



Care of Critically Ill Patients

Influence of muscle strength on early mobility in critically ill adult patients: Systematic literature review



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ABSTRACT

Background: Muscle strength may be one indicator of readiness to mobilize that can be used to guide decisions regarding early mobility efforts and to progressively advance mobilization.

Objectives: To provide a synthesis of current measures of muscle strength in the assessment of early mobilization in critically ill adult patients who are receiving MV therapy.

Methods: Research studies conducted between 2000–2015 were identified using PubMed, CINAHL, MEDLINE, and the Cochrane Database of Systematic Reviews databases using the search terms “muscle strength”, “intensive care”, “mechanical ventilation” and “muscle weakness”.

Results: Nine articles used manual muscle testing, the Medical Research Council scale and/or hand-held dynamometer to provide objective measures for assessing muscle strength in the critically ill adult patient population.

Conclusions: Further research is needed to examine the application of standardized measures of muscle strength for guiding decisions regarding early and progressive advancement of mobility goals in adult ICU patients on MV.

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Introduction

Immobility in the critically ill adult patient

Muscle weakness, prevalent in the critically ill patient, is multi-factorial in its causes and may be compounded by neuromuscular, cardiovascular, pulmonary, psychological, pharmacological and equipment barriers.^{9,21,27} Intensive care unit (ICU) patients may experience deficits in their attention, arousal and cognitive abilities²⁶, especially if neuromuscular blocking agents and sedatives have been administered as part of their plan of

care. Neuromuscular dysfunction has been identified as an etiology of muscle weakness due to disease processes found in the ICU patient population, such as sepsis, multiple organ dysfunction syndromes, and acute respiratory distress syndrome.^{11,15} Further complicating muscle weakness in critically ill patients are possible neurosensory impairments (e.g., tactile, auditory, visual) and localized barriers/injuries (e.g., invasive lines/tubes, pressure ulcers) frequently experienced during critical illness. Reduced venous return resulting in deep vein thrombosis^{8,23} and pulmonary complications, such as atelectasis and pneumonia, are unfortunate sequelae of muscle weakness and immobility.^{8,23}

Persistent muscle weakness and immobility due to muscle deconditioning can be unfortunate consequences of mechanical ventilation therapy. Mechanical ventilation, the process of exchanging oxygen and carbon dioxide using a device, may impact early mobilization and lengthen the ICU stay. It is well established that the implementation of an early mobilization program improves patient outcomes, to include functional status, patients getting out of the bed sooner in the ICU setting, and decreased hospital and ICU days.^{2,6,19,28} However, health care

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team members are often hesitant to initiate early mobility interventions for patients who require MV because of perceptions that they may put the patient at increased risk of accidental extubation or injury. In recent years, several research studies have concluded that mobilizing patients on MV therapy is safe, feasible and minimizes the long-term effects of immobilization.^{2,6,19,28} Muscle strength is often assessed in other patient populations to guide the delivery of activity interventions and determine rehabilitation needs. Less attention, however, has been focused on identifying the influence of muscle strength on early mobilization in the critically ill adult patient on MV therapy. Equally important is determining how muscle strength can be measured in this patient population at the bedside. Understanding and recognizing the influence of muscle strength on decreasing muscle deconditioning has the potential to increase early mobilization in this patient population. Muscle strength is an important measure for predicting and evaluating early mobilization in the critically ill adult patient on MV therapy. Therefore, a literature review was performed to provide a synthesis of current measurements of muscle strength used in the assessment of readiness to mobilize in critically ill adult patients who are receiving MV therapy. The questions guiding the systematic literature review were:

- (a) What measurements have been used to assess muscle strength in adult critically ill patients receiving mechanical ventilation therapy?
- (b) Which measurements demonstrate readiness for early mobilization in adult critically ill patients receiving mechanical ventilation therapy?

Muscle strength in the critically ill adult patient

Despite the dissemination of literature promoting the importance of early mobilization in the critically ill patient receiving MV therapy, there is a lack of research that has explored the influence of muscle strength on early mobilization in this patient population. Numerous patients admitted to an ICU setting acquire a syndrome described as a neuromuscular dysfunction, which is characterized as generalized limb and respiratory muscle weakness.⁵ This syndrome, which has come to be known as critical illness neuromyopathy (CINM), occurs in critically ill patients without previous neuromuscular disease, indicating its simultaneous development with the critical illness and/or treatments.^{11,21,22} CINM has a respiratory neuromuscular weakness and peripheral neuromyopathy components.⁹ The respiratory neuromuscular component of CINM has been shown to be a predictor of delayed weaning in patients receiving MV therapy as well as associated with peripheral myopathy weakness.⁹ Although the respiratory component of CINM is not the focus of this literature review, it is a vital assessment area in the overall outcome of critically ill adults being able to perform activities during and following their ICU stay.

The peripheral neuromyopathy weakness component of CINM, which has come to be described as ICU-acquired weakness (ICU-AW),¹⁰ has raised awareness of its clinical significance in the critically ill adult. The prevalence of muscle weakness in patients who regain normal consciousness after greater than one week of MV therapy is 25%–60%.¹⁰ These patients have demonstrated muscle waste peaking during the first three weeks of ICU stay, indicating early physical activity in this patient population can benefit overall muscle health and minimize muscle deconditioning.¹⁴ Patients experiencing ICU-AW often have a diagnosis of sepsis leading to multiple organ and respiratory failure requiring prolonged MV therapy.²² Patients exhibiting both limb and respiratory weakness are at risk of experiencing clinically significant decline in their muscle strength, requiring purposeful interventions to support early mobility. While there has been a significant focus on respiratory muscle weakness, less emphasis has been placed on measuring limb strength as a potential influence of mobility readiness.

Methods

Eligibility criteria and sources

Using the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines,¹⁸ the PubMed/MEDLINE, CINAHL, and the Cochrane Database of Systematic Reviews databases were searched to access research studies published between the years 2000–2015 to reflect current best practice. The articles were primary research conducted in an adult ICU setting on patients receiving MV therapy, assessing muscle strength and reported in the English language. This literature review was conducted from May 2014–November 2015 using the search terms “muscle strength”, “intensive care”, “mechanical ventilation” and “muscle weakness”. Although this literature search started in May 2014, it was not completed until November 2015 due to time constraints in completing the search.

Search and study selection

Using the PubMed database, the above-mentioned search terms were used with a search date range of “01/01/2000 through 11/14/2015”, “humans”, “English language”, and “adults: 19+ years” as additional limiters. The results yielded a total of 97,848 articles. Each search term was added to the search builder section of the advanced search method using the “AND” operator, yielding (34) articles. This same process was used for each of the other database searches. Screening of the articles was independently performed by the primary author. Using the inclusion and exclusion criteria, initial screening included a review of each article's title, which eliminated (17) articles due to the title having a different patient or disease foci, such as red blood cells, neurologic disease, electrical stimulation and heart transplantation. An additional (11) articles were eliminated after reading the title, full abstract, introduction

Table 1
Literature search inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> ✓ Adults >18 years old ✓ Admitted to an ICU setting ✓ Receiving mechanical ventilation for duration of their participation in study ✓ Assessing muscle strength ✓ English language, spoken and comprehended by the patient ✓ Original Study (not a review, editorial) 	<ul style="list-style-type: none"> ✓ Patients not in the ICU setting during study ✓ Patients with pre-existing neuromuscular disorders, trauma, missing limbs, orthopedic disorders, unable to ambulate independently or with an assist device during their admission and patients with cardiac dysfunctions ✓ Patients using nerve stimulation ✓ Patients not awake, currently on sedation, paralyzed or that require stimulated muscle force

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