MECHANICAL VENTILATION

Care of patients undergoing weaning from mechanical ventilation in critical care


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Abstract
There are several reasons why mechanical ventilation – the use of an artificial device to assist a patient to breathe – may be initiated, for example to enable general anaesthesia for patients undergoing surgery, and for those with a compromised airway or respiratory failure. It is important that critical care nurses have the skills and knowledge to care for patients who are undergoing weaning from mechanical ventilation. This is to ensure that patients are weaned safely and as soon as possible, to improve their outcomes and avoid an increase in patient mortality and morbidity through complications that can arise such as airway trauma and ventilator-associated pneumonia. Furthermore, there are resource and cost implications of patients not being weaned as soon as possible.

Keywords
critical care, critical care nursing, extubation, mechanical ventilation, mechanical ventilation weaning, respiratory failure

EFFECTIVE RESPIRATION depends on the combination and interdependence of several functions within the respiratory, cardiovascular and central nervous systems. Failure of any of these systems will disrupt homeostasis and result in rapid cell death because of hypoxia and accumulation of toxic waste products in the body (Patton and Thibodeau 2015). When a patient’s self-ventilation is inadequate, mechanical ventilation or invasive ventilator support functions to assist or replace a patient’s own ventilation (Woodrow 2012). The three main indications for mechanical ventilation are (Baid et al 2016):

• Reversing life-threatening hypoxaemia.
• Decreasing the work or effort of breathing.
• Supporting or assisting breathing in acute ventilatory failure.

Mechanical ventilation in critical care involves the use of positive pressure to ventilate a patient’s lungs (Cutler and Cutler 2010). The overall aim of mechanical ventilation is to improve gas exchange. This is achieved by altering a patient’s lung movement, through the control of airflow during inspiration, gas pressure and speed of expiration (Mallett et al 2013). Table 1 defines some of the commonly used terms in this area.

Mechanical ventilation is achieved through a patient being sedated and an appropriately trained healthcare practitioner inserting an endotracheal tube. After the endotracheal tube has been inserted, a cuff is inflated at the end of the tube to enable it to sit securely within the airway. This cuff allows a secure route for gasses to pass to and from the ventilator and the patient. Once this has been achieved, the patient is connected to a mechanical ventilator.

There are several modes of mechanical ventilation that can fully control the patient’s ventilation or assist the patient’s self-ventilation. Traditionally, ventilation modes can be divided into three categories:
pressure, volume and spontaneous. However, modes of ventilation have recently been developed that cross these boundaries (Mallett et al 2013). The most common modes of mechanical ventilation are outlined in Table 2.

When a patient is commenced on mechanical ventilation, the weaning process should begin as soon as possible (Boles et al 2007). The term ‘weaning’ describes the entire process of withdrawing the patient from mechanical ventilatory support (Boles et al 2007). The Intensive Care Society (ICS) (2007) defined weaning as ‘the gradual reduction of ventilatory support and its replacement with spontaneous ventilation’. While this definition is widely accepted, it should be noted that there are other accepted definitions worldwide.

Successful weaning is dependent on the patient demonstrating a strong respiratory effort, an appropriate level of consciousness to sustain spontaneous breathing, sufficient respiratory muscle strength and a stable cardiovascular system (Cutler and Cutler 2010). The incidence of weaning failure is significant, with 20-30% of patients being deemed difficult to wean from mechanical ventilation (Table 1) (Heunks and van der Hoeven 2010). Several patient groups, such as those with chronic obstructive pulmonary disease, cardiac diseases, spinal injuries and people aged over 65 years, are at increased risk of weaning failure (Jeganathan et al 2015).

