Long-Term Mechanical Ventilation

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KEYWORDS

• Tracheostomy • Neuromuscular disease • Long-term acute care • Home care

KEY POINTS

- The population of patients using long-term noninvasive and invasive ventilation has been growing over the last two decades, requiring better resources to support ventilation outside of hospitals.
- Long-term ventilation is performed in a variety of settings including long-term acute care facilities, skilled nursing facilities, and home. The latter provides better quality of life and greater satisfaction at lower cost, but poses challenges that prevent some from using it.
- The equipment available for long-term ventilation has improved and is good but issues of reimbursement and availability of trained caregivers are ongoing problems.

INTRODUCTION

For most patients, mechanical ventilation is a short-term therapy used to support gas exchange until an acute cause of respiratory failure resolves. As the management of critically ill patients has advanced, more patients are surviving their acute illness but certain percentages are left with continued ventilator dependence. Although the group of patients requiring prolonged mechanical ventilation (PMV) is less than 10% of all patients requiring mechanical ventilation, they consume up to 40% of intensive care unit (ICU) patient days and Medicare ranks them first in charges per patient.[1,2] Moreover, the number of these patients has increased substantially over the years with one review estimating a 190% increase in the incidence of tracheostomy for PMV from 1993 to 2002.[3] There are also children born with neurologic disorders and adults with progressive disorders that require lifelong ventilator support.

EPIDEMIOLOGY

Over the last two decades the prevalence of long-term ventilation has risen dramatically. The often cited ventilator weaning trials of the early and mid-1990s consistently demonstrated that approximately 10% of patients in ICUs were not able to be liberated from ventilators within 14 days.[4] This inevitably leads to growing numbers of patients requiring prolonged ventilation. Nevertheless, in the early 1990s there were few options for ventilator-dependent individuals and some would reside in acute care hospitals indefinitely. This was not an ideal situation for anyone involved. Patients were forced to live away from family, in settings that were not designed with creature comforts in mind. Hospitals lost money as insurers began to cap reimbursement based on diagnosis-related groups. Despite these pressures, there are ample data demonstrating increases in the incidence of mechanical ventilation, PMV, and tracheostomy in the United States. However, it is difficult to accurately quantify the actual number of

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long-term ventilator patients in the United States. One way to gauge the increase in prolonged ventilation is to look at the use of tracheostomies. Tracheostomy use for PMV rose from 8.3 per 100,000 population in 1993 to 24.2 per 100,000 in 2002.[2] A survey of long-term ventilation in Boston published in 2010 found the prevalence of long-term mechanical ventilation to be 7.4 per 100,000.[5] If this is extrapolated to the entire US population, there are approximately 10,966 people on long-term invasive ventilation.[6] Further extrapolation from data on children in Pennsylvania yields an estimate of approximately 4802 children using invasive ventilation nationwide.[6] This article characterizes the features, outcomes, and logistics that must be taken into consideration while caring for the unique patient population requiring PMV.

VENTILATOR DEPENDENCY

Rigorous assessment of these patients has been hindered by the lack of standard definitions for what constitutes ventilator dependency. Throughout the literature and even within governmental regulatory bodies, such as the Centers for Medicare and Medicaid Services (CMS), the definition of PMV varies substantially from the number of days on mechanical ventilation (ranging from 2 to 29 days), the need for mechanical ventilation after leaving the ICU, or simply the need for tracheostomy with 96 or more hours of mechanical ventilation.[7–11] The 1998 American College of Chest Physicians Consensus Conference proposed that ventilator-assisted individuals were those with indications for mechanical ventilation beyond the ICU including persistent symptomatic respiratory insufficiency without failure to tolerate or improve with noninvasive ventilation, uncontrollable airway secretions, impaired swallowing leading to chronic aspiration and repeated pneumonias, or severely weakened or paralyzed respiratory muscles.[12] To refine these arbitrary guidelines, a 2005 consensus conference proposed a standardized definition of PMV as the need for greater than or equal to 21 consecutive days of mechanical ventilation for 6 or more hours per day.[7]

The declaration of chronic, or even lifelong, ventilator dependency differs greatly depending on the cause of respiratory failure and the probability of ventilator liberation. For example, a different threshold may be used to declare ventilator dependency in a patient recovering from acute respiratory distress syndrome compared with a patient with a high cervical spinal cord injury. The Canadian Thoracic Society published a series of disease-specific recommendations for the use of invasive ventilation in disease-specific states with the caveat that the decision to initiate or continue mechanical ventilation must be based on individual patient characteristics.[13]

Spinal Cord Injury

The need for mechanical support in individuals with spinal cord injury depends on the grade and level of injury. During the initial year of injury, however, improvements in respiratory function may occur spontaneously with only 5% of patients requiring ventilator support after the first year.[14] Complete cervical cord lesions are associated with the highest degree of respiratory dysfunction. One case series reported that 100% of patients with complete injuries at or above the C5 level required a definitive airway and tracheostomy, although only 71% of patients required mechanical ventilation at time of discharge. In contrast, 15% of patients with complete injuries below C6 required mechanical ventilation at time of discharge, although 79% initially required mechanical respiratory support and 50% received tracheostomy. Patients with incomplete injuries rarely required tracheostomy.[15] Each patient must be evaluated individually for the need for long-term ventilation acutely and in follow-up to assess for the ability to support spontaneous breathing in the first critical year.[13] In retrospective review, ventilator dependency was the strongest negative predictor of survival during the first year after hospital discharge,[16] with respiratory complications accounting for 31% of deaths.[17] For patients who require assisted ventilation, noninvasive approaches may be associated with fewer complications as long as mental status and bulbar musculature function remain intact. Despite the risk of respiratory complications, quality of life and life satisfaction scores remain high in patients with tetraplegia and many of these patients are able to be managed at home.[18–20]

Chronic Respiratory Diseases

Acute episodes of respiratory failure in patients with chronic lung disease, such as chronic obstructive pulmonary disease (COPD) or interstitial lung disease (ILD), account for a significant number of ICU admissions every year. The need for mechanical ventilation in these cases is dictated by the immediate clinical picture. Ventilator liberation, however, is often complicated by pre-existing parenchymal disease, which is an independent predictor of failure to wean from the ventilator in the inpatient setting.[21] It has been estimated that COPD accounts for 25% of weaning failures leading to the need for PMV.[11,22,23] Very

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