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Mechanical Ventilation in Critically Ill Patients in ICU: Review Article

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ABSTRACT

Background: Mechanically ventilating is frequently performed life-saving procedure in the emergency room (ER). With the duration of stay of ventilated patients in ERs rising, it is critical for emergency physicians to have a firm grasp on procedures for optimizing mechanical ventilation and minimizing consequences. Numerous positively pressured ventilation techniques are available; they are derived from different permutations of triggered volume- and pressure-cycled ventilations and supply ventilation at a variety of rates, pressures and volumes. Inadequate ventilatory treatment may result in significant respiratory and extrapulmonary injury that may go undetected.

Objective: The aim of this review article was to highlight mechanical ventilation in critically ill patients in ICU.

Conclusion: Non-invasive ventilation is an excellent first-line therapy for hypoxemic or hypercapnic respiratory failure in critically ill patients, failure of non-invasive ventilation necessitates introduction of intubation and invasive mechanical ventilation as second line therapy.

Keywords: Intubation, Invasive ventilation, Mechanical ventilation, Noninvasive ventilation.

INTRODUCTION

The requirement for ventilatory assistance is among the most frequent reasons for intensive care unit (ICU) admission. The ICU known today was born when mechanical ventilation was introduced into medical practice in the 1940s. In spite of its use, mechanical ventilation has been extensively acknowledged for its detrimental impact on the lungs. Thus, while deciding whether to mechanically ventilate a patient, the main reason for ventilatory assistance and its reversibility must be considered. Additionally, the ventilation objective and hence the optimal method of ventilation must be determined for each patient in order to maximize benefit and minimize adverse effects[(1)].

Mechanical ventilation is indicated for a variety of reasons, which have historically been classified as hypoxia and ventilatory respiratory failures. Respiratory distress, blockage of the airway, decreased or inadequate respiratory drive, irregular chest wall, and respiratory muscle exhaustion are among factors that lead to respiratory failure. It should be highlighted, however, that the main rationale for ventilation must be curable to enable sooner weaning off[(2)].

Previously, the effect of mechanical ventilation was investigated. **Esteban and colleagues** described the characteristics and results of mechanically ventilated adult patients. They discovered that 33% of the admissions to the ICU were on mechanical ventilation and that "survival relied on both variables existing at the time of mechanical ventilation initiation and patient treatment in the ICU"[(3, 4)].

Taking the patient off ventilator assistance is termed as weaning a patient off mechanical ventilation. The choice of weaning a patient off the ventilator is determined by the attending clinician's clinical judgment. Up to 20% of patients on mechanical ventilation in the ICU had recurring problems weaning off the ventilator. The observations indicated a much-increased incidence of weaning failure. This is related with a prolonged length of ventilation and the sequel that accompany it. However, there are several elements that contribute to effective weaning[(5)].

Weaning was significantly affected by the duration of mechanical ventilation. The longer a patient is ventilated during their ICU stay, the lower the likelihood of the weaning process occurring. This discovery, however, should be regarded cautiously. It may be due to unclear if prolonged ventilation caused difficulties with weaning or whether a lack of judgment on weaning resulted in prolonged ventilation[(6)].

Blackwood and colleagues previously determined that using an uniform weaning approach in the intensive care unit resulted in a decrease in mechanical breathing time. As a result, it is prudent to undertake a ventilated weaning procedure[(7)].

The treatment of critically sick patients necessitating mechanical ventilation requires considerable time and resources. These individuals need specialized treatment and are at an increased risk of unfavorable outcomes. Inadequate monitoring and/or care of the individuals may constitute a significant risk to patients' safety, resulting in issues and bad results[(8)].

Critical sickness management is currently regarded as a continuum that starts with prehospital treatment and progresses through emergency department intervention to ICU admission and managing. However, in the emergency department, physician engagement with this group of high-risk patients may vary. Additionally, emergency rooms often lack the resources and staff necessary for long-term care of the seriously sick[(8)].

Emergency doctors and nurses have little training in the continuous treatment of patients who are ventilated invasively or noninvasively, especially in

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North America, where mechanical ventilation is often introduced and maintained by respiratory therapists. However, after the patient is stabilized, these doctors with specific training in ventilation control often leave the emergency room and return only to review patients and enable transfers at the request of emergency department personnel[8].

Noninvasive ventilation:

- **Indications:**

In recent years, the emergency department has seen an upsurge in the use of noninvasive ventilation, notably for the treatment of acute cardiogenic pulmonary edema (ACPE) and aggravation of chronic obstructive pulmonary disease (COPD). Noninvasive ventilation alleviates a few of the risks related to invasive ventilation, including ventilator associated pneumonia, ventilator-associated lung damage, and pneumothorax[9].

Moderate to severe tachypnea, dyspnea, indicators of increased labor of breathing, like auxiliary muscle usage and abdominal paradox, acute (or acute on chronic) ventilatory failure, and hypoxemia are all indications for noninvasive ventilation. Candidates for noninvasive ventilation should retain a patent airway and make spontaneous breathing attempts[10].

- **Ventilator modes and settings:**

As previously noted, noninvasive breathing may be administered by noninvasive pressure support ventilation (NIPPV) or continuous positive airways pressure (CPAP). NIPPV utilizes inspiratory pressure support (also known as inspiratory positive airway pressure) to aid with ventilation and is used in conjunction with peak end expiratory pressure (PEEP) (also referred to as expiratory positive airway pressure)[11].

Positive airway pressure raises tidal volume proportionally to the amount of pressure applied and is often set between 8 and 20 cm H_2O, whereas expiratory positive airway pressure is typically set between 4 and 10 cm H_2O[12].

