Providing palliative care for patients receiving mechanical ventilation

Part 1: Invasive and non-invasive ventilation

Christopher E. Cox*, Joseph A. Govert*, Hasan Shanawani*, Amy P. Abernethy†

*Department of Medicine, Division of Pulmonary & Critical Care Medicine, Duke University Medical Center, Durham, North Carolina, USA
†Department of Medicine, Division of Medical Oncology, Duke University Medical Center, Durham, North Carolina, USA

Intensive care units (ICUs) provide care to many patients who ultimately die while receiving, or after withdrawal of, mechanical ventilation. During the transition from curative to palliative care, it is important to emphasise comfort and symptoms' relief. This includes management of the mechanical ventilator. This review outlines a framework for symptoms-based ventilation of the critically ill patient. A future paper will address withdrawal of mechanical ventilation.

One out of five persons dies in an ICU, often after receiving mechanical ventilation (1). Mechanical ventilation is synonymous with critical illness to laypersons and healthcare providers alike. The care of patients who require ventilatory assistance often dominates ICUs in many countries, as this is the most common mode of life support provided to the critically ill (2,3). Even with the most advanced treatment available, about half of those who require mechanical ventilation will die (4). Of those who die while receiving mechanical ventilation, over half have the ventilator withdrawn, though there is considerable variation by hospital and practitioner (5,6).

The goals of critical care are to provide both quality curative care as well as quality end-of-life-care; managing a seriously ill or dying patient receiving mechanical ventilation thoughtfully is central to this mission. Appreciating the physiological complexities of these patients and their interaction with the ventilator is essential to supporting them through a critical illness. In this paper, we aim to address a number of questions that healthcare providers may have about providing palliative care to patients who are receiving mechanical ventilation.

PALLIATIVE CARE OF THE VENTILATED PATIENT

Palliative care is comprehensive, interdisciplinary care, focusing primarily on promoting quality of life for patients with a terminal illness and for their families (7). Perhaps equally relevant to ICU-based palliative care is the attention given to patients' quality of dying and death – or the consistency of a person's preferences for dying with others' perceptions of the actual death itself (8). Domains of the quality of dying and death include symptoms and personal care, preparation for the end of life, circumstances of the moment of death, family issues, treatment preferences, and a person's sense of meaning and purpose (9). In fact, a specific questionnaire has been developed to measure this construct in clinical practice that has evidence of reliability and validity (10). Of the domains of the quality of dying and death relevant to the mechanically ventilated patient, healthcare providers in the ICU often have the closest involvement with symptom management, relating to family members and loved ones, and managing supportive interventions and therapies such as mechanical ventilation itself.

QUALITY INDICATORS FOR END-OF-LIFE CARE

Providing quality end-of-life care and ensuring appropriate services to dying patients and their families should be the goal of all clinicians in ICUs. A helpful framework for guiding and assessing the quality of end-of-life care has
recently been developed that includes the following seven quality indicators (11):

2. Optimising communication within the team, as well as with patients and families.
4. Providing adequate emotional and practical support for patients and families.
5. Addressing symptoms and providing comfort care.
6. Offering spiritual support.
7. Establishing an emotional and organisation support structure for ICU clinicians.

THE PATIENT, DISEASE AND THE MECHANICAL VENTILATOR

Severely ill patients treated in ICUs may develop acute respiratory failure necessitating mechanical ventilation because of gas exchange abnormalities, ventilation abnormalities, or both (Table 1). The severe hypoxaemia seen in patients with acute lung injury or the hypercarbia observed in patients with chronic obstructive pulmonary disease (COPD) exacerbations may herald progressive respiratory muscle fatigue, organ compromise, and respiratory failure. Mechanical ventilation can support these patients while definitive curative therapies are undertaken to correct the underlying disorders leading to respiratory failure such as sepsis, pneumonia, or heart failure. The indications for use of mechanical ventilation are varied (Table 2), though include first and foremost a patient’s desire to undergo this supportive measure. Mechanical ventilation is not a curative therapy in itself and its misapplication can promote systemic inflammation and increase mortality in certain disease states (12–14). However, thoughtful management of the mechanical ventilator can promote patient comfort in any disease state and is, therefore, an aspect of quality curative care as well as quality end of life care.

