JOURNAL OF INTERNATIONAL CRISIS AND RISK COMMUNICATION RESEARCH
ISSN: 2576-0017
2024, VOL 7, NO S10

The Role of the Nurse in Managing Mechanically Ventilated Patients

Mohammed Jawad Alabdulwahhab [(1)], Abdullah Abdrabalrassol Alabbas [(2)], Younis Ahmed Ali Alhababi [(3)], Youssif Husein Ali Alattafi [(4)], Maged Nasser Ali Almatter [(5)], Mohammed Hejji Almousa [(6)], Bader Naji Haydar Alhaidar [(7)], Mohammed Jameel Mohammad Alsalman [(8)], Ammar Abdullah Alali [(9)], Fadhel Hussain Ahmed Bushaja [(10)], Mohammed Ibrahim Ali Almusallam Alsayed [(11)], Sari Abdulwahab Alobid [(12)], Kadem Ali Alali [(13)], Hesham Najeeb Alali [(14)], Abdullah Abbas Alhafith [(15)].

[1]Nursing Technician, Alhassa Psychiatric Hospital, Ministry of Health, Kingdom of Saudi Arabia. Mohammed-j10@hotmail.com
[2]Specialist-Nursing, Alhassa Psychiatric Hospital, Ministry of Health, Kingdom of Saudi Arabia. Alves12315@hotmail.com
[3]Nurse Technician, Alhassa Psychiatric Hospitals, Ministry of Health, Kingdom of Saudi Arabia. Lexuslx2001@hotmail.com
[4]Nursing Technician, Psychiatric Hospital Alhassa, Ministry of Health, Kingdom of Saudi Arabia. yalattafi@gmail.com
[5]Nursing Technician, Alhassa Psychiatric Hospital, Ministry of Health, Kingdom of Saudi Arabia. malmatter@moh.gov.sa
[6]Nursing Technician, Psychiatric Hospital Alhassa, Ministry of Health, Kingdom of Saudi Arabia. mhalmousa@moh.gov.sa
[7]Nurse Technician, Alhassa Psychiatric Hospitals, Ministry of Health, Kingdom of Saudi Arabia. balhaider@moh.gov.sa
[8]Nursing Technician, Al Ahssa psychiatric Hospital, Ministry of Health, Kingdom of Saudi Arabia. jamoh12@hotmail.com
[9]Nursing Technician, Psychiatric Hospital Alhassa, Ministry of Health, Kingdom of Saudi Arabia. amabalali@moh.gov.sa
[10]Specialist-Nursing, Psychiatric hospital in Alhassa, Ministry of Health, Kingdom of Saudi Arabia. fbushaja@moh.gov.sa
[11]Nursing Specialist, Alhassa Psychiatric Hospital, Ministry of Health, Kingdom of Saudi Arabia. Mohmedib79@gmail.com
[12]Nursing Technician, Psychiatric Hospital Alhassa, Ministry of Health, Kingdom of Saudi Arabia. Sariaa@moh.gov.sa
[13]Nurse Technician, Alhassa Psychiatric Hospital, Ministry of Health, Kingdom of Saudi Arabia. kaalali@moh.gov.sa
[14]Nursing Specialist, Alhassa Psychiatric Hospitals, Ministry of Health, Kingdom of Saudi Arabia. hnalali@moh.gov.sa
[15]Nursing Specialist, Alhassa Psychiatric Hospitals, Ministry of Health, Kingdom of Saudi Arabia. Aaalhafith@gmail.com

ABSTRACT

Mechanical ventilation is a complex intervention that requires comprehensive nursing care to ensure patient safety and comfort. This review outlines the critical principles in managing mechanically ventilated patients, focusing on patient assessment and safety. The Emergency Care Cycle framework, consisting of the Primary and

Secondary Surveys, is used to guide a systematic approach to patient assessment. Key safety considerations include continuous monitoring, availability of emergency equipment, and routine safety measures. The Primary Survey follows the "ABCDE" mnemonic to identify immediate life-threatening situations, while the Secondary Survey involves a detailed head-to-toe evaluation of each body system. Specific considerations for mechanically ventilated patients are discussed, including neurological assessment, artificial airway management, airway patency, breathing, cardiovascular function, gastrointestinal system, metabolic system, renal system, and skin integrity and mobility. Evidence-based practices and guidelines are presented to support optimal patient care. Promoting patient safety and comfort requires a multifaceted approach that encompasses advanced technical skills, extensive knowledge of invasive monitoring, and the application of targeted interventions. Adhering to best practices and evidence-based guidelines is essential to minimize complications and improve outcomes for mechanically ventilated patients in the intensive care unit.

