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## Update on Mechanical Ventilation in the Intensive Care Unit

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# Update on Mechanical Ventilation in the Intensive Care Unit

## I. NONINVASIVE POSITIVE PRESSURE VENTILATION

### CASE 1 PRESENTATION

Patient 1 is a 65-year-old man who presents to the emergency department complaining of increasing shortness of breath and dyspnea on exertion. The patient has had multiple admissions to the hospital for exacerbations of chronic obstructive pulmonary disease (COPD) in the past 5 years. The most recent admission resulted in a prolonged stay in the intensive care unit (ICU) and required intubation and mechanical ventilation for 12 days. Following discharge the patient did not return to his baseline status. After consultation with his primary care physician during his most recent office visit, he completed an advance directive that precludes the use of invasive mechanical ventilation.

The current exacerbation began approximately 4 days prior to admission with the onset of a low-grade fever, sputum production, and difficulty breathing. He called his primary care physician and was placed on antibiotics and oral prednisone at 30 mg per day. Despite these medications his symptoms progressed to a point at which he was able to walk only 50 ft before he developed shortness of breath.

In the emergency department, patient 1 appears to be in significant respiratory distress and is using his accessory muscles of respiration. He is unable to complete a sentence without pausing for air. An arterial saturation measured by pulse oximetry reveals an oxygen saturation level of 84%. His blood pressure is 100/50 mm Hg, his pulse is 110 bpm, his respiration rate is 30 breaths/min, and his temperature is 101.1°F. His neck veins are distended. Breath sounds are decreased in his chest but faint audible wheezing is heard in all lung zones. He is hyperresonant and his diaphragm is depressed and not contributing significantly to his respirations. The abdominal examination is relatively benign, but examination of his extremities shows significant clubbing, mild cyanosis, and 2+ pitting edema of the lower extremities.

Laboratory evaluation reveals an elevated leukocyte count (15,500 cells/mm<sup>3</sup>) with a mild left shift. Serum

bicarbonate level is increased. Arterial blood gases show a PO<sub>2</sub> of 40 mm Hg, a PCO<sub>2</sub> of 62 mm Hg, and a pH of 7.30.

Despite his respiratory distress patient 1 clearly restates that he will not consider intubation.

- **Given patient 1's clinical status and advance directive, what options are available for treatment?**
- **Are there ventilatory-assisting devices that can be utilized in nonintubated patients?**
- **What are the risks and benefits of using noninvasive methods of ventilation?**

### NONINVASIVE VENTILATION

Noninvasive ventilation is the delivery of assisted mechanical ventilation without the use of an invasive artificial airway. Devices for delivering noninvasive ventilation have been available for centuries but fell out of favor with the increasing use of invasive positive pressure ventilation (IPPV) during the 1960s. Although mechanical ventilation is a lifesaving procedure, its use is complicated by serious morbidity and mortality. Endotracheal intubation can precipitate cardiac arrest, cause aspiration of foreign materials into the lungs, and result in laryngeal or tracheal injury.<sup>1</sup> Inability to communicate has been found to contribute to sleep disturbances and insecurity, anxiety, and even panic.<sup>2</sup> Tracheal tubes are implicated in the genesis of nosocomial pneumonia and sinusitis. Indirectly, the need for heavy sedation and some of the difficulties in weaning from ventilatory support may be related to the presence of an endotracheal tube. Over the past 5 years, the use of noninvasive positive pressure ventilation (NPPV) in the acute hospital setting has been steadily increasing.

Because of the many exclusions to its use, NPPV is appropriate for only a minority of patients with acute respiratory failure, but recent studies suggest that this may account for up to 23% of patients admitted to a medical ICU<sup>3</sup> or 31% of those admitted with a diagnosis of COPD exacerbation.<sup>4</sup>

As a rule, attempts to make noninvasive ventilation work should not persist for longer than 1 to 2 hours without clear evidence of benefit and tolerance. Meduri et al<sup>5</sup> noted that an improvement in Paco<sub>2</sub> and pH during