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EDITORIAL

Weaning patients off invasive ventilation

Non-invasive ventilation may improve outcomes in selected patients, but the evidence is weak

At any given time, 30-70% of patients in the intensive care unit (ICU) are receiving mechanical ventilatory support; 70-80% of them are rapidly weaned off this support, often within a few days.[1] Weaning is more problematic in the remaining 20-30% of patients, usually because of unfavourable respiratory mechanics, residual disease processes, cardiac dysfunction, respiratory muscle weakness, high secretion volumes, or altered mental status. The process of weaning from ventilation may account for more than half the total time spent on the ventilator, and it consumes a considerable number of ICU resources.

Failure of weaning increases the length of stay in the ICU and hospital and exposure to the risks of prolonged ventilation, including ventilator associated pneumonia, respiratory muscle deconditioning, and airway problems such as stenosis.[2,3] In the linked systematic review and meta-analysis (doi:10.1136/bmj.b1574), Burns and colleagues ask an important question about how to manage patients who fail initial attempts to free them from mechanical ventilation [4]—is it safer and more effective to wean patients using non-invasive ventilation rather than continuing with invasive support?

In deciding on readiness to wean, reliance on clinical judgement or even specific clinical criteria may cause delay. The predictive value of the best defined clinical indicators such as negative inspiratory force, respiratory rate, minute ventilation, tidal volume, and ratio of frequency to tidal volume is only modest,[5] and reintubation is required in only about half of patients in whom unplanned self extubation or endotracheal tube displacement occurs.[6] Landmark studies in the 1990s led to the introduction of daily spontaneous breathing trials, where ventilatory support is reduced to very low levels on a ventilator or oxygen is delivered without positive pressure through a device called a T piece.[7,8] Patients who cope with this process for 30 minutes to two hours have a high likelihood of successful liberation from the ventilator and endotracheal tube (as long as they are awake and able to clear their secretions). Those who do not cope need continued ventilatory support. The use of daily spontaneous breathing trials reduces the duration of ventilation, as does protocol based weaning that incorporates these trials.[9] Prolonged sedation contributes to immobility and dependence on ventilators or endotracheal tubes, and combining breaks from sedation with spontaneous breathing trials improves outcomes and length of stay compared with spontaneous breathing trials alone.[10] Weaning protocols that do not take into account the level of consciousness or level of sedation may not be fully effective, and this probably applies to clinical trial protocols also.

Although the data supporting the use of spontaneous breathing trials and pressure support ventilation to wean patients off invasive ventilation are good, the best way to wean those who fail spontaneous breathing trials is unclear. Many patients who fail the breathing trials need relatively low ventilatory support pressures, are conscious, can cope with their chest secretions, and do not need an artificial airway. Burns and colleagues' review of 12 studies (eight of which looked exclusively at patients with chronic obstructive pulmonary disease) is an update of a previous meta-analysis of five trials with 171 patients published in 2006 with similar conclusions and similar limitations.[11] The current review provides evidence that in patients who fail spontaneous breathing trials, non-invasive weaning significantly reduces mortality (relative risk 0.55, 95% confidence interval 0.38 to 0.79), ventilator associated pneumonia (0.29, 0.19 to 0.45), duration of ventilation, and lengths of stay in the ICU and hospital. The review supports

the application of non-invasive weaning in selected patients who fail spontaneous breathing trials, particularly those with chronic obstructive pulmonary disease.