Keywords: Nurse Role, Mechanically Ventilated Patients, Ventilator Management, Critical Care Nursing, Intensive Care Unit (ICU)Nurses, Mechanical Ventilation

Introduction

The use of mechanical ventilation is necessitated by various clinical and physiological factors. Managing patients on mechanical ventilation is a multifaceted challenge for nurses, requiring advanced technical skills, extensive knowledge of invasive monitoring, and the application of targeted interventions to provide care. Each critically ill patient brings unique clinical justifications for mechanical ventilation and specific complexities linked to their condition. It is widely acknowledged that the underlying reason for mechanical ventilation and the patient's initial admission influence the approach to patient assessment and management. Nevertheless, certain evidence-based, collaborative principles form the foundation of nursing care for such patients in the intensive care unit (ICU). These principles prioritize patient safety—encompassing the assessment of both the patient and the equipment—and patient comfort, which involves proper positioning, hygiene, stress management, and pain and sedation control.

Numerous confounding variables affect the care of critically ill patients receiving mechanical ventilation in the ICU. As a result, not all practices in this context are supported by evidence. Given the limited evidence-based literature on the overall care of mechanically ventilated patients, this paper relies on common practices supported by expert opinions or anecdotal evidence. This discussion outlines the critical principles in managing mechanically ventilated patients, with this first part of a two-part series focusing on patient assessment and safety.

Patient Safety

Promoting the safety of mechanically ventilated patients can be effectively achieved by adopting a structured health assessment framework. The Emergency Care Cycle is one such framework that facilitates a systematic and comprehensive approach to patient assessment. It consists of two components: the Primary Survey, which identifies immediate life-threatening conditions and the Secondary Survey, which adopts a head-to-toe systems-based approach to assess the functionality of individual body systems (Nettina, 2006). Using this framework, the safety considerations for mechanically ventilated patients are discussed.

Several general safety considerations are essential for mechanically ventilated patients in the ICU. These patients require continuous monitoring and observation, necessitating a recommended nurse-to-patient ratio of 1:1 to ensure prompt response to any alarms (ACCCN, 2005; Winters and Munro, 2004). Promoting safety also involves ensuring the availability of emergency equipment to address potential incidents like accidental extubation or ventilator failure (Yeh et al., 2004). Routine safety measures applicable to all critically ill patients should also be observed, including verifying intravenous infusions, inspecting patient equipment and alarm settings, and confirming the correct attachment and functionality of monitoring devices.

Primary Survey

The Primary Survey focuses on identifying life-threatening situations that require immediate attention (Nettina, 2006). It follows the "ABCDE" mnemonic: Airway, Breathing, Circulation, Disability, and Exposure. This approach remains consistent regardless of whether the patient is mechanically ventilated. Key considerations include securing the artificial airway to prevent displacement and verifying the correct insertion length of the airway. While mechanical ventilators and monitoring devices provide valuable numerical data, these should complement, not replace, physical assessments of the patient. Physical observations are crucial for verifying the validity of numeric readings and ensuring accurate patient assessment.

Secondary Survey

The Secondary Survey involves a detailed evaluation of each body system using a head-to-toe format (Hillman and Bishop, 2004). Mechanical ventilation is often initiated due to acute dysfunction in one or more body systems. However, artificial respiratory support can disrupt physiological homeostasis, further impairing function (Hillman and Bishop, 2004). Comprehensive assessment of all body systems is critical for early identification of complications and timely intervention to minimize risks. This section discusses considerations specific to mechanically ventilated patients.

Neurological System

Assessing the neurological status of mechanically ventilated patients involves various methods. The Glasgow Coma Scale (GCS) is widely used to evaluate consciousness levels based on arousal and verbal/physical responses (Fischer and Mathieson, 2001). However, the administration of sedatives or muscle relaxants and the inability of ventilated patients to provide verbal responses can limit the accuracy of the GCS. Alternative communication scoring systems have been developed to address these limitations, enabling assessments through non-verbal communication methods such as mouthing words, using letter boards, or writing notes (Lindgren and Ames, 2005). Additionally, pupil size and reactivity should be assessed as part of focused neurological evaluations (Fischer and Mathieson, 2001). In sedated patients, early neurological changes, such as decreased consciousness, may be masked, leaving late signs like pupillary changes as key indicators of neurological deterioration.

