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[Intervention Review]

Automated versus non-automated weaning for reducing the duration of mechanical ventilation for critically ill adults and children

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ABSTRACT

Background

Automated closed loop systems may improve adaptation of the mechanical support to a patient's ventilatory needs and facilitate systematic and early recognition of their ability to breathe spontaneously and the potential for discontinuation of ventilation.

Objectives

To compare the duration of weaning from mechanical ventilation for critically ill ventilated adults and children when managed with automated closed loop systems versus non-automated strategies. Secondary objectives were to determine differences in duration of ventilation, intensive care unit (ICU) and hospital length of stay (LOS), mortality, and adverse events.

Search methods

We searched the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2011, Issue 2); MEDLINE (OvidSP) (1948 to August 2011); EMBASE (OvidSP) (1980 to August 2011); CINAHL (EBSCOhost) (1982 to August 2011); and the Latin American and Caribbean Health Sciences Literature (LILACS). In addition we received and reviewed auto-alerts for our search strategy in MEDLINE, EMBASE, and CINAHL up to August 2012. Relevant published reviews were sought using the Database of Abstracts of Reviews of Effects (DARE) and the Health Technology Assessment Database (HTA Database). We also searched the Web of Science Proceedings; conference proceedings; trial registration websites; and reference lists of relevant articles.

Selection criteria

We included randomized controlled trials comparing automated closed loop ventilator applications to non-automated weaning strategies including non-protocolized usual care and protocolized weaning in patients over four weeks of age receiving invasive mechanical ventilation in an intensive care unit (ICU).

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Data collection and analysis

Two authors independently extracted study data and assessed risk of bias. We combined data into forest plots using random-effects modelling. Subgroup and sensitivity analyses were conducted according to a priori criteria.

Main results

Pooled data from 15 eligible trials (14 adult, one paediatric) totalling 1173 participants (1143 adults, 30 children) indicated that automated closed loop systems reduced the geometric mean duration of weaning by 32% (95% CI 19% to 46%, $P = 0.002$), however heterogeneity was substantial ($I^2 = 89\%$, $P < 0.00001$). Reduced weaning duration was found with mixed or medical ICU populations (43%, 95% CI 8% to 65%, $P = 0.02$) and Smartcare/PS™ (31%, 95% CI 7% to 49%, $P = 0.02$) but not in surgical populations or using other systems. Automated closed loop systems reduced the duration of ventilation (17%, 95% CI 8% to 26%) and ICU length of stay (LOS) (11%, 95% CI 0% to 21%). There was no difference in mortality rates or hospital LOS. Overall the quality of evidence was high with the majority of trials rated as low risk.

Authors' conclusions

Automated closed loop systems may result in reduced duration of weaning, ventilation, and ICU stay. Reductions are more likely to occur in mixed or medical ICU populations. Due to the lack of, or limited, evidence on automated systems other than Smartcare/PS™ and Adaptive Support Ventilation no conclusions can be drawn regarding their influence on these outcomes. Due to substantial heterogeneity in trials there is a need for an adequately powered, high quality, multi-centre randomized controlled trial in adults that excludes 'simple to wean' patients. There is a pressing need for further technological development and research in the paediatric population.

PLAIN LANGUAGE SUMMARY

Do ventilators that manage the reduction in ventilator support (weaning) reduce the duration of weaning compared to strategies managed by clinicians?

Background and Importance

Critically ill patients receiving assistance from breathing machines (ventilators) may be restored to normal breathing using clinical methods (collectively termed weaning) that require both expertise and continuous monitoring. Inefficient weaning may result in a prolonged time on a ventilator putting patients at risk of lung injury, pneumonia, and death. At times delivery of the most effective and efficient care may be difficult due to organizational constraints. Computerized weaning systems may provide a solution to inefficient weaning methods. In this Cochrane review we evaluated if computerized weaning systems were more effective than clinical methods used by clinicians for reducing inappropriate delays in weaning, the overall duration of ventilation, and the length of intensive care unit (ICU) and hospital stays.

Findings

We identified 17 studies that provided information on a total of 1173 people including 1143 adults and 30 children. Studies were conducted in people with medical reasons for needing admission to ICU such as pneumonia and other infections, people admitted following trauma, and people admitted after heart or other forms of surgery. As well, various commercially available computerized weaning systems were studied. We found that computerized weaning systems resulted in a reduced weaning duration as well as reduced overall time on the ventilator and stay in an ICU. The average time for a person to be weaned off the ventilator was reduced by 32%. The overall time on the ventilator was reduced by 17% and the length of stay in ICU by 11%. Not all studies demonstrated these reductions. Studies conducted only in people admitted to ICU following surgery did not demonstrate reductions in weaning, overall time on a ventilator, or ICU stay.

Limitations

Because of differences in the methods and results of some studies included in this review, further large scale research is warranted. There is also a need for more studies that examine the effect of computerized weaning systems in children.