MECHANICAL VENTILATION: A BRIEF REVIEW

In many countries, non-specialists manage the majority of patients requiring mechanical ventilation (15,16). However, seriously ill or dying ICU patients may have the most complex illnesses and ventilatory demands that can, in turn, challenge the healthcare provider. Understanding the basic types of ventilator is essential to managing some of these potentially difficult cases and optimising the patient–ventilator synchrony – the quality of the interaction between the patient and ventilator that results in a delivered breath – needed to maximise comfort (17).

Conventional mechanical ventilation

To deliver a specific volume, the mechanical ventilator has to deliver a certain driving pressure to overcome endotracheal tube and airways resistance (flow-related pressure), inflate...
the lungs (lung compliance-related pressure), and offset the
chest wall pressure (chest wall compliance-related pressure).
Therefore, each ventilator-delivered breath involves the inter-
play of flow, volume, and pressure. However, a ventilator can
only control one of these variables at a time. Nearly all ven-
tilators are either ‘pressure controlled’ or ‘volume controlled’
on this basis; flow controlled ventilators are rarely encoun-
tered in clinical practice. Pressure controlled ventilators will
have consistent pressure waveforms, though variable flow
and volume tracings (Fig. 1). Volume ventilators will produce
consistent volume and flow waveforms, though have varying
pressure tracings (Fig. 2). Ventilators also can be set to deliv-
er specific patterns of breaths (i.e. mandatory or assisted
breaths). These patterns include ‘continuous mandatory ven-
tilation’ (every breath is mandatory), ‘intermittent mandatory
ventilation’ (mandatory breaths with spontaneous breaths
permitted in between), ‘synchronised intermittent mandatory
ventilation’ (synchronised mandatory breaths with spon-
taneous breaths in between), and ‘pressure support’ (every
breath is spontaneous and typically augmented by a preset
inspiratory pressure).

Each ventilator-delivered breath can be described by
certain ‘respiratory phase variables’ such as the breath’s
trigger, limit, and cycle values. Inspiration is most com-
monly triggered by patient effort (by pressure or flow
changes) or time. Flow triggering compared with pressure
triggering reduces the work of breathing (18). Each breath
is limited by one variable, typically flow or pressure. For
example, in the pressure control mode, breaths are limited
by a preset pressure while volume control breaths are lim-
ited by a preset flow. Once a breath reaches a limiting set-
ing, it is immediately stopped. At this point inspiration is
terminated, or cycled, and expiration begun when a spe-
cific cycle setting is met by a variable. Volume modes are
cycled by the set volume delivered while pressure con-
trolled breaths are cycled by time. Pressure support
breaths are cycled by changes in flow.

Non-invasive positive pressure ventilation (NIV)
An important consideration in the acute setting is whether
or not ventilatory support is warranted for a patient, and
if so, whether non-invasive ventilation is appropriate. NIV
can lessen the sensation of dyspnoea and the work of
breathing, improve the efficiency of gas exchange, and
reduce the likelihood of needing endotracheal intubation
(19,20) NIV also may be a reasonable option for patients who
do not wish to undergo endotracheal intubation under any
circumstances. Non-invasive ventilators provide respiratory
support without endotracheal intubation via a special
nasal or face mask. These ventilators are described typi-
cally as either continuous positive applied pressure
(CPAP) or bilevel positive applied pressure (BiPAP)
devices. CPAP is equivalent to the positive end-expiratory pressure (PEEP) applied by mechanical ventilators via endotracheal tubes. BiPAP machines can be fairly sophisticated and are capable of providing inspiratory positive airway pressure (IPAP – essentially pressure support) as well as expiratory positive airway pressure (EPAP, same as CPAP or PEEP). BiPAP machines can provide the equivalent of pressure support, pressure control, pressure assist-control, or simply CPAP. In the absence of a dedicated BiPAP machine, the equivalent of BiPAP can also be provided through nearly any mechanical ventilator with the appropriate mask.

