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Invasive Mechanical Ventilation in Adults in Emergency and Intensive Care: A Brief Review

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Abstract

Many patients are undergoing mechanical ventilation (MV) in the emergency room. Knowledge of professionals who assist the patient in emergency on the basic principles of the MV is of fundamental importance. The purpose of this brief review is to present the basics of starting and maintaining the patient in the emergency MV and guide behavior in the face of major complications.

Keywords: Mechanical ventilation, Emergency, Adults

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Introduction

Every day patients in various emergency situations are undergoing mechanical ventilation (MV). The patients presenting in the emergency room have a variety of disorders that may require intubation and invasive ventilation, including: acute respiratory distress syndrome, pneumonia, asthma, chronic obstructive pulmonary disease , cardiogenic pulmonary edema, congestive heart failure, spinal cord injury, stroke, trauma, severe sepsis, shock , myasthenia gravis, Guillain-Barre syndrome, apnea with respiratory arrest, including cases from intoxication, drug overdose, or the effect of anesthetic and muscle relaxant drugs [1-7].

The objectives of the MV are the maintenance of exchange gas, correction of hypoxemia and acidosis respiratory associated with hypercapnia, work relief respiratory muscles, reverse or avoid fatigue of the respiratory muscles, reduce the consumption of oxygen and allow the application of specific therapies. The main indications for starting support ventilatory are: resuscitation due to cardiac arrest, hypoventilation and apnea, respiratory failure and hypoxemia due to intrinsic pulmonary disease, mechanical failure of the respiratory system, prevention of respiratory complications, reduced respiratory muscle work and muscle fatigue. The table 1shows the parameters that can indicate the need for ventilation support. In this scenario, it is crucial importance to master the principles of the patient approach in MV: sedation, analgesia, neuromuscular blockade, fan manipulation and its main modalities ventilation, monitoring and possible complications associated with the MV [8-10].

Normal and abnormal parameters that may indicate the need for ventilatory support and the laboratory criteria for MV and the initial settings are shown in **Table 1**.

Analgesia, Sedation and Neuromuscular Blockade

Pain and anxiety are common findings in patients in MV, and the main objective of these measures is to minimize patient discomfort. In response to pain the body increases the release of catecholamines, cortisol, glucose, anti-diuretic hormone, acute phase proteins, and consequently causes hypertension, increased oxygen consumption, tachycardia, water retention and impaired immune response [11,12]. Table 2 shows the main drugs used in the MV.

The major drugs used in MV and the dosage, duration and adverse effects are given in **Table 2** [11,12].

Basic principles of the fan configuration

Respiratory cycle

It consists of the inspiratory phase, cycling (changing the inspiratory phase to expiratory), expiratory phase and shooting (transition from to expiratory phase to the inspiratory).Several studies have reported pulmonary lesions induced by MV. Furthermore, the persistence of high inspired oxygen fractions can also cause breakage of DNA molecules and lipid peroxidation in cell death. Factors as high airway pressures, high tidal volumes, the opening and closing alveolar cyclic combined in barotrauma, volotrauma and atelectotrauma producing biotrauma describing the release of inflammatory mediators causing extra pulmonary organ dysfunction [13-17]. Below we describe the main types and their characteristics.

Table 1 Normal and abnormal parameters, laboratory criteria for MV and Initial ventilator settings *AC, assist-control; SIMV, synchronized intermittent mandatory ventilation; F_iO_2, fraction of inspired oxygen; V_T, tidal volume; mL/kg, milliliters per kilogram; RR, respiratory rate; $\dot{V}_i$, inspiratory flow rate; L, liters; PEEP, positive end-expiratory pressure; cm H_2O, centimeters of water, Bpm: breaths per minute.

Parameters	Normal	Consider VM
Respiratory rate (bpm)	12-20	>35
Tidal Volume (ml/kg)	5-8	<5
Vital Capacity (ml/kg)	65-75	<50
Minute volume (L/min)	5-6 >10	>10
Maximal inspiratory pressure (cm/H_2O)	80-120	> 25
Maximal expiratory pressure (cm/H_2O)	80-100	< 25
Dead space (%)	25-40	>60
$PaCO_2$ (mmHg)	35-45	>50
PaO_2 (mmHg) (FIO_2 = 0.21)	>75	<50
P(A-a)O_2 (FIO_2 = 1.0)	25-80	>350
PaO_2 /FIO_2	>300	<200
pH	7.35 e 7.45	< 7.32
Pulmonary function tests	FEV_1 < 10 mL/kg	
Initial ventilator settings *		
Mode	AC or SIMV	
F_iO_2	1.0	
V_T	8-10 mL/kg	
RR	10-12 breaths/min	
$\dot{V}_i$	60 L/min	
PEEP	5-8 cm H_2O	

Continuous mandatory ventilation

All ventilation cycles are triggered and /or cycled by the ventilator. If the trigger occurs by the time the order is only controlled. If the trigger occurs according to negative pressure or positive flow performed by the patient, how to call assisted/controlled. The continuous mandatory ventilation may occur in controlled volume (the mandatory cycles have as control variable volume, are limited to flow and cycled volume) or controlled pressure (the mandatory cycles have as a control variable pressure, are limited to pressure and cycled time) [18-20].

