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AIRWAY MANAGEMENT IN EMERGENCY SITUATIONS: INDICATIONS, TECHNIQUES, STRATEGIES AND CHALLENGES

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ABSTRACT

Respiratory failure occurs when the respiratory system is not able to meet the body's oxygen demands. That is, oxygen is insufficient or CO_2 is not eliminated properly, thus accumulating in the bloodstream. It is classified into two main types: type I (hypoxemic), characterized by PaO_2 below 60 mmHg, and type II (hypercapnic), with $PaCO_2$ above 50 mmHg. Type I results from changes in oxygenation (such as ARDS or pneumonia), while type II is related to hypoventilation (such as in intoxication or neuromuscular diseases).

Effective management of respiratory failure requires prioritization of the airway. Basic methods, such as nasal cannula and oxygen masks, serve mild to moderate situations, while advanced devices, such as orotracheal intubation, are indispensable for severe and critical cases. Intubation is the gold standard in severe acute respiratory failure with a decreased level of consciousness, as it protects the airway, improves ventilation, and allows the administration of medications.

Maneuvers such as Head-Tilt, and Jaw-Thrust, and devices such as Guedel's cannula are essential to keep the airway patent in emergencies. Advanced techniques, such as cricothyroidotomy, are used in extreme situations. Preparation of staff and materials, including equipment checklists, is vital.

Challenges to maintaining oxygenation, ventilation, and patent airway include difficult airway recognition, resource limitations, and complications such as aspiration or trauma. Continuous staff training and technological advances, such as video laryngoscopes, have improved outcomes.

In emergencies, appropriate airway management, adapted to the clinical situation, is crucial to stabilize the patient, prevent unfavorable outcomes, and ensure the effectiveness of oxygenation and ventilation.

Keywords: Airway. Emergency. Indications. Strategies. Challenges.

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INTRODUCTION

Airway management is an essential competence for the clinical practice of health professionals who work in pre- and intra-hospital emergencies. The inability to maintain a patent airway, as well as the inability to oxygenate and ventilate, can lead to fatal consequences, such as hypoxia, brain injury, cardiorespiratory arrest, and death (BRAGA et al., 2023).

The airways are responsible for conducting air to the lungs, being essential to carry oxygen to the alveoli to enable hematosis and gas exchange. It can be divided anatomically as the upper airway, with the structures that are present outside the thoracic cavity, such as the nasal cavity, pharynx, and larynx. The lower airway is made up of structures that are present in the rib cage, such as the trachea, bronchi, bronchioles, and alveoli. We can also classify the airway as conductive portion and respiratory portion (CONSERVA et al., 2024).

These structures have different functions that allow heating, humidifying, filtering and conducting air to the alveoli where gas exchange will occur, thus allowing aerobic cellular respiration. For this to be possible, there is a series of interactions of organs and systems, from central control by the medulla oblongata in the brainstem to the passage of O2 and carbon dioxide in the alveolarcapillary membrane (SANTANA et al., 2020).

Ventilation is a physiological process that depends on the integrity and proper functioning of the central nervous, respiratory, and cardiovascular systems. This mechanism can be altered by several factors, such as changes in airway permeability, either by a foreign body, secretions, tongue base drooping in unconscious patients, in situations of flow obstruction, such as bronchospasm crises and also in situations with changes in the permeability of the alveolar-capillary membrane, such as in patients with pulmonary fibrosis, acute pulmonary edema, chronic obstructive disease, asthma, pneumonia, among others (MIGUEL et al., 2024).

The main indications for airway management in emergencies are acute respiratory failure, airway obstruction due to trauma or foreign body, altered mental status, with risk of aspiration, and need for mechanical ventilation in critically ill patients due to emergency or to promote protective ventilation aiming at a poor prognosis in the following hours (BRAGA et al., 2023; PEREIRA et al., 2022).

Respiratory Failure is a condition that represents the inability of the respiratory system to provide sufficient O2 supply to maintain the functioning of the body, causing

an alteration in oxygenation or the inability to eliminate carbon dioxide adequately due to an alteration in ventilation. These changes are potentially life-threatening if they are intense and not addressed correctly. Because they carry potential risks to life since the tissues do not survive without the presence of O2 (SANTOS et al., 2020).