Prolonged delays in the discontinuation of mechanical ventilation can increase complications such as airway trauma and ventilator-associated pneumonia (VAP) (MacIntyre et al 2001, White 2012). Patients who have failed to respond to discontinuation attempts, or require mechanical ventilation beyond 24 hours, may be referred to as ‘ventilator dependent’ (MacIntyre et al 2001, White 2012). It is important to identify the cause of ventilator dependence, since reversible conditions can be treated and, as such, assist with improving patient outcomes. There are several reasons why patients may become ventilator dependent, including neurological, respiratory, cardiovascular and psychological issues (MacIntyre et al 2001, White 2012).

Critical care nurses require an understanding of the physiology and pathophysiology of the respiratory system, as well as the knowledge and skills to provide care for patients undergoing mechanical ventilation and, specifically, weaning from mechanical ventilation to ensure optimal patient outcomes (Adam et al 2017).

**TABLE I. Commonly used terms in mechanical ventilation**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>Intubation</td>
<td>Insertion of a tube into an organ or body part, in this case the insertion of an endotracheal tube through the mouth or nose into the trachea to achieve a patent airway (Mosby 2016)</td>
</tr>
<tr>
<td>Extubation</td>
<td>Removal of a tube from an organ or body part, in this case removal of an endotracheal tube (Mosby 2016)</td>
</tr>
<tr>
<td>Anatomical dead space</td>
<td>The space before the level of the terminal bronchioles or the volume of air inhaled, usually around 150mL, which does not contribute to gas exchange (Cutler and Cutler 2010)</td>
</tr>
<tr>
<td>Positive end-expiratory pressure</td>
<td>Pressure in the lungs (alveolar pressure) above atmospheric pressure at the end of expiration (Cutler and Cutler 2010)</td>
</tr>
<tr>
<td>Simple weaning</td>
<td>Successful extubation from the first attempt at initiating weaning (Intensive Care Society (ICS) 2007)</td>
</tr>
<tr>
<td>Difficult weaning</td>
<td>Patients who take up to seven days to achieve successful extubation, or require up to three spontaneous breathing trials (ICS 2007)</td>
</tr>
<tr>
<td>Prolonged weaning</td>
<td>Three failed spontaneous breathing trials or failure to wean following seven days of weaning after the first spontaneous breathing trial (ICS 2007)</td>
</tr>
<tr>
<td>Tidal volume</td>
<td>Lung volume representing the normal volume of air displaced between normal inhalation and exhalation when extra effort is not applied (ICS 2007)</td>
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**Weaning from mechanical ventilation**

The ICS (2007) described weaning from mechanical ventilation as ‘the gradual decrease of ventilatory support and its replacement with the patient’s own spontaneous ventilation. In some cases, this process is rapid and uneventful; however, for some patients the process may be prolonged for days or weeks’. Weaning beyond +/- 5 to 21 days is considered to be prolonged weaning (ICS 2007).
The ICS (2007) emphasised that prolonged weaning from mechanical ventilation is an issue in every intensive care unit (ICU) and is associated with increased patient mortality and morbidity, as well as having cost and resource implications.

Sedation may be required for the patient to tolerate insertion of the endotracheal tube and mechanical ventilation. However, the adverse effects of prolonged sedation are often underestimated (Whitehouse et al 2014). Prolonged sedation may be associated with: increased mortality; increased duration of mechanical ventilation; further critical illness such as the potential for sepsis and multiple organ failure; and post-traumatic stress disorder (Whitehouse et al 2014).

The ICS (2007) stated that mechanical ventilation can only be discontinued when the patient can breathe spontaneously. The most important factor in the weaning process is to treat or minimise the underlying condition that may prevent weaning, since it will not be possible to wean the patient from mechanical ventilation if they are not able to breathe independently (ICS 2007). There are several factors than can prevent weaning, including sedation, pain, abdominal distention, pleural effusion and pneumothorax (ICS 2007).

Davidson et al (2016) recommended that patients who are mechanically ventilated should have a documented weaning plan, and spontaneous breathing should be established as soon as possible. A daily assessment of readiness for weaning should be undertaken, and transition from controlled ventilation to assisted ventilation, such as pressure support ventilation (PSV) (Table 2), should occur as soon as possible (Davidson et al 2016).

