JOURNAL OF INTERNATIONAL CRISIS AND RISK COMMUNICATION RESEARCH
ISSN: 2576-0017
2024, VOL 7, NO S6

The Impact of Early Mobilization on Respiratory Outcomes in Ventilated Patients

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Abstract
Background: Prolonged MV may result in multiple complications related to MV in critically ill patients, including VAP, muscular weakness, and difficult or delayed weaning. Early mobilization has emerged as one potentially promising strategy to prevent such complications and improve patient outcomes. However, the effectiveness of EM in improving respiratory outcomes remains debated..
Objective: This review evaluates the available evidence on the impact of early mobilization on respiratory outcomes in mechanically ventilated patients.
Methods: We performed a systematic review of studies published between 2000 and 2023 that examined the effects of early mobilization on respiratory parameters such as VAP incidence, duration of mechanical ventilation, and weaning time.
Results: Most studies indicate that EM can reduce the incidence of VAP, shorten the duration of mechanical ventilation, and improve weaning outcomes. However, the results vary depending on patient population, timing, and methods of mobilization.
Conclusion: Early mobilization appears to be an effective intervention for improving respiratory outcomes in critically ill patients on mechanical ventilation, though further well-designed trials are needed to establish optimal protocols.
Keywords: Early Mobilization, Mechanical Ventilation, Respiratory Outcomes, Ventilator-Associated Pneumonia (VAP), Weaning from Ventilation

1. Introduction

Mechanical ventilation (MV) is a life-support modality for patients with respiratory failure, but its prolonged use has several complications related to the ventilator itself, such as ventilator-associated pneumonia, muscle atrophy, ventilator dependency, and delayed weaning from the ventilator. **(1)**

Early mobilization during mechanical ventilation, which consists of the execution of early physical activities or exercises, seems to be a promising intervention for the management of these complications**.(2)**

The concept of EM is that early engagement of patients in physical activity may help maintain or improve muscle strength, lung function, and overall recovery, which could reduce the length of stay in the ICU, complications, and duration of weaning**.(3)**

Although interest is growing and some positive findings have been reported, the evidence regarding the effect of early mobilization on respiratory outcomes for mechanically ventilated patients

is still emerging. This review aims to summarize current evidence with respect to this topic, discuss mechanisms through which early mobilization may affect respiratory outcomes, and point out challenges and limitations of this intervention**.(4)**

Early mobilization in critically ill patients, especially those who are mechanically ventilated, has become a focus of increasing interest as an intervention that may improve a variety of clinical outcomes, including respiratory function.**(5)**

Mechanical ventilation can have substantial adverse effects on respiratory mechanics, muscle strength, and recovery in general; thus, early intervention by way of mobilization is being investigated as a method to counteract these effects**.(6)**

Early mobilization has been associated with a reduced duration of mechanical ventilation. Indeed, early mobilization may enhance a patient's ability to tolerate weaning from mechanical ventilation, thereby reducing the duration of mechanical ventilation. This could be due to enhanced respiratory muscle strength and improved lung function, both of which are critical for successful weaning**.(7)**

Regular mobilization improves lung perfusion and ventilation, enhancing the efficiency of oxygen exchange and CO2 clearance. This is particularly important in critically ill patients, who may experience impaired gas exchange due to both the underlying disease and the mechanical ventilation itself**.(8)**

Ventilator-associated pneumonia is one of the serious complications of mechanical ventilation, greatly increasing morbidity and mortality. Early mobilization has been associated with decreased incidence of VAP through improving lung function and preventing prolonged immobility. Mobilization may facilitate the clearance of secretions from the lung, reduce the risk of atelectasis, and stimulate cough; all these factors help reduce infection risk**.(9)**

One of the major barriers to early mobilization in ventilated patients is safety. Concerns regarding dislodgement of tubes, wires, and other medical devices, along with the potential for worsening of underlying conditions, often make healthcare providers cautious about the initiation of early mobilization.**(10)**

However, it is suggested that with appropriate protocols and monitoring, the risk can be minimized, and generally, early mobilization is safe for mechanically ventilated patients**.(10)**

It therefore follows from the evidence that early mobilization is indeed associated with substantial positive changes in respiratory outcomes among mechanically ventilated patients, including enhanced gas exchange, reduced incidence of ventilator-associated complications such as VAP, better preservation of respiratory muscle function, and speedier recovery**. (11)**

On the other hand, early mobilization can only succeed provided that planning, safety of the patient, and coordination by health teams are in place. Future studies may continue to optimize protocols, establish the best timing and intensity of mobilization, and further determine long-term benefits in ventilated patients**.(12)**

Early mobilization is carried out through the organized efforts of a multidisciplinary team of nurses, physiotherapists, respiratory therapists, and physicians. The assurance of availability and training of such teams is paramount for successful implementation..**(13)**

2. Methods

Literature search was performed for the period from 2000 to 2023. Searches were conducted using key terms related to the topic of interest, including "early mobilization," "mechanical ventilation," "respiratory outcomes," "ventilator-associated pneumonia," and "ICU." To be included, studies had to be RCTs, cohort studies, and observational studies that assessed the effect of early mobilization on respiratory outcomes, including incidence of VAP, duration of mechanical ventilation, weaning time, and LOS. Excluded were studies that had no control group, those that focused on outcomes other than respiratory, and case reports..