Many ventilated patients require sedation to tolerate the therapy. To mitigate the risks associated with oversedation, such as prolonged ventilation and extended ICU or hospital stays, tools have been developed to measure sedation levels and agitation (Heffner, 2000; Hogarth and Hall, in press). Including a target score on sedation-agitation scales in sedation orders enables ICU nurses to adjust sedation doses appropriately (Ely et al., 2003). This aspect will be discussed further in the second part of this series.

Neuromuscular blockade may sometimes be necessary to facilitate ventilation. Ensuring partial rather than complete paralysis reduces the risk of complications like critical illness neuropathy (De Jonghe et al., 2004). Peripheral nerve stimulators are commonly used to monitor the degree of paralysis, and paralytic agents are titrated accordingly. Additionally, Bispectral Index Score (BIS) monitoring, which evaluates electroencephalographic (EEG) data to estimate sedation levels, is gaining popularity for use in paralyzed patients (Riker and Fraser, 2001). While BIS monitoring is frequently used in anesthetic practices, its application in ICU settings requires further research (LeBlanc et al., 2006).

Assessing the conscious state and communication abilities of mechanically ventilated patients is critical to tailoring the most effective care approaches. This topic will be explored further in the second part of this series.

Artificial Airway

All mechanically ventilated patients require an artificial airway to facilitate respiratory support. Whether this is an endotracheal or a tracheostomy tube, considerations of placement, security, and cuff management are critical.

Improper placement of the artificial airway poses significant risks, including ineffective ventilation, aspiration, and airway trauma due to esophageal intubation or malposition within the trachea (Winters & Munro, 2004). Initial placement is typically verified using various techniques depending on the equipment available. However, displacement can occur due to factors such as head movement, tension during transport, or surrounding tissue swelling (DeBoer et al., 2003). Ongoing assessment is therefore essential to maintain safety.

Common methods for confirming tube placement include auscultation, end-tidal carbon dioxide monitoring, and chest radiography (DeBoer et al., 2003). Auscultation of lung fields is widely used but can be misleading due to referred sounds (DeBoer et al., 2003; Grmec, 2002). End-tidal CO_2 monitoring, through capnometry or capnography, is considered reliable for placement verification, though its efficacy may depend on clinical context, equipment availability, and user expertise (Knapp et al., 1999; Grmec, 2002). Radiological imaging, often regarded as the gold standard, is limited by its inability to provide continuous data, delays in interpretation, and challenges in assessing anatomical detail (DeBoer et al., 2003). Measurement of tube length relative to fixed structures, such as teeth or gums, is a practical and consistent approach. Given the limitations of individual methods, combining two or more techniques—at least one providing continuous data—is recommended to ensure accurate assessment.

Securing the tube is vital to maintaining placement and minimizing airway trauma caused by excessive movement. Techniques for securing artificial airways should account for head and neck mobility, ease of adjustment, and reduction of tissue injury. Methods include cotton tape, specially designed tube holders, and non-stretch adhesive tapes. Although studies compare these methods, no definitive conclusions on their superiority have been drawn (Gardner et al., 2005). Regular evaluation ensures that the chosen method is applied correctly and maintains the tube in the desired position.

The artificial airway also poses risks of complications, particularly from improper cuff inflation. Underinflation can lead to aspiration, while overinflation may cause tracheal mucosal injury (Vyas et al., 2002). Evidence supporting a single superior management technique is limited. A descriptive study by Crimlisk et al. (1996) highlighted three primary strategies: maintaining cuff pressures below 25 mmHg, inflating the cuff with the minimal volume of air required to prevent inspiratory leakage (minimal occlusive volume), or allowing a small air leak during inspiration (minimal leak technique). When achieving the desired seal proves difficult, factors such as inflation pressures, head movement, and airway-to-tube diameter ratios should be considered (Vyas et al., 2002).