The patient can be assessed as ready to wean using the physiological parameters outlined in The Intensive Care Foundation (ICF) (2015) Handbook of Mechanical Ventilation. These criteria include clinical assessment of adequate cough, absence of excessive respiratory secretions and resolution of disease acute phase for which the patient was intubated, as well as objective measurements of clinical stability, adequate oxygenation, adequate pulmonary function, adequate mentation (mental activity), and if the patient has no sedation or adequate mentation on sedation (or is a stable neurologic patient). However, the ICF (2015) emphasise that these criteria are not a strict requirement for readiness to wean, but should be used as a guide for decision-making since the patient may not meet all the criteria simultaneously.

Davidson et al (2016) stated that daily spontaneous breathing trials and progressive reduction of PSV are satisfactory methods of weaning. A spontaneous breathing trial involves using a T-piece (a T-shaped adaptor that connects to an artificial airway and does not deliver any ventilator support), or continuous positive airway pressure (Table 2) of ≤7cm H₂O, and is monitored closely for 30-120 minutes. To achieve

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**TABLE 2. Common modes of mechanical ventilation**

<table>
<thead>
<tr>
<th>Mode of mechanical ventilation</th>
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<tr>
<td>Pressure control ventilation</td>
<td>Exposure of the airway to a set pressure at a set frequency, for a set period. The volume delivered will depend upon the compliance of the patient’s lungs and chest wall</td>
</tr>
<tr>
<td>Bi-level positive airway pressure ventilation</td>
<td>Pressure-controlled ventilation with spontaneous breathing permitted throughout the respiratory cycle; the spontaneous breaths are pressure supported</td>
</tr>
<tr>
<td>Airway pressure release ventilation</td>
<td>Maintains a high airway pressure for a prolonged period, intermittently releasing gas for short periods at a lower pressure. The tidal volume delivered is dependent on the compliance of the lungs and the difference between the set high (inspiratory) and low (expiratory) pressures</td>
</tr>
<tr>
<td>Assist-control ventilation</td>
<td>Mixed ventilation mode whereby the patient receives a mandatory breath with a set pressure or set tidal volume. If the patient is able to trigger the ventilator, the patient’s breath will be assisted. If the patient is not able to trigger the ventilator, the patient's breath will be fully controlled</td>
</tr>
<tr>
<td>Synchronised intermittent mandatory ventilation</td>
<td>Mixed ventilation mode combining mandatory controlled breaths (volume or pressure controlled) and spontaneous pressure supported breaths</td>
</tr>
<tr>
<td>Pressure support ventilation</td>
<td>Assists inspiration through increasing the airway pressure in response to the patient’s spontaneous breath</td>
</tr>
<tr>
<td>Continuous positive airway pressure</td>
<td>Continuous positive airway pressure delivered throughout the respiratory cycle for the patient who is able to breathe spontaneously</td>
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(Adapted from Intensive Care Foundation 2015)
a successful spontaneous breathing trial, the patient must be comfortable, haemodynamically stable within acceptable parameters and have adequate gas exchange (ICF 2015). The patient is deemed to have failed the spontaneous breathing trial if the following are present (ICF 2015):

- Agitation and anxiety.
- Depressed mental status.
- Diaphoresis (sweating).
- Cyanosis.
- Evidence of increasing effort.
- Increased accessory muscle activity.
- Facial signs of distress.
- Dyspnoea (difficult or laboured breathing).
- Partial pressure of oxygen (PaO₂) ≤6.67-8kPa on fraction of inspired oxygen (FiO₂) ≥0.5 or saturated arterial oxygen (SaO₂) <90%.
- Partial pressure of carbon dioxide (PaCO₂) >6.67kPa or an increase in PaCO₂ >1.07kPa.
- pH <7.32 or a decrease in pH ≥0.07.
- Respiratory rate divided by tidal volume (rapid shallow breathing index) >105 breaths/minute/L.
- Heart rate >140 beats/minute or increased by ≥20%.
- Systolic blood pressure >180mmHg or increased by ≥20%.
- Systolic blood pressure <90mmHg.
- Cardiac arrhythmias.