For the management of these clinical situations, we can use some airway devices such as simple oxygen masks, venturi masks, nasal catheters, non-rebreathing masks, valve bag masks, and devices necessary to maintain a patent airway such as oropharyngeal or nasopharyngeal cannulas. In more severe situations and according to the patient's needs, we can use more advanced techniques such as orotracheal intubation, and even surgical methods such as cricothyroidotomy and tracheostomy (CONSERVA et al., 2024).

Given the diversity of clinical scenarios and the severity of the conditions encountered in emergencies, it is crucial to know the clinical indications for each type of oxygenation or ventilation method, as well as the available maneuvers and techniques, effective strategies, and the challenges associated with airway management. This knowledge allows for a structured approach and increases the chances of success in the intervention (BRAGA et al., 2023).

OBJECTIVE

The general objective of this study is to analyze airway management in emergencies, addressing the main clinical indications, materials needed, techniques used, strategies to maximize the safety and efficacy of the procedure, and the challenges faced by health professionals. The aim is to provide a comprehensive and practical view for application in the clinical context.

The specific objectives

1. Determine the indications for airway management
2. Name which airway devices are suitable for oxygenation and ventilation
3. Stipulate the strategies for the success of an adequate road
4. Establish the main challenges of airway management

METHODOLOGY

Considering that theoretical studies are an indispensable basis for field and laboratory research, we opted for conceptual deepening and searching for official data

on the object of study, allowing the knowledge of reality as well as the possibility of critical reflection on the subject within the scope of Brazilian reality.

Based on the understanding of Creswell (2007) for whom the Literature Review is configured as a preliminary stage of scientific studies, then the research is a Literature Review in which articles published in the National Library of Medicine (Pubmed), Virtual Health Library (VHL), Web of Science, Lilacs and Capes Journals were used as the basis of the study by descriptors obtained by the Health Sciences Descriptors (DeCS) of the VHL.

This is a literature review of articles published in the National Library of Medicine (Pubmed), Virtual Health Library (VHL), Web of Science, Lilacs and Capes Journals by descriptors obtained by the Health Sciences Descriptors (DeCS) of the VHL. The following descriptors were searched: Airway AND Emergency AND Indications in "All fields".

For the selection of articles, the following steps were followed: (I) search for articles in the databases; (II) reading of titles and abstracts, with analysis according to the eligibility criteria and; (III) full-text analysis of the papers, including in the systematic review only those required by the inclusion criteria and did not meet any of the exclusion criteria.

The following inclusion criteria were selected: (1) studies involving airway management in emergencies; (2) studies that had as their object of study the indications, techniques, strategies, and challenges of airway management in emergencies; (3) articles published in the last 4 years. There were no restrictions on sample size or foreign language.

As exclusion criteria, articles were excluded that: (1) were published before 2020; (2) studied situations that do not include airway management in emergencies; (3) were duplicates; (4) they were not directly related to airway management, its indications, techniques, strategies, and challenges;

RESULTS AND DISCUSSION

Respiratory Failure is a clinical condition that represents the situation where the respiratory system is unable to provide sufficient O2 supply for tissue perfusion or is represented by the inability to eliminate carbon dioxide (CO2) adequately due to an alteration in ventilation. It is a syndrome resulting from several pulmonary and non-

pulmonary etiologies. It can be classified in several ways, such as its pathophysiological type, type I (hypoxemic) and Type II (Hypercapnia), according to its time of installation through arterial blood gas analysis, acute or chronic (MIGUEL et al., 2024).

The arterial blood gas criteria that define type I respiratory failure (hypoxemic) are paO2 below 60 mmHg and paCO2 is usually normal or decreased. That is, there is an alteration in oxygenation and not in ventilation. Its pathophysiological mechanism is represented by changes in ventilation, but by hypoxemia resulting from changes in diffusion or the ventilation/perfusion ratio, as occurs in Acute Respiratory Distress Syndrome (ARDS). It can also be caused by cardiogenic etiologies, characterized by pulmonary capillary pressure above 18 mmHg, as in congestive heart failure, or non-cardiogenic heart failure, with pulmonary capillary pressure below 18 mmHg, as represented by pneumonia and ARDS (MELO et al., 2022).