Inclusion Criteria

- Adult patients (18 years and older) on mechanical ventilation
- Studies evaluating early mobilization protocols in ICUs or similar settings
- Reports on respiratory outcomes such as VAP incidence, mechanical ventilation duration, weaning time, and ICU length of stay

Exclusion Criteria

- Studies focusing solely on non-respiratory outcomes (e.g., muscle strength, mobility scales)
- Case reports or small-scale observational studies with insufficient data

3. Early Mobilization Protocols

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The protocols of early mobilization differ widely in the studies regarding the type of mobilization, timing, frequency, and intensity.**(14)**

Some are passive movements or passive exercises of range-of-motion, initiated within 24 to 48 hours of intubation, while others include more active mobilizations like sitting on the bed, standing, and walking after the patient is hemodynamically stable**..(15)**

3.1 Timing of Mobilization

The timing of early mobilization varies from as early as 24 hours post-intubation to several days later. Some suggest that the initiation of mobilization within the first 48 hours of ventilation may be beneficial, while others propose that mobilization has to be tailored to the condition and stability of the patient.**(16)**

Timing can also be influenced by the severity of the underlying condition, the level of sedation, and the presence of other comorbidities..**(17)**

3.2 Types of Mobilization

Mobilization techniques range from passive exercises, such as limb range-of-motion, to active participation, such as sitting or standing. **(18)**

These techniques prevent deconditioning, improve lung function, reduce the risk of atelectasis, and maintain muscle strength, all of which may improve respiratory outcomes**..(19)**

4. Impact on Respiratory Outcomes

4.1 Ventilator-Associated Pneumonia (VAP)

The biggest complication among mechanically ventilated patients and associated with extended ICU admissions, higher mortality rates, and higher health care expenses is VAP. Studies have reported the incidence of VAP reduced by the adoption of early mobilization. **(20)**

Patients that received early mobilization also provided a 30% decrease in risks of developing VAP in comparisons to patients not receiving such early mobilization ($p < 0.05$). This effect is believed to be due to improved lung expansion, reduced stasis of secretions in the lungs, and increased activity of respiratory muscles**..(21)**

4.2 Duration of Mechanical Ventilation

One of the important respiratory outcomes which early mobilization influences is the duration of mechanical ventilation.**(22)**

Indeed, by enhancing faster weaning and increasing the strength of the patient's respiratory muscles, EM has been evidenced to decrease the duration of ventilation. a mean reduction of 2.3 days in the duration of mechanical ventilation in the early mobilization group compared to the standard care group ($p = 0.02$)**.(23)**

4.3 Weaning Time

Weaning from mechanical ventilation is often prolonged in critically ill patients, especially in the presence of any underlying respiratory conditions or complications. Early mobilization may enhance the weaning process through an improvement in respiratory function and muscle strength. **(24)**

Early mobilization was associated with a faster weaning process, with a reduction in weaning time by 1.5 days ($p < 0.05$). The effect was more pronounced in patients who received more intensive mobilization protocols..**(25)**

4.4 ICU Length of Stay (LOS)

Shortening the length of stay in the ICU is one important goal in the management of critical care, as longer ICU stays are associated with increased complications and higher costs. Available evidence regarding the impact of early mobilization on ICU LOS is mixed; however, some studies suggest there may be a benefit. Early mobilization was associated with a significant reduction in ICU LOS by 3 days on average ($p = 0.03$), probably because of the earlier recovery of respiratory function and reduced need for prolonged ventilatory support..**(26)**

5. Mechanisms of Early Mobilization on Respiratory Function

Several mechanisms may explain how early mobilization improves respiratory outcomes**:(27)**

- **Prevention of Atelectasis:** Early mobilization helps maintain lung volume and prevent atelectasis, improving ventilation-perfusion matching.
- **Improvement of Respiratory Muscle Strength:** EM prevents the atrophy of respiratory muscles and enhances diaphragm function, which can aid in weaning from mechanical ventilation.
- **Enhanced Clearance of Pulmonary Secretions:** Mobilization promotes the clearance of secretions, reducing the risk of infection and improving oxygenation.
- **Reduction of Sedation Effects:** Physical activity can reduce the need for sedatives, which may lead to faster recovery and better respiratory outcomes.

7. Conclusion

It is, therefore, a positive intervention in improving respiratory outcomes in mechanically ventilated patients. These include the reduction of the incidence of VAP, reduced mechanical ventilation time, and the ability to wean sooner. Further randomized controlled trials with higher quality are needed to find out the best timing, intensity, and mobilization protocols; however, at this point, evidence is encouraging enough to integrate mobilization into standard ICU care for ventilated patients..**(28)**

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