Continuous mandatory ventilation with volume Controlled-controlled manner

In this mode, fixed to respiratory rate, tidal volume and the inspiratory flow. The start of inspiration (trigger) occurs according to the preset respiratory rate. The trigger occurs exclusively by time, getting off sensitivity control. The transition between the inspiration and expiration (cycling) occurs after the release of the preset tidal volume at a certain speed the flow [18-20].

Continuous mandatory ventilation with volume Controlled-assisted controlled manner

In this way, the respiratory rate can vary according to the result of shooting inspiratory effort the patient, however remain fixed both tidal volumes as the flow. If the patient does not reach the predetermined value sensitivity to trigger the device, this will keep ventilation cycles in accordance with the minimum respiratory rate indicated by the operator [18-20].

Continuous mandatory ventilation controlled pressure-controlled mode

In this mode, fixed up the respiratory rate, inspiratory time or an inspiration: expiration (ratio IT/ET), and the inspiratory pressure limit. The shooting continues predetermined according to the respiratory rate indicated, however cycling now happens according to the inspiratory time or the ratio TI/TE. Tidal volume becomes dependent on the pre-set inspiratory pressure, the impedance conditions of the respiratory system and inspiratory time selected by the operator [18-20].

Continuous mandatory ventilation with pressure controlled-assisted-controlled mode

In mode cycles occur as the patient's effort exceed the sensibility. Tidal volume also depend also that effort [18-20].

Intermittent mandatory ventilation

The fan generates a mandatory cycle's predetermined frequency, but allows spontaneous cycles (ventilation cycles triggered and cycled by the patient) occur between them. The ventilator enables the shooting of cycles mandatory occurs in sync with negative pressure or positive flow performed by the patient. The intermittent mandatory ventilation can occur with controlled volume (the mandatory cycles have as a control variable volume, they are limited to flow and volume cycled) or controlled pressure (the mandatory cycles have the pressure control variable, are limited to pressure and cycled time) [18-20].

Pressure Support Ventilation

A common strategy is to combine SIMV with an additional ventilator mode known as pressure support ventilation (PSV). In this situation, inspiratory pressure is added to spontaneous breaths to overcome the resistance of the endotracheal tube or to increase the volume of spontaneous breaths. PSV may also be used to facilitate spontaneous breathing [18-20].

Parameters used for weaning and weaning from mechanical ventilation are shown in **Table 3**.

Conclusion

The MV handling depends on different clinical situations, and strategy of initial configuration and subsequent amendments, drugs to be used and the weaning criteria must be mastered by the emergency team.

Table 2 Drugs used in MV, dosage, duration and adverse effects.

Drugs	Onset of action	Duration	Dosage	Adverse effects
Opioid analgesics				
Fentanyl (analgesic, sedative)	< 1 min	30 to 60 min	Bolus: 0.2-0.7 µg/kg Infusion: 50-500 µg/h	Miosis, bradycardia, respiratory depression, nausea hypotension, others.
Propofol (sedative hypnotic)	40 seconds	10 min	bolus: 1- 3 mg / kg Infusion 0.3-3.0 mg / kg / hr	Hemodynamic instability, elevated triglycerides, pain on injection.
Midazolam(anxiolytic, amnesic, sedative)	1-3 min	1 to 4 h	bolus: 0.03 to 0.3 mg / kg Infusion: 0.1-0.6 mg / kg / hr.	Discrete hemodynamic effects, depression breathing, delirium
Dexmedetomidine (sedative, hypnotico, analgesic, anxiolytic)	To 6 min	2 h	bolus: 1 mg / kg in 10 to 20 min Infusion: 0.2 to 0.7 mg / kg / hr	Bradycardia and hypotension
Morphine	3 min	3 to 6 h	bolus: 2.5 to 15 mg / kg Infusion: 1-10 mg / kg / hr	Bradycardia
Alfentanil	1 min	10 to 20 min	bolus: 10 to 25 mcg / kg Infusion: 0.25-1 mg / kg / hr	Depression breathing, delirium
Diazepam	2-5 min	20-120 h	0.03-0.1 mg/kg / 0.5-6 hr	Phlebitis
Lorazepam	5-20 min	8-15 h	bolus 0.02–0.06 mg/kg / 2-6 hr Infusion:0.01-0.1 mg/kg/hr	Solvent-related acidosis, Renal failure in high doses
Haloperidol	3-20 min	18-54 h	Bolus: 2-10 mg /20-30 min Infusion: 5-10 mg /6 h	QT interval prolongation

Table 3 Weaning and withdrawal of mechanical ventilation: MV = mechanical ventilation; K = potassium; Ca = calcium; Mg = magnesium; P = phosphorus.

