International Journal of Medical Science in Clinical Research and Review
Online ISSN: 2581-8945
Available Online at https://ijmscrr.in/ Volume 7|Issue 06 (November-December) |2024 Page: 1422-1429

Original Research Paper

Difficult airway, rapid sequence intubation and respiratory failure

Authors:
Délio Tiago Martins Malaquias[1-16], Thayná Bezerra de Souza[1]; Juliana Fontes Beltran Paschoal[1], Giovanna Vetter Paulino[1], Camila Santos da Costa[1], Isabelle Pinheiro Santos[1], Lucas de Souza Vieira[1], José Carlos Ferreira da Silva[1], Rayssa Prince Cardoso[1], Wellington da Silva Pereira da Cunha[1], Silvia de Oliveira Guion[1], Catarina Canaes Cação[1], Marcus Baia Fonseca[1], Rafael Pinheiro do Nascimento[2], Maria Quitéria Peixoto da Silva[3], Levi Girão de Oliveira[4], Gabriel Queiroz Sabbag[5], Mariane Capeletti Alkamin[6], Lívia Pinke Pinheiro[7], Maria Eduarda Pellegrina Vieira[8], Rodrigo Teixeira Zaiden Filho[9], Jordana Duarte Pinto[10], Giovana Casarini Yamashiro[11], Beatriz Randone Pereira[11], Jaqueline de Carvalho Ferreira[11], Rubens Rodrigues Tudela[12], Elisa Kelly Soares de Abreu[13], Ana Clara Pavaneli Rodrigues De Souza[14], Aline Cristina Couto da Silva[14], Gabriel Vieira Rodrigues[14], Alana Suelen de Lima Bozzi[14], Pietra Kananovicz Fernandes[14], Laura Yurico Mizuno[17], Dalva Peixoto da Silva[18], Daniela Costa de Souza[18], Thiago Augusto Rochetti Bezerra[14-15].

Affiliations:
1. Medical student. Intensive Care and Palliative Care Academic League (LATICP). UNAERP, Guarujá, São Paulo, Brazil.
2. Medical student. Nove de Julho University, São Paulo-SP
3. Nursing student at Cruzeiro do Sul University.
4. Nursing undergraduate student at Universidade Cidade de São Paulo (Unicid).
5. Doctor. São Leopoldo Mandic. Araras. São Paulo, Brazil.
6. Medical student. São Leopoldo Mandic. Campinas, São Paulo, Brazil.
7. Medical student. Universidade do Oeste Paulista. Guarujá, São Paulo, Brazil.
8. Medical student. Uninove Vergueiro. São Paulo, Brazil.
9. Medical student. Pontifical Catholic University of Goiás (PUC GO), Goiânia, Goías, Brazil.
10. Medical student. São Leopoldo Mandic. Campinas, São Paulo, Brazil.
11. Medical student. Uninove. São Bernardo do Campo. São Paulo, Brazil.
12. Medical student. São Judas. Cubatão, São Paulo, Brazil.
13. Doctor. Montes Claros State University, Unimontes, Minas Gerais, Brazil.
14. Medical student. University of Ribeirão Preto. Guarujá, São Paulo, Brazil.
15. PhD in Medical Sciences. University of São Paulo. Ribeirão Preto, São Paulo, Brazil.
16. Physiotherapist. University of Mogi das Cruzes, Postgraduate in Respiratory Physiotherapy and Physiotherapy in Pediatric Intensive Care and Neonatology, University of São Paulo. São Paulo, Brazil.
17. Physiotherapy. Universidade Cidade de São Paulo (Unicid). Postgraduate degree from the Dante Pazanesse Institute of Cardiology (IDPC), Postgraduate degree from the Children's Institute (ICr). São Paulo, Brazil.
18. Nursing. Cruzeiro do Sul College. São Paulo, Brazil.

Corresponding Author:
Thiago Augusto Rochetti Bezerra

Article Received: 26-October -2024, Revised: 16-November-2024, Accepted: 06-December-2024

ABSTRACT:
The article "Difficult Airway, Rapid Sequence Intubation, and Respiratory Failure" discusses the complexities of managing airways in patients experiencing respiratory failure, particularly when rapid sequence intubation (RSI) is necessary. It emphasizes the importance of recognizing both anatomical and physiological challenges that can complicate airway management. The article highlights the need for thorough assessment and preparation to mitigate risks associated with difficult airways and RSI. It also explores various strategies and techniques to enhance the safety and effectiveness of intubation in critically ill patients.