The arterial blood gas criteria that define respiratory failure type II (Hypercapnic) are paCO2 above 50 mmHg. This occurs due to alteration of alveolar ventilation, i.e., hypoventilation causing inadequate elimination of CO2. This occurs in poisoning by barbiturates, opioids, stroke, and neuromuscular diseases, such as spinal cord trauma and myasthenia gravis. It can also occur in asthma and COPD, due to airflow obstruction (GAWLINSKI et al., 2023).

The criteria for determining the time of onset, in addition to the patient's clinical practice, are represented by pH compensation by counterregulatory mechanisms, especially renal compensation representing a more chronic situation of respiratory failure (BUSANELLO et al., 2021).

It is worth noting that patients with severe hypoxemia, type I, may also evolve, later, to muscle fatigue with consequent alveolar hypoventilation, thus resulting in type II insufficiency (REIS et al., 2023).

Generally, the mechanisms of pH regulation are represented by the buffer system that occurs from seconds to minutes, by respiratory mechanisms from minutes to hours, and finally by renal mechanisms from hours to days (AMERICAN et al., 2022).

These situations of respiratory failure require adequate management of the airways because, without this knowledge and their devices, the patient can have severe hypoxemia, leading to cardiorespiratory arrest and even death. It is worth emphasizing the importance of maintaining the airway to the trivia, being the first conduct in the face

of patients with respiratory failure or in cardiorespiratory arrest (CONSERVA et al., 2024).

This permeability can be done through special maneuvers such as Head-Tilt + Chin-Lift: head tilt + chin lift to open the airway in a patient without cervical trauma. The Jaw-Thrust maneuver consists of pulling the patient's jaw with possible cervical trauma. The Heimlich Maneuver: To open the airway in a choking patient, with a foreign body. Guedel's cannula can also be used for patients with a decreased level of consciousness without coughing or vomiting reflexes, to prevent airway occlusion due to falling base of the tongue (DA SILVA et al., 2022; BARBOSA et al., 2022;).

Key indications for airway management in emergencies include:

- Acute respiratory failure;
- Airway obstruction due to trauma or foreign body;
- Altered mental status, with risk of aspiration;
- Need for mechanical ventilation in critically ill patients.

Early recognition of the need for clearance maneuvers and airway devices is essential to avoid unfavorable adverse outcomes and to enable successful oxygenation and ventilation. However, the health professional must be prepared for possible airway failures. For this, scales such as *Mallampati* and criteria of difficult intubation can be used as predictive tools to prepare for possible intubation (DA SILVA et al., 2022).

Airway management techniques range from basic methods, such as airway opening maneuvers and simple devices for oxygenation and ventilation, to advanced and surgical interventions. The choice of these devices should be stipulated according to the needs and the clinical and laboratory situation of the patient, as well as the methods available at the time of the intervention (YAMASHITA et al., 2024).

We can classify as basic methods, the first useful approaches in the initial maintenance of oxygenation in an urgent or emergency situation. Basic devices for oxygenation include the nasal catheter, oxygen mask, venturi mask, valve bag mask, and oropharyngeal or nasopharyngeal cannulas and non-rebreathing mask (BRAGA et al., 2023).

The nasal cannula, also known as an oxygen catheter, can deliver up to 44% oxygen. It is a good device to be used initially in situations of mild to moderate hypoxemia. It is a low-flow system, in which the oxygen offered mixes with the ambient air, and the estimated oxygen supply increases by 4% with the increase in flow by 1 L.

By offering 1 L/min of O2, it is possible to guarantee a supply of 24%, in 2 L/min of 28%, 3 L/min of 32%, 4 L/min of 36%, 5 L/min of 40%, and 6 L/min of 44% (FROTA et al., 2020; CARVALHO et al., 2022).

A face mask is a device that can deliver up to 60% oxygen. Through a high-flow system, it can be adjusted between 6 and 15 L/min. It is indicated for patients with moderate/severe hypoxemia, especially in tachypneic patients who breathe through the mouth. The face mask with oxygen reservoir, on the other hand, provides up to 100% oxygen. Its use requires a high flow of oxygen, from 10 to 15 L/min to keep the oxygen reservoir always full of the gas (SÉ et al., 2021).

The Venturi Mask allows for a more precise adjustment of the FiO2 offered to the patient. The oxygen levels offered are 24 to 50%, following a standard table, according to the regulating valve being used. By changing the regulating valve, a more precise adjustment of the fraction of oxygen offered is possible. The blue valve offers 24% of O2, the yellow 28%, the white 31%, the green 35%, the red 40% and the orange 50%. It is widely used in CO2-retaining patients with chronic hypercapnia, and its use reduces the chance of inducing narcosis due to unwanted hyperoxia (FROTA et al., 2020).

