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The Effect of Early Systematic Rehabilitation on the Prognosis of ICU Patients on Mechanical Ventilation: A Meta-Analysis

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ADMINISTRATIVE INFORMATION

Support - N/A.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 18 July 2024 and was last updated on 18 July 2024.

INTRODUCTION

Review question / Objective This study aims to evaluate the impact of early systematic rehabilitation exercise on the prognosis of ICU patients on mechanical ventilation using meta-analysis and to explore the optimal timing for early systematic rehabilitation. The goal is to provide a reference for the clinical practice of early rehabilitation exercise in the ICU.

Condition being studied With the advancement of medical technology, the survival rate of patients in the Intensive Care Unit (ICU) has significantly improved. Clinical data shows that approximately 30-90% of ICU patients worldwide receive mechanical ventilation treatment. However, despite the improvement in short-term survival, ICU patients undergoing mechanical ventilation may face psychological and physiological risks due to limited activity. Previous studies have indicated that ICU patients often experience decreased muscle mass and function, ICU-acquired weakness (ICU-AW), anxiety, or depression, collectively known as ICU syndrome.

Early rehabilitation exercise has become a rising trend with promising applications for improving clinical treatment outcomes in mechanically ventilated patients. Early rehabilitation exercise programs have become part of ICU care standards, typically including progressive mobilization, passive or active exercise, and neuromuscular electrical stimulation. However, due to the poor capacity for active exercise among mechanically ventilated patients, only about 8-16% can progress to autonomous walking. Previous studies have shown that early systematic rehabilitation for mechanically ventilated patients is safe and feasible. Early rehabilitation exercise can improve functional outcomes and reduce hospital stay duration.

Nevertheless, the optimal timing for initiating early rehabilitation exercise in ICU patients remains controversial. Zhou et al.]suggested that starting

exercise within 24 hours of ICU admission might reduce ICU-AW and enhance muscle strength. Fossat et al. conducted early rehabilitation exercise using bedside cycling and electrical stimulation of the quadriceps within 30 hours of ICU admission, but muscle strength did not significantly improve at discharge.

METHODS

Participant or population The 16 studies involved 2097 ICU patients on mechanical ventilation, with 1050 patients receiving early systematic rehabilitation interventions. The average age of the study subjects ranged from 48 to 66 years, with an average APACHE II score between 15 and 28.

Intervention Early systematic rehabilitation for ICU patients on mechanical ventilation; standard rehabilitation for ICU patients on mechanical ventilation.

Comparator Mechanical Ventilation Time, ICU-AW, Length of Hospital Stay,MRC Score,Barthel index, Mortality.

Study designs to be included Study type was a randomized controlled trial (RCT).

Eligibility criteria
Inclusion Criteria:
1. Studies published in peer-reviewed journals in English or Chinese.
2. Study subjects were ICU patients undergoing mechanical ventilation.
3. The experimental group received any form of early systematic rehabilitation exercise, while the control group received standard rehabilitation.
4. At least one of the following outcome measures was reported: duration of mechanical ventilation (days), ICU length of stay (days), total hospital length of stay (days), ICU mortality, in-hospital mortality, ICU-AW, Barthel index, and Medical Research Council (MRC) score.
5. Study type was a randomized controlled trial (RCT).
Exclusion Criteria:
1. Non-human studies.
2. Conference abstracts, case reports, systematic reviews, and other types of research.
3. Studies with insufficient outcome data that cannot be analyzed.
4. Duplicate publications of the same study.
5. Studies where the full article could not be obtained.

Information sources three English databases (PubMed, Web of Science, Cochrane Library) and three Chinese databases (CNKI, Wanfang Database, VIP Database).

Main outcome(s) Early systemic rehabilitation can significantly improve mechanical ventilation time (MD: -1.91; 95% CI: -2.88, -0.94), ICU-AW risk (RR: 0.58; 95% CI: 0.40, 0.84), ICU length of stay (MD: -2.01; 95% CI: -2.83, -1.18), and total length of stay (MD: -2.18; 95% CI: -4.29, -0.07). The analysis of the implementation time of early systemic rehabilitation shows that early rehabilitation exercise applied within 48 hours and 72 hours after admission to the intensive care unit or mechanical ventilation has varying degrees of effects on mechanical ventilation time (<=72 hours, MD: -2.51; 95% CI: -4.42, -0.60), ICU hospitalization time (<=48 hours, MD: -1.58; 95% CI: -2.65, -0.51;<=72 hours, MD: -2.49; 95% CI: -4.43, -0.55), and total hospitalization time (<=48 hours, MD: -3.17; 95% CI: -7.13, -0.29). However, no significant correlation was found between early systemic rehabilitation and MRC score, Barthel index, and mortality.

Quality assessment / Risk of bias analysis The quality of the included studies was assessed using the Cochrane Collaboration's risk of bias tool, evaluating aspects such as random allocation methods, allocation concealment, blinding, completeness of outcome data, selective reporting, and other potential sources of bias.

Strategy of data synthesis Data analysis was conducted using Reman 5.3. Mean difference (MD) was used for continuous data, while relative risk (RR) was used for categorical data, with a 95% confidence interval (CI) to estimate the range of effect size. Since the random-effects model is more conservative than the fixed-effects model, we used the conservative model to address potential effect differences across studies and populations. Heterogeneity was assessed using the Q test and I^2 statistic to determine the presence and extent of heterogeneity. Studies were considered to have good homogeneity if I^2 0.05. Unless otherwise specified, the significance level was set at 0.05.

Subgroup analysis We conduct subgroup studies on factors such as Mechanical Ventilation Time, ICU-AW, Length of Hospital Stay,MRC Score.

Sensitivity analysis The sensitivity analysis passed because after deleting any of them,the combined results of the remaining literature did not significantly differ from what they would have been.

Country(ies) involved China.

Keywords Early Rehabilitation Exercise; ICU Mechanical Ventilation;Meta-analysis.

Contributions of each author

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