Airway Patency

Assessing airway patency involves evaluating lung secretions and implementing appropriate management strategies. Mechanically ventilated patients are at heightened risk of complications due to impaired normal respiratory functions. Artificial airways bypass the upper airway's humidification and filtration mechanisms, while medical gases are typically cold and dry, and disease processes may compromise the cough reflex (St John & Malen, 2004; Jaber et al., 2004). Lung secretions should be monitored for color, consistency, and volume (Winters & Munro, 2004). While endotracheal suctioning supports secretion removal, it is a potentially hazardous procedure requiring careful execution.

Evidence suggests suctioning frequency should be based on patient needs rather than routine intervals (Day et al., 2002). Physical assessment—including auscultation and palpation—along with trends in secretion production, airway pressures, oxygen saturation, and end-tidal CO_2 levels, guides suctioning requirements (Winters & Munro, 2004). Targeted suctioning minimizes exposure to complications.

Hypoxemia is the most common suctioning complication (Demir & Dramali, 2005). Techniques to mitigate hypoxemia include hyperoxygenation or hyperinflation, either separately or combined. While effective, these methods can cause respiratory or hemodynamic instability (Day et al., 2002; Oh & Seo, 2003). In a randomized controlled trial, Demir and Dramali (2005) found that patients suctioned without hyperoxygenation under specific conditions (e.g., $FiO_2 \leq 50\%$, PEEP ≤ 8 cm H_2O, mean pre-suction PaO_2 of 95.49 mmHg) showed no significant hypoxemia differences.

This suggests the importance of assessing individual patient status—such as PEEP, FiO_2, and PaO_2—prior to suctioning to minimize adverse effects.

Instilling normal saline before suctioning remains a debated practice. Although theorized to loosen and stimulate secretion clearance, evidence indicates it may be harmful (Blackwood, 1999; Day et al., 2002).

Several suctioning techniques aim to reduce associated risks. Catheter size should be less than half the artificial airway's diameter to prevent atelectasis (Day et al., 2002). The catheter should be inserted to the carina's depth and retracted 1 cm before suctioning begins (Day et al., 2002). Limiting suction duration to 10–15 seconds and restricting passes to three per episode reduces hypoxemia and trauma risks. Negative suction pressures exceeding 200 mmHg have been associated with tracheal damage, with recommendations suggesting 80–170 mmHg as safer limits (Day et al., 2002; Donald et al., 2000).

Open versus closed suction systems are another consideration. Closed systems reduce hypoxemia, preserve PEEP, and minimize contamination but may not decrease suctioning-related complications (Subirana et al., 2003; Zeitoun et al., 2003). A review by Grap and Munro (2004) suggests no clear advantage in preventing ventilator-associated pneumonia (VAP). However, closed systems reduce ventilation circuit breaks, limiting environmental contamination risks (Kollef, 1999).

Finally, ensuring proper humidification is vital. Insufficient humidification can cause airway obstruction and tissue damage (Jaber et al., 2004). Both heated humidifiers and heat-moisture exchangers are effective but have associated risks, including bacterial contamination or increased work of breathing (Kelly et al., 2004). The choice of system should reflect anticipated ventilation duration, spontaneous breathing effort, and secretion characteristics, with patient assessment guiding adjustments as needed. A holistic approach, including adequate systemic hydration, also supports optimal humidification management (Kelly et al., 2004).

Breathing

A thorough comprehension of the adequacy of ventilation and oxygenation in mechanically ventilated patients is crucial, as the ventilator coordinates much, if not all, of the respiratory effort. This understanding is informed by physical assessment and analysis of laboratory and patient monitoring data.

Physical assessment provides critical insights into the patient's interaction with the ventilator. Signs such as dyspnea, asynchronous chest and abdominal movements, use of accessory muscles, and agitation can indicate that ventilator settings are not aligned with the patient's needs (Hillman and Bishop, 2004). Furthermore, physical assessment can help clinicians detect subtle respiratory changes that might otherwise be missed. For instance, altered breath sounds and asymmetrical chest movements may signal the onset of a pneumothorax, even when other symptoms, such as dyspnea and rapid, shallow breathing, are obscured by sedation or full mandatory ventilation.

Monitoring data from the ventilator also provides valuable information on the patient's respiratory condition and the appropriateness of ventilator settings. Parameters like respiratory rate, tidal volume, minute volume, and airway pressures, both as isolated values and as trends, offer insight into lung function and respiratory effort over time (Jubran and Tobin, 1996).