NIV has been used successfully in the management of patients with acute respiratory failure from a variety of causes including COPD exacerbations, congestive heart failure, hypoxaemic respiratory failure, and others (Table 3; 21–25). It is of special interest as part of palliative care for patients with preterminal conditions who develop acute respiratory failure but decline intubation (26–28). Compared to patients who undergo endotracheal intubation, patients provided with NPIV are sometimes (but not always) more comfortable, require less sedation, suffer fewer complications, and are able to continue verbal communication (29). Although non-invasive in the sense that no endotracheal tube is involved, NIV requires appropriate patient selection, close attention of trained staff, and monitoring (sometimes invasive) in either an ICU or step-down ward in most institutions. NIV suffers several limitations, most especially the need for patient co-operation, which may be limited when the patient suffers preterminal delirium. Another potential problem is the likelihood that respiratory support may be required for some time, perhaps days or indefinitely. NIV is not intended to be used in this situation and its complications are likely to develop such as mask-associated skin ulceration. It should be avoided in patients with frank respiratory arrest. Additional poor candidates include unstable patients with delirium or obtundation, uncontrolled arrhythmias, gastrointestinal bleeding, and excessive secretions.

There is little consensus on the optimal time to initiate NIV. When the care team considers a patient to have failed conventional supplemental oxygen therapy and initial NIV settings vary widely for any given disease, depending on the disease severity and patient tolerance of ventilation. It also depends on the goals outlined by the patient and care team, as they determine the cause of respiratory decompensation, the location of NIV administration (home, hospital, ICU, hospice care), and where NIV and conventional (endotracheal) ventilation fit into the care plan. It might be argued that there is little to lose by providing NIV to patients with respiratory failure who do not wish to be intubated: it may reverse the acute deterioration and provide initial relief from dyspnoea. However, with ultimately high associated mortality rates and the

### Table 3. Indications and contra-indications to non-invasive positive pressure ventilation (NIV)

<table>
<thead>
<tr>
<th>Indications</th>
<th>Chronic</th>
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<tbody>
<tr>
<td>Acute</td>
<td>Respiratory failure or insufficiency without need for immediate intubation</td>
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<tr>
<td></td>
<td>Pulmonary oedema</td>
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<tr>
<td></td>
<td>Acute respiratory acidosis/acute bronchitis</td>
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<td></td>
<td>Respiratory distress with use of accessory muscles or abdominal muscles</td>
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<table>
<thead>
<tr>
<th>Contra-indications</th>
<th>Respiratory or cardiac arrest</th>
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<tbody>
<tr>
<td></td>
<td>Multiple organ failure</td>
</tr>
<tr>
<td></td>
<td>Cause of decompensation unlikely to improve significantly in 24–48 h</td>
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<tr>
<td></td>
<td>Haemodynamic instability</td>
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<tr>
<td></td>
<td>Cardiac arrhythmias</td>
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<tr>
<td></td>
<td>Risk for decompensation unlikely to improve significantly in 24–48 h</td>
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<tr>
<td></td>
<td>Inability to protect the airway</td>
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<tr>
<td></td>
<td>Patient is uncooperative, agitated, or has diminished mental status</td>
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<tr>
<td></td>
<td>Excessive secretions or inability to clear secretions</td>
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<tr>
<td></td>
<td>Upper GI bleed</td>
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<td></td>
<td>Gassing for air</td>
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<td></td>
<td>Facial trauma or deformity</td>
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<td></td>
<td>Recent gastric surgery</td>
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<tr>
<td></td>
<td>Excessive air leak during NIV administration</td>
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Adapted from Meyer and Hill (25) and Stauffer and Silvestri (29).
discomfort many patients suffer with it (30), caregivers should be careful to determine whether patients have an aversion to endotracheal intubation only, long-term NIV, or all forms of life support. Indeed, as NIV blurs the line between palliative and life-prolonging ventilation, NIV adds a complex dimension to palliative care in the acute and chronic setting.