However, these criteria must be used as a guide alongside clinical judgement (ICF 2015). If the patient fails the spontaneous breathing trial, mechanical ventilation should continue and the patient should be reassessed on a daily basis (ICF 2015). If the patient fails three consecutive spontaneous breathing trials or has been mechanically ventilated for longer than one week, a more gradual approach to reducing support from the mechanical ventilator may be required (Adam et al 2017).

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The patient’s respiratory support should gradually be decreased until full discontinuation of mechanical ventilation is achieved and the patient can be extubated. If ventilatory support is still required post-extubation, a non-invasive positive pressure ventilation system may be used during the weaning phase (ICS 2007). The ICS is currently conducting a large randomised controlled trial investigating the clinical benefits and cost-effectiveness of using non-invasive weaning strategies as an intermediate step to wean patients off mechanical ventilation, compared with other weaning strategies (Warwick Clinical Trials Unit 2016).

**Trachostomy**

The ICS (2007) recommended that in patients failing to wean rapidly (+/- 5 to 21 days), a trachostomy should be considered because it can facilitate weaning from mechanical ventilation. Trachostomies reduce the anatomical dead space (Table 1) and therefore make weaning easier since the work or effort of breathing is reduced (Woodrow 2012). The ICS (2014) stated that the use of temporary trachostomies in the general critical care population has increased because it is believed that they promote early weaning, patient mobilisation and reduced sedation requirements. However, early insertion of a trachostomy has not been found to reduce
mortality, VAP and the duration of invasive mechanical ventilation (Davidson et al 2016). Additionally, tracheostomies are associated with preventing an adequate cough and can impair a patient’s ability to swallow (ICS 2007).

**Extubation**

Extubation should take place following a successful spontaneous breathing trial or a prolonged weaning plan for the patient (ICF 2015). The criteria for extubating a patient are as follows (ICF 2015):

- Patient should be awake.
- Patient should be able to cough.
- Patient should be able to follow instructions.
- Successful completion of a spontaneous breathing trial.
- Patient haemodynamically stable.
- Breathing spontaneously with minimal support.
- Appropriate respiratory observations.
- Patient able to maintain airway patency. The Difficult Airway Society (2011) algorithm can also assist healthcare practitioners when extubating patients (Figure 1). Failed extubation is defined as the requirement for reintubation within 72 hours following a planned extubation, and can occur in up to 34% of patients (Krinsley et al 2012). Therefore, it is essential that patients are assessed appropriately using clinical assessments and objective measurements throughout weaning and extubation, since failed extubations are associated with a significant increase in morbidity.

**Figure 1. Extubation algorithm from the Difficult Airway Society (DAS)**

![Difficult Airway Society Extubation Algorithm 2011](image)

HDU = high dependency unit; ICU = intensive care unit; OSA = obstructive sleep apnoea

(Reproduced from Popat et al (2012) with permission from the Association of Anaesthetists of Great Britain and Ireland/Blackwell Publishing Ltd)
Risk factors for extubation failure include: rapid, shallow breathing during spontaneous breathing trials; increased age; prolonged duration of mechanical ventilation; increased severity of illness; and pneumonia or pulmonary disease as the cause for mechanical ventilation (Davidson et al 2016). Additional respiratory support, such as ventilatory support, should be provided if risk factors for extubation failure are identified (Davidson et al 2016).