Gas exchange monitoring is an integral part of managing mechanically ventilated patients. Arterial blood gas (ABG) analysis remains the gold standard for evaluating arterial oxygen and carbon dioxide levels. However, due to the associated costs and complications of frequent ABG testing, non-invasive techniques such as pulse oximetry and capnometry are often employed. Pulse oximeters, for example, have an accuracy of ±2% for oxygen saturations above 70% (Jensen et al., 1998). Similarly, capnometry provides a numerical estimate of end-tidal carbon dioxide levels, and studies by Capovilla et al. (2000) and Frakes (2001) demonstrate its utility in stable ventilation/perfusion states. Even in unstable conditions, discrepancies between end-tidal and arterial carbon dioxide levels can indicate changes in dead space and perfusion (Soubani, 2001; Frakes, 2001). However, understanding the mechanisms underlying these measurements is critical to avoid misinterpretation (Martin and Wilson, 2002). When used correctly, these non-invasive tools offer a continuous, safe means of assessing gas exchange.

Cardiovascular System

Mechanical ventilation can significantly impact cardiovascular function, primarily through increased intrathoracic pressure, which reduces preload by diminishing venous return. These effects are exacerbated in patients with high positive end-expiratory pressure (PEEP) settings or on inverse ratio ventilation, with the degree of impairment depending on the patient's baseline cardiovascular health (Pinsky, 2005). ICU nurses must perform comprehensive cardiovascular assessments to evaluate cardiac output and identify complications associated with its inadequacy. This involves monitoring heart rate, rhythm, blood pressure, central venous pressure (CVP), peripheral perfusion, urine output, chest X-rays, and serum electrolytes (McGrath and Cox, 1998). Additionally, regular hemoglobin assessment is crucial to manage the impact of anemia on oxygen transport capacity, with blood conservation strategies often necessary (Fowler and Berensen, 2003). Continuous multi-lead electrocardiography is recommended for early detection and treatment of cardiac arrhythmias or myocardial ischemia (Robb, 1997).

A newer method, Pulse Pressure Variation, evaluates fluid status through respiratory-induced variations in pulse pressure using arterial catheters or plethysmographs. Preliminary findings indicate it could provide an accurate measure of fluid status using existing equipment (Cannesson et al., 2005).

Accurately determining cardiac output in critically ill patients remains challenging with basic parameters. The bolus thermodilution method via pulmonary artery catheterization is considered the gold standard (Zink et al., 2004), but other methods like continuous thermodilution, transthoracic/transesophageal echocardiography, pulse contour analysis, and esophageal Doppler offer continuous or less invasive alternatives (Adams, 2004). Maintaining adequate fluid volume status, such as a CVP of 10–12 mmHg, can optimize preload and reduce the risk of impaired cardiac output (Pinsky, 2005).

Ventilated patients are at a heightened risk of deep vein thrombosis (DVT) due to venous stasis from immobility and reduced venous return (Pinsky, 2005). Early preventative measures, including thromboembolic deterrent (TED) stockings, sequential compression devices, passive exercises, and anticoagulant therapy, are vital. A combination of mechanical and pharmacological interventions is recommended for effective DVT prophylaxis (Yang, 2005).

Gastrointestinal System

Nutritional management is a critical aspect of care for mechanically ventilated patients, whose oral intake is often restricted by endotracheal tubes and sedation levels, though tracheostomized patients may eat orally. Early enteral feeding via oro/nasogastric tubes is a well-established practice for these patients (Lindgren and Ames, 2005). Using structured feeding protocols, which monitor absorption, gradually increase feeding rates, and administer prokinetic agents as needed, yields the best outcomes (Bowman et al., 2005). While caloric requirements in critically ill patients remain debated, moderate caloric intake, around 9–18 kcal/kg/day, has been associated with favorable outcomes (Krishnan et al., 2003). Gastrointestinal (GIT) function can be compromised by reduced splanchnic blood flow due to decreased cardiac output and the use of sedatives and narcotics, which impair motility (Aneman et al., 1999). Regular assessments for abdominal discomfort, bowel sounds, gastric aspirates, and bowel movements are essential (Bowman et al., 2005). Adequate nutrition becomes particularly important during the weaning phase of ventilation, as patients need sufficient energy and muscle function to reduce reliance on ventilatory support (Lindgren and Ames, 2005). Indicators such as muscle mass, physical strength, body weight, and serum electrolytes, especially phosphate, guide nutritional interventions to support muscle function (McClave et al., 2002).