MAXIMISING PATIENT COMFORT

Mechanical ventilation is not a benign therapy for most patients. Severely ill patients may experience physical and mental distress while receiving mechanical ventilation because of its invasive nature, the interventions associated with it (e.g. endotracheal tubes, intravenous catheters, and restraints), and its potential complications (e.g. pneumothorax, air trapping). Patients who are mechanically ventilated generally are unable to talk or eat, further contributing to their potential distress. Depending on the severity of a patient’s underlying respiratory failure, differing degrees of ventilator support may be required. As higher levels of mechanical support are provided (increased PEEP and inspiratory pressures), patients may experience greater discomfort manifested as agitation, tachypnoea, or grimacing. In a recent study, half of patients interviewed recalled receiving mechanical ventilation (31). Of these, 68% had pain and anxiety related to the endotracheal tube, the median pain rating being a 6/10. Of the patients who recalled the ICU in general, nearly 40% experienced significant general pain. Many ventilated patients also experience significant distress during procedures healthcare providers may not associate with discomfort such as deep tracheal suctioning (32). The SUPPORT study also documented that 40% of patients with acute respiratory failure and sepsis spent their last days with significant general pain (33).

In particular, the sensation of dyspnoea, or perceived discomfort in breathing, is common among the critically ill receiving mechanical ventilation (34). Dyspnoea is thought to result in part from a mismatch between the central nervous system respiratory centre’s signal output and the afferent feedback then received from respiratory system receptors (35). SUPPORT also showed that over 55% of patients with acute respiratory failure and sepsis had significant dyspnoea in the last 3 days of life (33). Patients receiving mechanical ventilation may have dyspnoea for reasons related to the ventilator itself that can be treated effectively if recognised. For example, patients may experience increased work of breathing associated with air trapping, or ‘auto-PEEP’. ‘Auto-PEEP’ describes positive intrathoracic pressure present at the end of expiration in addition to the set level of PEEP. The likelihood of developing significant air trapping is associated with increases in minute ventilation (respiratory rate x tidal volume), inspiratory:expiratory time ratio, and the product of airways’ resistance and compliance. Air trapping can be a challenging management issue in patients with severe COPD who need prolonged expiratory times to allow return of the delivered tidal volume. When air trapping develops, patients may have difficulty triggering breaths and thus have to perform significant additional work to receive a reasonable tidal volume. Air trapping can be identified most practically by examining the flow waveform on the ventilator, ensuring that expiratory flow
returns to baseline before the next breath is delivered (Fig. 3). Also, many ventilators feature an end-expiratory pause control that allows automatic calculation of auto-PEEP, though the patient should be given neuromuscular blocking agents or sedatives to enable accurate measurements. In a pressure mode, air trapping may result in progressively smaller delivered tidal volumes. Clinicians can remedy this situation by improving patient–ventilator synchrony and addressing tachypnoea, excessive tidal volumes, and high inspiratory to expiratory ratios. Increasing the set PEEP level (but keeping the PEEP level less than the amount of ‘auto-PEEP’) in certain situations may reduce the work needed to overcome the ‘auto-PEEP’ and trigger ventilator breaths (36).

Palliation of the pain, anxiety, and discomfort associated with mechanical ventilation is critical to the provision of quality ICU care. This is generally achieved by using analgesics (fentanyl, morphine) and sedatives (benzodiazepines, propofol). The doses of pain and anxiety relieving medications required by individual patients depend on the severity of the patient’s disease and their mechanical ventilation requirements. Some patients may be successfully treated with intermittent low dose regimens while other patients will require doses of medications that essentially induce a pharmacological coma.

SUMMARY
Mechanical ventilation is a supportive, not curative, therapy associated with physical and mental discomfort. Providing palliative care for the critically ill patient receiving mechanical ventilation involves attending to symptoms’ control, communicating clearly with family members and loved ones, and optimising the patient–ventilator interaction. Meeting these goals adequately require teamwork from the ICU staff and respect for the patient, their family, and their loved ones (37). In the next part to this series, we will discuss withdrawing ventilation, including considerations and methods.

REFERENCES