Multidisciplinary team approach
For effective patient weaning from mechanical ventilation, each member of the multidisciplinary team in critical care is required to contribute their expertise through collaborative practice. The Core Standards for Intensive Care Units (The Faculty of Intensive Care Medicine (FICM) and ICS 2013) outlines the roles of each member of the multidisciplinary team and emphasises that their contribution is pertinent to caring for the patient weaning from mechanical ventilation. Consultant-led medical teams, physiotherapists, dietitians, and speech and language therapists, have an essential role in caring for the patient weaning from mechanical ventilation. Physiotherapy involvement is essential to effectively manage the patient’s chest physiotherapy and commence appropriate physical rehabilitation for patients with a tracheostomy. The FICM and ICS (2013) standards state that physiotherapists are essential in developing weaning and rehabilitation strategies that work together to optimise the patient’s lung capacity and lung reserve. The implementation of rehabilitation and early mobilisation in patients who are mechanically ventilated is associated with benefits in physical and psychological function (Ntoumenopoulos 2015); it also decreases the risk of polyneuropathy and reduces the duration of weaning (Blot et al 2014). Physical rehabilitation is crucial since muscle weakness after mechanical ventilation is associated with mortality (Medrinal et al 2017). However, despite physiotherapists often being consulted and contributing actively to weaning protocols, most physiotherapists contribute to weaning through early prescription of exercise rather than the adjustment of respiratory support (Morar and van Aswegen 2016).

Critical care nurses have an important role in ensuring that set nutritional goals are met for patients (Marshall et al 2012). During the acute phase of illness, inconsistent delivery of nutrition can advance malnutrition further (Ros et al 2009). Adequate nutrition must be established in weaning patients because they have increased metabolic requirements because of the body’s normal response to stress involved in critical illness, and they rely on administration of nutritional support to meet their increased demands (Marshall et al 2012).

Critical care nurses have a crucial role in the collaboration of the multidisciplinary team, because they have knowledge of the patient’s response to weaning. Therefore, nurses can support the weaning process using a patient-centred approach, by individualised planning and by assessing patients’ physical and emotional resources (Cederwall et al 2014).

Nursing considerations
Critical care nurses are involved in assessing and monitoring the patient weaning from mechanical ventilation, using the ABC (airway, breathing, circulation) approach. Signs of airway compromise, respiratory distress and cardiovascular instability must be recognised and acted on promptly. Higginson (2011) stated that critical care nurses remain best placed to facilitate effective weaning. Additionally, adjusting weaning parameters requires a high level of skill and training, as well as a comprehensive knowledge of cardiorespiratory physiology and pathophysiology (Higginson 2011).

Tingsvik et al (2015) found that the main factor that influenced the decision-making process regarding when to commence weaning, and when to adjust parameters in accordance with weaning protocols, was the overall assessment of the patient, and that successful weaning required a
skilled, competent nurse. Kydonaki et al (2016) supported these findings, adding that novice critical care nurses required more experience of weaning patients to understand how and when to wean, and to enhance their assessment skills, than experienced nurses. They found that one sample group of nurses in their study demonstrated advanced clinical reasoning in the weaning process. They attributed this to the continuous development programme on mechanical ventilation and weaning that was in place on the unit in which they worked, provided by the medical team. Therefore, investment in nurse education in this area could be an important factor in enhancing the effective management of patients undergoing weaning from mechanical ventilation.

Assessment using the ABC approach

Airway

The airway patency of patients weaning from mechanical ventilation is paramount since they will have an artificial airway (an endotracheal tube or tracheostomy). Patients with a blocked or displaced airway will die quickly if not managed appropriately. Therefore, nurses must have appropriate airway management skills to ensure the position of the airway is secure and the airway remains patent (Higginson et al 2010).

The patency of an artificial airway must be checked regularly. An artificial airway must be secured so that it is immobile (Cutler and Cutler 2010). The size and position of the artificial airway should be documented and checked at least once per shift (Woodrow 2012). The cuff pressure within the artificial airway, whether it be a tracheostomy or endotracheal tube, should be checked and documented regularly. It should not exceed 30cm H₂O. Excessive cuff pressure can result in tissue damage and complications such as tracheal stenosis, ulceration and necrosis (Adam et al 2017).