Mechanical ventilation may also compromise hepatic blood flow via the portal vein due to reduced cardiac output (Aneman et al., 1999). Regular liver function tests and clotting time assessments are essential for detecting hepatic impairment (Winters and Munro, 2004).

Metabolic System

Temperature monitoring is a fundamental yet essential aspect of patient assessment, as an elevated temperature may indicate an infectious response (Winters and Munro, 2004). Mechanically ventilated patients face an elevated risk of acquiring nosocomial infections due to suppressed immune function and the presence of artificial devices such as endotracheal tubes (ETTs), urinary catheters, and central venous catheters (Lindgren and Ames, 2005). Common markers used to detect infection include white blood cell count, C-reactive protein (CRP), interleukin-6 (IL-6), and procalcitonin (PCT) levels. A prospective study by Gaini et al. (2006) demonstrated that CRP and IL-6 are more sensitive indicators of infection than PCT, which is more effective in assessing infection severity. In some intensive care units (ICUs), routine surveillance of high-risk patients, particularly those who have been ventilated for 48 hours or longer, is employed to facilitate early detection of infections and address potential infection control challenges (Tablan et al., 2003).

Infection prevention measures are crucial and should accompany assessments to minimize the likelihood of nosocomial infections in mechanically ventilated patients. The Centers for Disease Control and Prevention, alongside the Canadian Critical Care Trials Group and the Canadian Critical Care Society, have issued guidelines promoting best practices to prevent ventilator-associated pneumonia. These guidelines recommend a multifaceted approach, including oral rather than nasal intubation, minimizing ventilator circuit disruptions, elevating the head of the bed, maintaining respiratory equipment, reducing the duration of mechanical ventilation, and implementing effective hand hygiene (Tablan et al., 2003; Dodek et al., 2004). Adherence to these strategies, in conjunction with strict application of Standard Precautions, should be integral to nursing care to mitigate the risk of nosocomial infections.

Blood glucose monitoring and management have become central to care for critically ill patients, including those who are mechanically ventilated. Research by van den Berghe et al. (2006) indicates that maintaining blood glucose levels within the range of 4.4–6.1 mmol/L is associated with decreased mortality. This is particularly relevant for ventilated patients, who often experience hyperglycemia due to the stress response activated by critical illness (Winters and Munro, 2004). The Surviving Sepsis Guidelines advocate for maintaining blood glucose levels below 8.3 mmol/L in patients with severe sepsis (Dellinger et al., 2004).

Renal System

Positive pressure ventilation can lead to reduced urine output due to neural and hormonal mechanisms, such as antidiuretic hormone secretion and activation of the renin–angiotensin–aldosterone system (Pinsky, 2005). Monitoring urine output closely, alongside serum urea and creatinine levels, is vital to identify potential renal dysfunction. According to an evidence-based review by Rhodes and Bennett (2004), maintaining a urine output of at least 0.5 mL/kg/h is a key indicator of adequate renal function. To prevent acute renal failure, it is essential to maintain sufficient cardiac output, mean arterial pressure, and renal perfusion pressure (Leblanc et al., 2005).

Skin Integrity and Mobility

The risk of skin integrity impairment is heightened in mechanically ventilated patients due to immobility stemming from sedation and ventilation (Lindgren and Ames, 2005). Preventing pressure ulcers effectively can reduce both ventilation duration and hospital stay (Wolverton et al., 2005). While the Braden and Norton scales have been validated through a multi-center prospective study (Schoonhoven et al., 2002), the Waterlow scoring system is specifically tailored for critically ill patients, as it incorporates the use of inotropic agents, cytotoxic drugs, and high-dose steroids into its risk assessment. Additionally, it provides strategies for pressure relief based on the determined level of risk (Boyle and Green, 2001).

Semi-recumbent positioning, as opposed to a supine position, has been suggested to reduce the incidence of ventilator-associated pneumonia according to findings from a randomized trial (Drakulovic et al., 1999). For patients requiring prolonged ventilation, mobility can be enhanced by placing the patient in a sitting position for extended periods during the day. This approach improves lung expansion and reduces the likelihood of ventilator-associated pneumonia (Safdar et al., 2005).

