muscle thickness (0.95-1.15cm) and then increased >2.0cm from day-40 (1 month posttransplant) to day-63. Echointensity (muscle quality) increased day-1 to day-11 by 15-30% for RF and 50% for VI muscles, and subcutaneous thickness increased by 30%. Changes in muscle echointensity may be related to oedema infiltration rather than muscle necrosis as echointensity/subcutaneous thickness scores were reduced back to baseline by day-30. At day-14 (ICU discharge) the Medical Research Council subscore was 58/60, and handgrip strength of 60 pounds.

Conclusions: This case report is novel as early exercise with FES-cycling was shown to be safe and feasible in a subject receiving MV, V-V ECMO, and transplantation. Muscle wasting was remarkably less than has been reported in the literature. Further research is required to confirm the efficacy of FES-cycling in this population.

Author Index