To ensure the artificial airway remains patent, gases delivered must be humidified and tracheal suctioning performed. Inadequate humidification could result in life-threatening complications such as blockage of the airway with tenacious sputum, secondary infection and impaired gas exchange (ICS 2014). Tracheal suctioning is an essential aspect of secretion control and maintenance of the artificial airway patency (ICS 2014). However, tracheal suctioning is associated with complications such as hypoxia, bradycardia, tracheal mucosal damage and bleeding. Consequently, suctioning requirements should be based on the patient’s individual need and the individual should be encouraged to expectorate their secretions (ICS 2014). Closed-circuit suction systems are advocated since suction-induced hypoxaemia can be reduced because the patient can maintain the oxygen concentration, tidal volume and positive end-expiratory pressure delivered by the ventilator while undergoing suctioning (Cutler and Cutler 2010).

If the patient weaning from mechanical ventilation shows signs of a blocked or displaced airway, such as sudden hypoxia or the triggering of ventilator pressure alarms, the position of the airway should be checked and tracheal suctioning performed to assess airway patency (Cutler and Cutler 2010). An anaesthetist or other appropriate healthcare practitioner must be called immediately to reposition the artificial airway or reintubate the patient if necessary.

The National Tracheostomy Safety Project (www.tracheostomy.org.uk) was developed to enhance the care of patients with a tracheostomy, including producing emergency algorithms to improve the management of tracheostomy-related critical incidents by first responders.

Breathing

When caring for the patient weaning from mechanical ventilation, observations must be undertaken continuously, with a focus on respiratory distress, hypoxaemia and fatigue (Cutler and Cutler 2010). Patients weaning from mechanical ventilation should be constantly monitored through pulse oximetry (oxygen haemoglobin saturation) and capnography (exhaled end-tidal carbon dioxide monitoring). Although these methods are not as reliable as
obtaining an arterial blood gas reading of the PaO₂ and PaCO₂, they can be used as a guide to assess the efficiency of ventilation (Adam et al 2017). Regular arterial blood gas measurements should be obtained to ensure the patient is ventilating adequately and ventilator support is adjusted accordingly, to normalise blood pH, PaO₂ and PaCO₂ levels.

The patient’s position when weaning from mechanical ventilation should be considered. They should be positioned in a 30-45 degree semi-recumbent position to increase the depth of breathing and reduce the resistance of inspiration and the incidence of VAP resulting from aspiration of stomach contents (Adam et al 2017).

There are four main steps to conducting a respiratory system examination: inspection, palpation, percussion and auscultation. The critical care nurse must examine the patient’s breathing to ensure equal air entry and detect any abnormalities that may prevent weaning, such as wheeze or crackles on auscultation, which could be indicative of pneumonia, atelectasis and other lung diseases (Cutler and Cutler 2010).

The nurse should monitor the patient’s respiratory rate and tidal volume on PSV because it may be necessary to adjust the pressure support to avoid tachypnoea or large tidal volumes. Because of the nature of critical illness and the effort of breathing, the patient is at a higher risk of respiratory fatigue and distress, and Newmarch (2006a) stated that critical care nurses are in an ideal position to identify signs of respiratory fatigue as early as possible because they have a high level of contact with patients. Patients weaning from mechanical ventilation should be monitored continuously for signs of respiratory distress. The most common signs are: rapid, shallow breathing; reduced tidal volumes; use of accessory muscles; tachycardia; reduced arterial oxygenation saturations; and increased carbon dioxide levels (Newmarch 2006a).

Circulation

To wean a patient from mechanical ventilation successfully, the patient must be haemodynamically stable within acceptable parameters at each phase of weaning. Positive pressure ventilation can decrease cardiac output, which can induce significant cardiopulmonary distress (Newmarch 2006a, 2006b). In this instance, weaning should be discontinued immediately. Therefore, patients weaning from mechanical ventilators should be attached to a cardiac monitor to observe for arrhythmias and blood pressure changes. Fluid balance must also be maintained since adequate hydration is essential in effective recovery from critical illness and in secretion management. However, fluid overload may delay weaning and contribute to its failure (Davidson et al 2016).