Other basic devices are used, but with the main objective of ventilation and oxygenation, we can highlight the bag-valve device and the bag-valve mask, also known as the AMBU. The bag-valve device consists of a self-inflating bag and a one-way valve that can be used in conjunction with a mask, endotracheal tube, or other airway devices (CONSERVA et al., 2024).

The bag-valve-mask, known as AMBU, is a ventilation device, for patients with or without an advanced airway device. It can be ventilated with a mask or directly in the orotracheal tube. When the bag-valve-mask is used in association with an oxygen reservoir, the fraction of oxygen inspired is practically 100%. It is indicated in rapid procedures, as well as in pre-oxygenation to obtain an advanced airway (SMITH et al., 2021).

Advanced techniques, also called definitive airway (which have a cuff inflated in the trachea) include orotracheal intubation and some surgical methods such as cricothyroidotomy and tracheostomy. Orotracheal intubation is the gold standard for patients who require invasive ventilation, in a situation of hemodynamic instability or inability to keep the airway functioning, while cricothyroidotomy is used as a rescue

measure, when intubation has some contraindication or where it is not sufficient to maintain adequate ventilation (COOK et al., 2024).

Orotracheal intubation is the most effective technique for airway protection and control, as well as for stabilizing acute respiratory failure and adjusting arterial blood gas analysis. It is done through the insertion of a tube via the orotracheal route. It thus allows the administration of high oxygen fractions, keeps the airway patent, allows the administration of some drugs through the airway, such as vasopressin, atropine, naloxone, epinephrine, and lidocaine, and protects the airway from gastric aspiration, secretions, and blood from the oropharynx (GRANATO et al., 2022).

The indication for intubation exists in 3 situations, when there is failure or difficulty to maintain the patent airway, when there is failure or difficulty to maintain oxygenation or ventilation, or when the patient has a poor prognosis and he will evolve in the near future to OTI, at this time I do it as a protective measure to avoid patient fatigue (GOMES et al., 2022).

The appropriate choice of the airway as well as its proper use are essential for the success of ventilation and/or oxygenation, that is, the application of appropriate strategies is decisive for the success of airway management (BRAGA et al., 2023).

Adequate preparation consists of using a checklist to ensure the presence of necessary equipment such as laryngoscopes, endotracheal tubes, supraglottic devices, aspiration points, oxygen points, adequate pre-oxygenation, sedative drugs or neuromuscular relaxants if necessary, among others (FILGUEIRA et al., 2020).

Just as there is a need to prepare the material, there is also a need to prepare the medical team, nurses, nursing technicians, and physiotherapists. Through regular training and updates on techniques and indications. As well as the need to train the team to work in high-pressure situations (RAMOS et al., 2022).

Among the main challenges of managing these patients in situations where the airway is needed, we can highlight the importance of recognizing a difficult airway. Identify in advance the anatomical, clinical, and functional characteristics that may hinder interventions. Another factor is the lack of equipment in the health facility the management of pre-hospital patients or the lack of experience of the physician and his team, especially in scenarios of low infrastructure, such as rural hospitals or remote regions (LIMA et al., 2020).

Other major complications can make management difficult, such as airway trauma, aspiration, or hypoxia during attempted intubation. Airway management in situations of trauma or cardiorespiratory arrest can be even more challenging due to the limited time for intervention and the patient's hemodynamic instability (KAPLAN et al., 2022).

CONCLUSION

Effective airway management in emergencies is a vital skill that the health team in an extra-hospital and in-hospital environment must know how to manage appropriately. To do so, this skill requires ongoing training, robust technical knowledge, and the use of appropriate strategies. The techniques must be adapted to the patient's clinical context, taking into account their saturation or respiratory effort, always prioritizing the patient's safety and stabilization (BRAGA et al., 2023).

Despite challenges such as a difficult airway, and intubation failures, the advancement of technological devices such as video laryngoscopes, and the use of structured protocols have contributed significantly to improving outcomes. The training of health professionals such as doctors, nurses, nursing technicians, and physiotherapists and the availability of resources continue to be fundamental pillars for success in airway management (COOK et al., 2020).

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