Conclusion

The nursing management of mechanically ventilated patients is a multifaceted process requiring advanced skills, critical thinking, and adherence to evidence-based practices. Nurses play an integral role in ensuring patient safety, optimizing ventilator settings, and preventing complications through vigilant monitoring, comprehensive assessments, and timely interventions. Each body system—respiratory, cardiovascular, metabolic, renal, and integumentary—requires specific considerations and targeted care strategies. By employing structured frameworks, such as the Emergency Care Cycle, and leveraging innovations in monitoring and management techniques, nurses can effectively address the complexities of mechanical ventilation. Ultimately, the nurse's role is pivotal in enhancing patient outcomes, minimizing the risks associated with ventilation, and ensuring a holistic approach to critical care.

References

Adams K. Hemodynamic assessment: the physiologic basis for turning data into clinical information. AACN Clin Issues 2004;15(4):534—46.

Aneman A, Eisenhofer G, Fandriks L, Olbe L, Dalenback J, Nitescu P, et al. Splanchnic circulation and regional sympathetic outflow during peroperative PEEP ventilation in humans. Br J Anaesth 1999;82(6):838—42.

Blackwood B. Normal saline instillation with endotracheal suctioning: primum non nocere (first do no harm). J Adv Nurs 1999;29(4):928—34.

Bowman A, Greiner J, Doerschug K, Little S, Bombei C, Comried L. Implementation of an evidence-based feeding protocol and aspiration risk reduction algorithm. Crit Care Nurs Q 2005;28(4):324—33.

Boyle M, Green M. Pressure sores in intensive care: defining their incidence and associated factors and assessing the utility of two pressure sore risk assessment tools. Aust Crit Care 2001;14(1):24—30.

Cannesson M, Besnard C, Durand P, Bohe J, Jacques D. Relation between respiratory variations in pulse oximetry plethysmographic waveform amplitude and arterial pulse pressure in ventilated patients. Crit Care 2005;9(5): R562—8.

Capovilla J, VanCouwenberghe C, Miller WA. Noninvasive blood gas monitoring. Crit Care Nurs Q 2000;23(2):79—86.

Crimlisk JT, Horn MH, Wilson DJ, Marino B. Artificial airways: a survey of cuff management practices. Heart Lung 1996;25(3):225—35.

Crunden E, Boyce C, Woodman H, Bray B. An evaluation of the impact of the ventilator care bundle. Nurs Crit Care 2005;10(5):242—6.

Day T, Farnell S, Wilson-Barnett J. Suctioning: a review of current research recommendations. Intensive Crit Care Nurs 2002;18:79—89.

De Jonghe B, Sharshar T, Hopkinsonb N, Outina H. Paresis following mechanical ventilation. Curr Opin Crit Care 2004;10:47—52.

DeBoer S, Seaver M, Arndt K. Verification of endotracheal tube placement: a comparison of confirmation techniques and devices. J Emergency Nurs 2003;29(5):444—50.

Dellinger P, Carlet J, Masur H, Gerlach H, Calandra T, Cohen J, et al. Surviving sepsis campaign guidelines for management of severe sepsis and septic shock. Intensive Care Med 2004;30(4):536—55.

Demir F, Dramali A. Requirement for 100% oxygen before and after closed suction. J Adv Nurs