Other considerations

Patients who are mechanically ventilated are at increased risk of preventable complications. Care bundles have been developed to reduce ventilator-acquired complications in ventilated patients (The FICM and ICS 2015). Common standards of care include: deep vein thrombosis (DVT) prophylaxis since the patient’s mobility is impaired; gastric ulcer prophylaxis since there is an increased risk of gastric ulcers in critical illness; oral hygiene to prevent VAP; haemoglobin trigger to transfuse blood if haemoglobin falls below 7g/dL; daily sedation holding to reduce duration of mechanical ventilation; and ventilator tube management to prevent airway loss (The FCIM and ICS 2015).

Communication

It is essential to continue to provide holistic care to patients who are critically ill, even when their physical requirements appear more significant. The critical care nurse must consider all dimensions of the patient’s needs, including physical, emotional, social and spiritual aspects (Cutler and Cutler 2010). A critical care admission is a stressful event for patients and their families or significant others (Blot et al 2014). MacIntyre et al (2001) emphasised that psychological factors can lead to ventilator dependence as well.
Weaning protocols

Despite recommendations from as early as 2001 for ICUs to develop and implement weaning protocols (MacIntyre et al 2001), many do not have a weaning protocol in place. Weaning protocols have been developed to provide guidance and criteria for critical care nurses to lead the process in weaning using a staged, structured approach. Blackwood et al’s (2011) systematic review concluded that weaning protocols were associated with significant reductions in mechanical ventilation, including a 25% reduction in total duration of mechanical ventilation, a 78% reduction in weaning duration and a 10% reduction in length of stay in the ICU. White et al (2011) found that weaning protocols supported a reduction in the duration of mechanical ventilation, improved patient outcomes, limited the use of resources and contained costs. Furthermore, the introduction of an evidence-based weaning protocol has been shown to contribute to improved clinical outcomes in mechanically ventilated patients (Zhu et al 2015). When Goodman (2006) developed and implemented a weaning protocol in one district general hospital, the most significant improvement was increased nurse autonomy and decision-making. The protocol also provided the nurse with a tool to enable discussion of the patient’s weaning with medical staff.

Despite this, research has found that critical care nurses rarely use weaning protocols, which are perceived only as guidelines for decision-making (Kydonaki et al 2014). Despite there being significant evidence to support the development and implementation of weaning protocols in terms of improving patient care and clinical outcomes, clinical judgement and experience may be the most significant influencing factor in providing an effective individualised weaning plan for the patient. Developing, trialling and implementing a weaning protocol within ICUs is recommended to evaluate whether they improve patient outcomes and increase nurse autonomy (Balas et al 2013).
Conclusion

Weaning a patient from mechanical ventilation is a complex process with many influencing factors. It should be instigated as soon as possible, because prolonged weaning can increase complications and mortality. Daily assessment of the patient’s readiness to wean and spontaneous breathing trials should be undertaken to extubate a patient successfully. Alternatively, a clear, documented, staged reduction plan of ventilator support may be required for patients undergoing prolonged weaning from mechanical ventilation. A tracheostomy should also be considered in this instance to facilitate the weaning process.

The critical care nurse has a central role in the care of patients undergoing weaning from mechanical ventilation. Use of the ABC approach to assessment can enhance patient safety and enable monitoring for signs of weaning failure.

Weaning protocols have been shown to reduce the duration of mechanical ventilation. However, some evidence suggests that education, clinical judgement and experience can have a significant influence on providing effective weaning care for the patient. Therefore, it is recommended that the weaning protocols that have been developed and implemented in ICUs are evaluated further to determine if they improve patient outcomes and increase nurse autonomy.

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