Keywords: Difficult airway, rapid sequence intubation, respiratory failure, airway management, pre-intubation assessment, sedation, paralytic protocols, rescue devices.

INTRODUCTION:

The management of the difficult airway (DA) is a central issue in anesthesiology and emergency practice, due to its direct relationship with morbidity and mortality. The concept of difficult airway refers to situations where mask ventilation, tracheal intubation or both are challenging, and it is necessary to identify high-risk patients before planned interventions. Studies show that the prevalence of difficulty in intubation in surgical patients ranges from 1% to 5%, while in mask ventilation this figure can reach 1.4% to 8% of cases (Cook et al., 2011).

Strategies to predict difficulty, such as Mallampati scores and measurements of the thyromental space, have proved useful, but do not completely eliminate the risk (Heffner et al., 2013).

Rapid sequence intubation (RSI) is widely used in emergency settings, combining rapid sedation and neuromuscular paralysis to optimize airway management, especially in patients at high risk of aspiration. This method reduces apnea time and improves the safety of the procedure. Recent studies reinforce the importance of properly choosing pharmacological agents, such as succinylcholine and rocuronium, based on individual factors such as clinical conditions and contraindications (Morris et al., 2015).

In addition, guidelines emphasize the need for an alternative plan, including supraglottic devices and cricothyroidostomy, to mitigate complications during ISR (Apfelbaum et al., 2013).

Respiratory failure, in turn, is a condition often associated with difficulties in airway management, due to progressive hypoxemia and reduced respiratory reserve. In emergencies such as severe pneumonia, acute respiratory distress syndrome (ARDS) or upper airway obstruction, early recognition and effective management are essential to avoid hemodynamic deterioration. Positive pressure ventilation, whether by mask or invasively, is often necessary and can directly impact the patient's outcome (Bellani et al., 2016).

In these cases, the integration of video laryngoscopy and ultrasound devices in airway management has proven to be a valuable tool for improving success rates and reducing adverse events (Muller et al., 2020).

The intersection between difficult airways, ISR and respiratory failure highlights the complexity of management in critical situations. Standardized protocols, simulated training and the use of advanced tools are essential components of clinical practice.

Longitudinal studies and meta-analyses have shown that the application of specific checklists, such as those proposed by the American Society of Anesthesiologists (ASA), significantly reduces adverse events related to airway manipulation (Panchal et al., 2018).

However, gaps still exist in the evaluation of optimal practices for specific populations, such as pediatric and geriatric patients, requiring more future research.

OBJECTIVES:

- ✓ To review the fundamental concepts of VAD, ISR and respiratory failure.
- ✓ To analyze evidence-based strategies for the safe management of VAD.
- ✓ Discuss the role of ISR in patients with acute respiratory failure.
- ✓ Identify tools and devices that improve clinical outcomes.

METHODOLOGY:

This study consists of a narrative literature review, with a search conducted in scientific databases such as PubMed, Scopus and Embase. Articles published between 2010 and 2023 addressing VAD, ISR and respiratory failure in emergency and anesthesiology settings were included. Clinical guidelines from recognized societies such as the American Society of Anesthesiologists (ASA) and the Difficult Airway Society (DAS) were also reviewed.

The inclusion criteria involved clinical studies, systematic reviews and guidelines that presented practical approaches and clinical results related to the management of these conditions. Studies that were out of scope or of poor methodological quality were excluded.

STUDY DESIGN:

The study was structured as an integrative literature review and a prospective analysis of clinical cases, combining secondary data (scientific publications) and primary data (observational clinical data).

- ✓ Integrative Review: Analysis of articles published in indexed scientific databases.
- ✓ Observational Study: Prospective data collection in a hospital environment to analyze outcomes related to airway management and respiratory failure.