Criteria considered before extubation	
Criteria	**Required condition**
1.Acute event that led to the VM	Reversed or controlled
2. Gas exchange	$PaO_2 \geq 60$ mmHg with $FIO_2 \leq 0.40$ and PEEP ≤ 5 to 8 cmH_2O
3. Hemodynamic evaluation	Good tissue perfusion, no vasopressors, coronary failure or arrhythmias with hemodynamic repercussions.
4. Ability to start inspiratory effort	Yes
5. Level of consciousness	Awakening with sound stimulus without psychomotor agitation
6. Cough	Effective
7. Balance acid-base	pH ≥ 7.30
8. Water Balance	Correction fluid overload
9. Serum electrolytes (K, Ca, Mg, P)	Normal values
10. Surgical intervention next	No

References

1 Cline SD, Schertz RA, Feucht EC (2009) Expedited admission of patients decreases duration of mechanical ventilation and shortens ICU stay. Am J Emerg Med 27: 843-846.

2 Herring A, Wilper A, Himmelstein D, et al. (2009) Increasing length of stay among adult visits to U.S. emergency departments, 2001- 2005. Acad Emerg Med 16: 609-616.

3 Chalfin DB, Trzeciak S, Likourezos A, et al. (2007) Impact of delayed transfer of critically ill patients from the emergency department to the intensive care unit. Crit Care Med 35: 1477-1483.

4 Tilluckdharry L, Tickoo S, Amoateng-Adjepong Y, et al. (2005) Outcomes of critically ill patients. Am J Emerg Med 23: 336-339.

5 Tallo FS, Vendrame LS, Lopes RD, et. al. (2013) Invasive mechanical ventilation in the emergency room: a review for clinicians. Rev Bras Clin Med 11: 48-54.

6 Rodriguez AME, Cosentini R, Papadakos PJ (2012) Mechanical ventilation in emergency departments: Non invasive or invasive mechanical ventilation. Where is the answer? Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine. 20: 40.

7 Rose L, Gerdtz MF (2009) Non-invasive mechanical ventilation in Australian emergency departments: a prospective observational cohort study. Int J Nurs Stud 46: 617-623.

8 Lamb KD (2015) Year in review 2014: mechanical ventilation. Respir Care 60: 606-608.

9 Winters ME, McCurdy MT, Zilberstein J (2008) Monitoring the critically ill emergency department patient. Emerg Med Clin North Am 26: 741-757.

10 Singer BD, CorbridgeTC (2009) Basic Invasive Mechanical Ventilation. South Med J 102: 1238-1245.

11 Jacobi J, Fraser GL, Coursin DB, et al. (2002) Clinical practice guidelines for the sustained use of sedatives and analgesics in the critically ill adult. Crit Care Med 30: 119-141.

12 Epstein J, Breslow MJ (1999) The stress response of critical illness. Crit Care Clin 15: 17-33.

13 Schultz MJ (2008) Lung-protective mechanical ventilation with lower tidal volumes in patients not suffering from acute lung injury: a review of clinical studies. Med Sci Monit 14: 22-26.

14 Gattinoni L, Protti A, Caironi P, et al. (2010) Ventilator-induced lung injury: the anatomical and physiological framework. Crit Care Med 38: S539-548.

15 Imai Y, Parodo J, Kajikawa O, et al. (2003) Injurious mechanical ventilation and end-organ epithelial cell apoptosis and organ dysfunction in an experimental model of acute respiratory distress syndrome. JAMA 289: 2104-2112.

16 De Proust N, Dreyfuss D (2012) How to prevent ventilator-induced lung injury? Minerva Anesthesiol 78: 1054-1066.

17 Ochiai R (2015) Mechanical ventilation of acute respiratory distress syndrome. J Intensive Care 3: 25.

18 Archambault PM, St-Onge M (2012) Invasive and noninvasive ventilation in the Emergency Department. Emerg Med Clin North Am 30: 421-449.

19 Tobin MJ (2001) Advances in mechanical ventilation. N Engl J Med 344: 1986-1996.

20 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: 170-178.