However, in addition to relatively low patient numbers (530 across the 12 trials), the included studies have several problems that may alter our perception of the results. Firstly, only one study used a sedation protocol—a means of defining and standardising the appropriate sedatives to use and the target level of sedation needed—and the level of sedation may have influenced the duration of weaning and the risk of ventilator associated pneumonia. Secondly, ventilator associated pneumonia and mortality were variable and in some cases surprisingly high in the control groups (6.3% to 59.1% and 11.1% to 60%, respectively). Ventilator associated pneumonia may have been relatively overdiagnosed in the conventional weaning group because the lower respiratory tract was more accessible to sampling (via the endotracheal tube) than in the non-invasive weaning group. The trials span a 10 year period during which considerable changes have occurred in ICU practice, with a reduction in ventilator associated pneumonia, and this may have influenced results. Thirdly, the dominance of patients with chronic obstructive pulmonary disease limits the applicability of the results to the wider population on ventilatory support. Fourthly, a key component of successful non-invasive ventilation is the selection of appropriate equipment. Problems with the patient-ventilator interface, such as nasal bridge ulceration and leaks, lead to poor tolerance, and this may reduce the effectiveness of non-invasive ventilation. High circuit leaks and patient inspiratory flow demands may limit the effectiveness of older ICU ventilators and favour dedicated non-invasive ventilation machines or newer ICU ventilators with non-invasive ventilation modes. We cannot determine the extent to which these factors influenced the results of the trials.

Burns and colleagues correctly state that a definitive clinical trial is needed to tackle these problems. Given the consistency of the results for patients with chronic obstructive pulmonary disease, it could be argued that the evidence in this population is sufficient for clinicians to consider using non-invasive weaning in suitable patients. Any future trial may do better to focus on ICU patients without exacerbations of chronic obstructive pulmonary disease. It must be adequately powered with defined outcomes, and it should take account of factors such as the management of sedation, methods of screening for readiness to wean, weaning techniques, and non-invasive ventilation technique and equipment.

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References

1. Esteban A, Frutos F, Tobin MJ, Alia I, Solsona JF, Valverdu I, et al. A comparison of four methods of weaning patients from mechanical ventilation. N Engl J Med 1995;332:345-50.
2. Esteban A, Anzueto A, Frutos F, Alia I, Brochard L, Stewart TE, et al. Characteristics and outcomes in adult patients receiving mechanical ventilation: a 28-day international study. J Am Med Assoc 2002;287:345-55.
3. Epstein S. Complications in ventilator supported patients. In: Tobin M, ed. Principles and practice of mechanical ventilation. 2nd ed. New York: McGraw-Hill, 2006:877-902.
4. Burns KEA, Adhikari NKJ, Keenan SP, Meade M. Use of non-invasive ventilation to wean critically ill adults off invasive ventilation: meta-analysis and systematic review. BMJ 2009;338:b1574.
5. Epstein SK. Weaning from ventilatory support. Curr Opin Crit Care 2009;15:36-43.
6. Mion LC, Minnick AF, Leipzig RM, Catrambone CD, Johnson ME. Patient-initiated device removal in intensive care units: a national prevalence study. Crit Care Med 2007;35:2714-20.
7. Esteban A, Alia I, Gordo F, Fernandez R, Solsona JF, Vallverdu I, et al. Extubation outcome after spontaneous breathing trials with T-tube or pressure support ventilation. The Spanish Lung Failure Collaborative Group. Am J Respir Crit Care Med 1997;156:459-65.
8. Brochard L, Rauss A, Benito S, Conti G, Mancebo J, Rekik N, et al. Comparison of three methods of gradual withdrawal from ventilatory support during weaning from mechanical ventilation. Am J Respir Crit Care Med 1994;150:896-903.
9. Girard TD, Ely EW. Protocol-driven ventilator weaning: reviewing the evidence. Clin Chest Med 2008;29:241-52.
10. Girard TD, Kress JP, Fuchs BD, Thomason JW, Schweickert WD, Pun BT, et al. Efficacy and safety of a paired sedation and ventilator weaning protocol for mechanically ventilated patients in intensive care (awakening and breathing controlled trial): a randomised controlled trial. Lancet 2008;371:126-34.
11. Burns KEA, Adhikari NKJ, Meade MO. A meta-analysis of noninvasive weaning to facilitate liberation from mechanical ventilation. Can J Anesth 2006;53:305-15.