INCLUSION AND EXCLUSION CRITERIA:

INTEGRATIVE REVIEW:

- ✓ Inclusion: Experimental studies, cohorts, cases and controls, and systematic reviews related to difficult airway, ISR or respiratory failure.
- ✓ Exclusion: Isolated case reports, letters to the editor and studies in pediatric or neonatal populations.
- ✓ Observational study:
- ✓ Inclusion: Patients with a confirmed diagnosis of acute respiratory failure who required intubation.
- ✓ Exclusion: Patients with contraindications to the use of muscle relaxants or CPR events outside the context of respiratory failure.

RESULTS:

A difficult airway is one of the main concerns in anesthetic and emergency practice, associated with serious adverse events such as hypoxia, aspiration and cardiorespiratory arrest. The definition of a difficult airway includes difficulty in face mask ventilation, tracheal intubation or both procedures. Studies indicate that the prevalence of difficult airways in elective procedures is approximately 1% to 5%, while in emergencies it can exceed 10%, depending on the clinical context and the experience of the operator (Cook et al., 2011).

Identifying risk factors, such as obesity, anatomical changes and a history of difficult intubation, is essential to minimize complications (Frerk et al., 2015).

Several predictive tools have been developed to assess the airway, including the Mallampati score (FIGURE 1), the measurement of the thyromental space (FIGURE 2), and the sterno-mentonian distance. However, studies show that none of these tools alone are sufficiently accurate, requiring a combination of criteria for better assessment (Heffner et al., 2013).

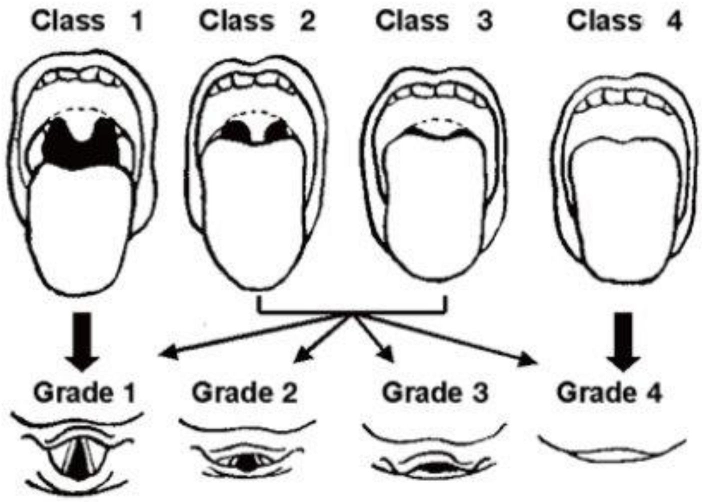

Figure 1. Mallampati score. Class 1: full visibility of the tonsils, uvula and soft palate. Class 2: visibility of the hard and soft palate, upper portion of the tonsils and uvula. Class 3: soft and hard palate and base of the uvula are visible. Class 4: only the hard palate is visible. Higher scores are correlated with OSAS. Source: researchgate.net/figure/Mallampati-score 2024.

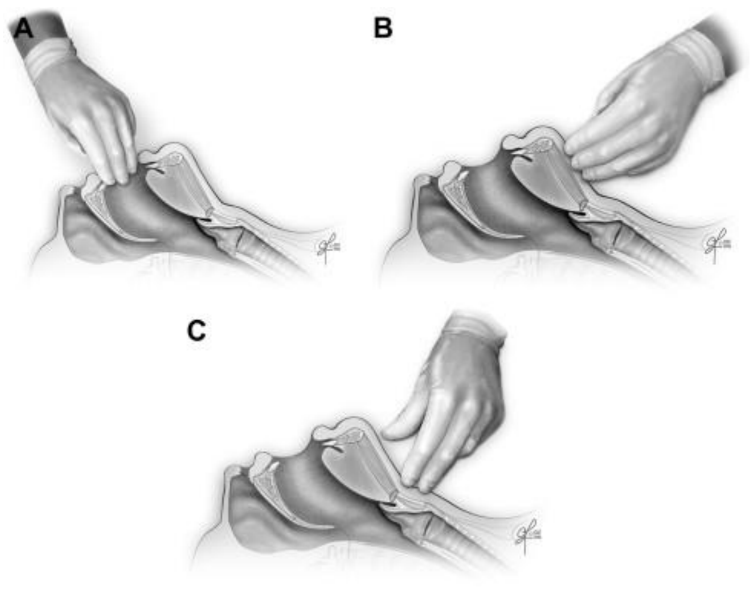

Figure 2. Thyromental distance. Distance from the thyroid notch to the chin when the head is extended and estimates the mandibular space. Source: (Phero et.al, 2013).