2005;51(3):254—351.
Dodek P, Keenan S, Cook D, Heyland D, Jacka M, Hand L, et al. Evidence-based clinical practice guideline for the prevention of ventilator-associated pneumonia. Ann Internal Med 2004;141(4):305—13.
Donald KJ, Robertson VJ, Tsebelis K. Setting safe and effective suction pressure: the effect of using a manometer in the suction circuit. Intensive Care Med 2000;26:15—9.
Drakulovic MB, Torres A, Bauer TT, Nicolas JM, Nogue S, Ferrer M. Supine body position as a risk factor for nosocomial pneumonia in mechanically ventilated patients: a randomised controlled trial. Lancet 1999;354:1851—8.
Ely W, Truman B, Shintani A, Thomason J. Monitoring sedation status over time in ICU patients: reliability and validity. JAMA 2003;289(22):2971—83.
Fischer J, Mathieson C. History of the Glasgow Coma Scale: implications for practice. Crit Care Nurs Q 2001;23(4):52—8.
Flancbaum L, Choban P, Sambucco S, Verducci J, Burge J. Comparison of indirect calorimetry, the Fick method, and prediction equations in estimating the energy requirements of critically ill patients. Am J Clin Nutr 1999;69(3):461—6.
Frakes MA. Measuring end-tidal carbon dioxide: clinical applications and usefulness. Crit Care Nurs 2001;21(5):23—37.
Fowler R, Berensen M. Blood conservation in the intensive care unit. Crit Care Med 2003;31(12):S715—20.
Gaini S, Koldkjaer O, Pedersen C, Pedersen S. Procalcitonin, lipopolysaccharide-binding protein, interleukin-6 and Creactive protein. Crit Care 2006;10(2).
Gardner A, Hughes D, Cook R, Henson R, Osborne S, Gardner G. Best practice in stabilisation of oral endotracheal tubes: a systematic review. Aust Crit Care 2005;18(4):158—65.
Grap MJ, Munro CL. Preventing ventilator-associated pneumonia: evidence-based care. Crit Care Nurse Clin N Am 2004;16:349—58.
Grmec S. Comparison of three different methods to confirm tracheal tube placement in emergency intubation. Intensive Care Med 2002;28:701—4.
Heffner J. A wake-up call in the intensive care unit. New Engl J Med 2000;342(20):1520—2.
Hillman K, Bishop G. Clinical intensive care and acute medicine. 2nd ed. Cambridge: Cambridge University Press; 2004.
Hogarth D, Hall J. Management of sedation in mechanically ventilated patients. Curr Opin Crit Care 10(1):40—6, in press.
Jensen LA, Onyskiw JE, Prasad NGN. Meta-analysis of arterial oxygen saturation monitoring by pulse oximetry in adults. Heart Lung 1998;27(6):387—408.
Jubran A, Tobin MJ. Monitoring during mechanical ventilation. Clin Chest Med 1996;17(3):453—73.
Kelly M, Gillies D, Lockwood C, Todd D. Heated humidification versus heat and moisture exchangers for ventilated adults and children (protocol). Cochrane Database Syst Rev 2004(1). Art. No.: CD004711. doi:10.1002/14651858.CD0004711.
Knapp S, Kofler J, Stoiser B, Thalhammer F, Burgmann H, Posch M, et al. The assessment of four different methods to verify tracheal tube placement in the critical care setting. Anesth Analg 1999;88:766—70.
Lindgren A, Ames N. Caring for patients on mechanical ventilation: what research indicates is best practice. AJN 2005;105(5):50—61.
Lorente L, Lecuona M, Martin MM, Garcia C, Mora ML, Sierra A. Ventilator-associated pneumonia using a closed versus an open tracheal suction system. Crit Care Med 2005;
33(1):115—9.
Martin S, Wilson M. Monitoring gaseous exchange: implications for nursing care. Aust Crit Care 2002;15(1):8—13.
McClave S, DeMeo M, DeLegge M, DiSario J, Heyland D, Maloney J. North American summit on aspiration in the critically ill patient: consensus statement. J Parenteral Enteral Nutr 2002;26(6):S80—5.
Safdar N, Dezfulian C, Collard H, Saint S. Clinical and economic consequences of ventilator associated pneumonia: a systematic review. Crit Care Med 2005;33(10):2184—93.
Schoonhoven L, Halboom J, Bousema M, Algra A, Grobbee D, Grypdonck M, et al. Prospective cohort study of routine use of risk assessment scales for prediction of pressure ulcers. Br Med J 2002;326(7381):165.
Soubani AO. Noninvasive monitoring of oxygen and carbon dioxide. Am J Emergency Med 2001;19(2):141—6.
St John RE, Malen JF. Contemporary issues in adult tracheostomy management. Crit Care Nurs Clin N Am 2004;16:413—30.

Mohammed Jawad Alabdulwahhab, Abdullah Abdrabalrassol Alabbas, Younis Ahmed Ali Alhababi, Youssif Husein Ali Alattafi, Maged Nasser Ali Almatter, Mohammed Hejji Almousa, Bader Naji Haydar Alhaidar, Mohammed Jameel Mohammad Alsalman, Ammar Abdullah Alali, Fadhel Hussain Ahmed Bushaja, Mohammed Ibrahim Ali Almusallam Alsayed, Sari Abdulwahab Alobid, Kadem Ali Alali, Hesham Najeeb Alali, Abdullah Abbas Alhafith