Pressure settings are chosen to optimize gas exchange and decrease respiratory effort while minimizing the increased air leak and pain linked to higher pressures. The distinction between inspiratory and expiratory positive airway pressure is the amount of pressure assistance provided; this must be considered while adjusting expiratory positive airway pressure settings. NIPPV is sometimes referred to as bilevel positive airway pressure, biphasic positive airway pressure (BiPAP) and NIPPV[13].

While CPAP does not actively aid with inspiration, it does maintain a consistent positive airway pressure (usually between 5 and 15 cm H_2O) during inspiration and expiration. While NIPPV needs a specialist ventilation machine to create inspiratory pressure support, CPAP may be given using a flow generator connected to a high flow oxygen output and a facemask equipped with a PEEP valve. NIPPV will result in larger improvements in oxygenation and respiratory acidosis, in addition to lower labor of breathing, when compared to CPAP[14].

- **Complications of noninvasive ventilation:**

Serious consequences include aspiration pneumonia, pneumothorax, and hemodynamic compromise due to elevated intrathoracic pressures, however these occur at a frequency of less than 5%. Rapid shallow breathing, deteriorating gas exchange, hemodynamic instability, and a diminished state of awareness are all signs of noninvasive ventilation failure and the necessity for intubation[15].

Invasive ventilation:

- **Indications:**

Apnea, deficiency of airway protection as a result of reduced consciousness level, hypoxemic or hypercapnic respiratory failure that doesn't respond to other therapies, upper airway blockage or damage and clinical signs of increased work of breathing and deteriorating respiratory distress, such as activation of accessory and expiratory muscles, tachypnea and irregular chest wall movement, are all signs for intubation and mechanical ventilation. As previously stated, noninvasive ventilation is an excellent first-line therapy for hypoxemic or hypercapnic respiratory failure in individuals with ACPE or (COPD)[16].

CONCLUSION

Non-invasive ventilation is an excellent first-line therapy for hypoxemic or hypercapnic respiratory failure in critically ill patients, failure of non-invasive ventilation necessitate introduction of intubation and invasive mechanical ventilation as second line therapy.

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REFERENCES

1. **Bibi S, Memon A, Sheikh J *et al.* (2008):** Severe acute maternal morbidity and intensive care in a public sector university hospital of Pakistan. J Ayub Med Coll Abbottabad., 20:109-12.
2. **Fan E, Del Sorbo L, Goligher E *et al.* (2017):**An Official American Thoracic Society/European Society of Intensive Care Medicine/Society of Critical Care Medicine Clinical Practice Guideline: Mechanical Ventilation in Adult Patients with Acute Respiratory Distress Syndrome. Am J Respir Crit Care Med., 195:1253-63.
3. **Peñuelas O, Frutos-Vivar F, Fernández C *et al.* (2011):** Characteristics and outcomes of ventilated patients according to time to liberation from mechanical ventilation. Am J Respir Crit Care Med., 184:430-7.
4. **Esteban A, Anzueto A, Frutos F *et al.* (2002):**Characteristics and outcomes in adult patients receiving mechanical ventilation: a 28-day international study. JAMA, 287:345-55.
5. **Nemer S, Barbas C, Caldeira J*et al.* (2009):** A new integrative weaning index of discontinuation from mechanical ventilation. Crit Care, 13:152-158.

6. **Girard T, Kress J, Fuchs B *et al.* (2008):** Efficacy and safety of a paired sedation and ventilator weaning protocol for mechanically ventilated patients in intensive care (Awakening and Breathing Controlled trial): a randomised controlled trial. Lancet, 371:126-34.
7. **Blackwood B, Wilson-Barnett J, Patterson C *et al.* (2006):**An evaluation of protocolised weaning on the duration of mechanical ventilation. Anaesthesia, 61(11):1079-86.
8. **Rose L (2012):** Management of critically ill patients receiving noninvasive and invasive mechanical ventilation in the emergency department. Open Access Emerg Med., 4:5-15.
9. **Hill N, Brennan J, Garpestad E *et al.* (2007):** Noninvasive ventilation in acute respiratory failure. Crit Care Med., 35:2402-7.
10. **Perrin C, Unterborn J, Ambrosio C *et al.* (2004):** Pulmonary complications of chronic neuromuscular diseases and their management. Muscle Nerve, 29:5-27.
11. **Seyfi S, Amri P, Mouodi S (2019):**New modalities for non-invasive positive pressure ventilation: A review article. Caspian J Intern Med., 10:1-6.
12. **Rabec C, Rodenstein D, Leger P*et al.* (2011):**Ventilator modes and settings during non-invasive ventilation: effects on respiratory events and implications for their identification. Thorax, 66:170-8.
13. **Jaber S, Chanques G, Jung B (2010):** Postoperative noninvasive ventilation. Anesthesiology, 112:453-61.
14. **Lumb A, Greenhill S, Simpson M *et al.* (2010):** Lung recruitment and positive airway pressure before extubation does not improve oxygenation in the post-anaesthesia care unit: a randomized clinical trial. Br J Anaesth., 104:643-7.
15. **Grogan K (2007):** Postoperative Pulmonary Management. The Johns Hopkins Manual of Cardiac Surgical Care. Mobile Medicine Series. 2ndedition. Philadelphia, PA: Mosby/Elsevier, Pp. 279. https://www.worldcat.org/title/johns-hopkins-manual-of-cardiac-surgical-care/oclc/147479264
16. **Racca F, Vianello A, Mongini T *et al.* (2020):** Practical approach to respiratory emergencies in neurological diseases. Neurol Sci., 41:497-508.