Patient Safety

Identifying and Managing Complications of Mechanical Ventilation

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KEYWORDS

- Ventilator-associated event • Ventilator-associated condition
- Ventilator-associated infection • Ventilator-associated pneumonia
- Acute respiratory distress syndrome • Pulmonary edema • Pleural effusion
- Atelectasis

KEY POINTS

- The umbrella term of ventilator-associated events (VAEs) is associated with infectious and noninfectious causes of mechanical ventilation complications.
- VAEs can be classified as ventilator-associated conditions (VACs), ventilator-associated infections (IVACs), or ventilator-associated pneumonia.
- Common VAEs in critical care are discussed according to the current literature base for each including ventilator-associated pneumonia, acute respiratory distress syndrome, pulmonary edema, pleural effusion, and atelectasis.

INTRODUCTION

Mechanical ventilation is an essential intervention provided by critical care services, although there are several potential complications that result from being mechanically ventilated. These ventilator-associated events (VAEs) can be infectious or noninfectious in nature as indicated in **Table 1**. It is important to identify the type and cause of a VAE to help plan clinical management, which is then specifically aimed at treating the source of the mechanical ventilation problem. A thorough understanding of how different VAEs arise will also enable critical care nurses to underpin their clinical practice with measures to prevent complications of mechanical ventilation from occurring. Essential preventative strategies include avoiding intubation where possible, keeping the duration of mechanical ventilation to a minimum, and actively targeting the most common causes of VAEs.[1]

The purpose of this article is to critically discuss the prevention, identification, and management of the major complications of mechanical ventilation within the context of critical care nursing practice. Current research and gaps in the evidence base for

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Table 1
Ventilator-associated events

Infectious	Noninfectious
Pneumonia	ARDS
	Pulmonary edema
	Pleural effusion
	Atelectasis

each topic will be highlighted throughout, and **Table 2** provides a summary of the nursing assessment findings and management associated with each complication.

VENTILATOR-ASSOCIATED PNEUMONIA

Ventilator-associated pneumonia (VAP) lacks a universal, internationally agreed definition as now exists for other common conditions in critical care such as sepsis,[2] acute coronary syndromes,[3] and acute respiratory distress syndrome.[4] The subjective nature of traditional VAP diagnosis methods, along with a high degree of inter-rater variability and inaccuracy, has meant many patients who previously met VAP diagnostic criteria did not actually have pneumonia.[5]

Magill and colleagues[6] address these issues with a new framework for the surveillance of VAEs.

Ventilator-associated condition (VAC) is defined as baseline of at least 2 days of stability with decreasing daily Fio_2 and positive end–expiratory pressure (PEEP) requirements, as well as subsequent deteriorating hypoxemia sustained for at least $\geq$2 days with daily Fio_2 increase of at least 0.20 or PEEP increase of at least 3 cm H_2O from the baseline period.

Ventilator-associated infection (IVAC) is defined as the VAC points described previously, as well as altered temperature (<36°C or 38°C) or leukocytes ($\leq$4000 cells/mm^3 or $\geq$12,000 cells/mm^3) and new antimicrobial(s) introduced and administered for $\geq$4 days.

VAP can be divided into 2 categories:

Possible VAP—quantitatively purulent secretions or positive culture from respiratory tract

Probable VAP—quantitatively purulent secretions and positive culture from respiratory tract or positive results from pleural fluid culture, lung histopathology, or other specific diagnostic tests[7]

Although this new perspective on defining and measuring VAP is a more objective process compared with previous practice, several things need to be considered:

- The publication by Magill and colleagues[6] stems from a VAP working group convened by the US Centers for Disease Control and Prevention[7] and included representatives from US organizations; other countries need to evaluate whether these recommendations are relevant to their own health care practice.
- The new definitions are not proposed for use in the clinical management of patients but aim to be for surveillance monitoring.
- Research is still needed on whether this new surveillance format is: valid and reliable in being linked to associated clinical outcomes, able to identify all types of pneumonia, and capable of improving VAP prevention and early detection in critical care units.[8]