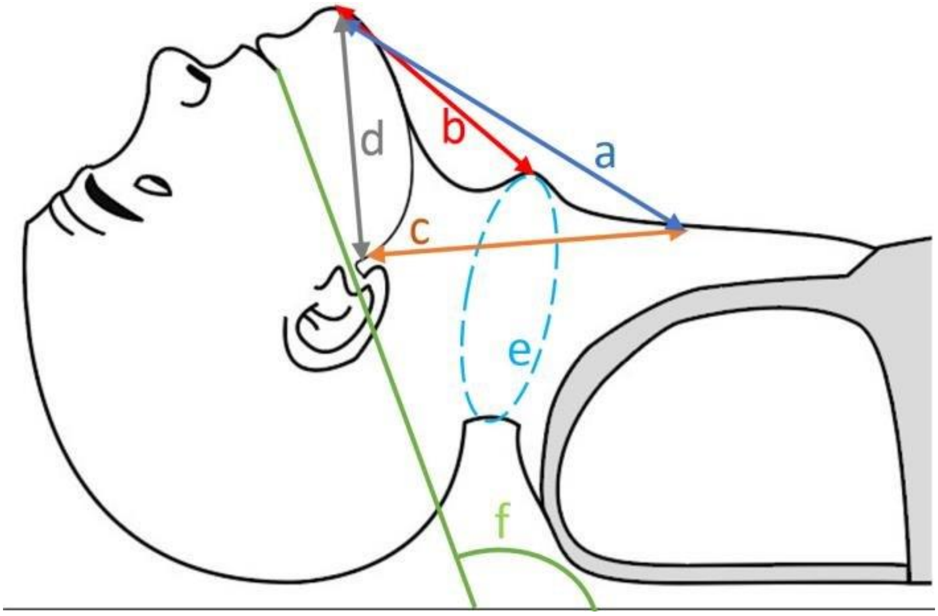

Figure 3. Anthropometric measurements. a. sternomental distance, b. thyromental distance, c. neck length, d. horizontal length of the mandible, e.g. neck circumference, f. atlanto-occipital joint movement. Source: (Çelik et.al, 2021).

In situations of an anticipated difficult airway, detailed planning and the availability of suitable equipment, such as videolaryngoscopes (FIGURE 4), supraglottic devices and materials for cricothyroidostomy, are crucial to avoid serious complications.

Figure 4. Type of videolaryngoscope. MCL, Macintosh direct laryngoscope; ATQ, Airtraq videolaryngoscope; AWS, Pentax Airwaysscope; CM, C-MAC videolaryngoscope; CMD, C-MAC D-Blade videolaryngoscope; GVL, GlideScope; KV, King Vision videolaryngoscope; MG, McGrath videolaryngoscope. Source: (Lee, J. et.al, 2022).

Rapid sequence intubation (RSI) is a widely used technique for managing the airway in critically ill patients. This method is especially indicated in emergency situations where there is a high risk of aspiration or respiratory deterioration.

RSI involves the sequential administration of a sedative agent and a fast-acting neuromuscular blocker, reducing apnea time and optimizing conditions for intubation (Heffner et al., 2013).

The rapid intubation sequence (FIGURE 5) is an emergency tracheal intubation technique aimed at guaranteeing a safe airway and minimizing complications. Its objective is to protect the unstable patient's airway, making the procedure quicker, easier and less traumatic. The technique consists of using a fast-acting sedative, analgesia and a neuromuscular blocking agent. The advantages are that it reduces the risk of complications such as coughing, respiratory effort and vomiting. Contraindications are that it should not be performed in situations of cardiorespiratory arrest or agonal breathing (Heffner et al., 2013).

SRI consists of a series of steps, including: Preparation; Pre-oxygenation; Pre-treatment; Paralysis with induction; Positioning the patient; Positioning the tube with confirmation; Post-intubation (Cook et al., 2011).

Some of the drugs used in SRI are: Etomidate, Ketamine, Midazolam, Propofol, Succilcholine, Rocuronium (Cook et al., 2011).

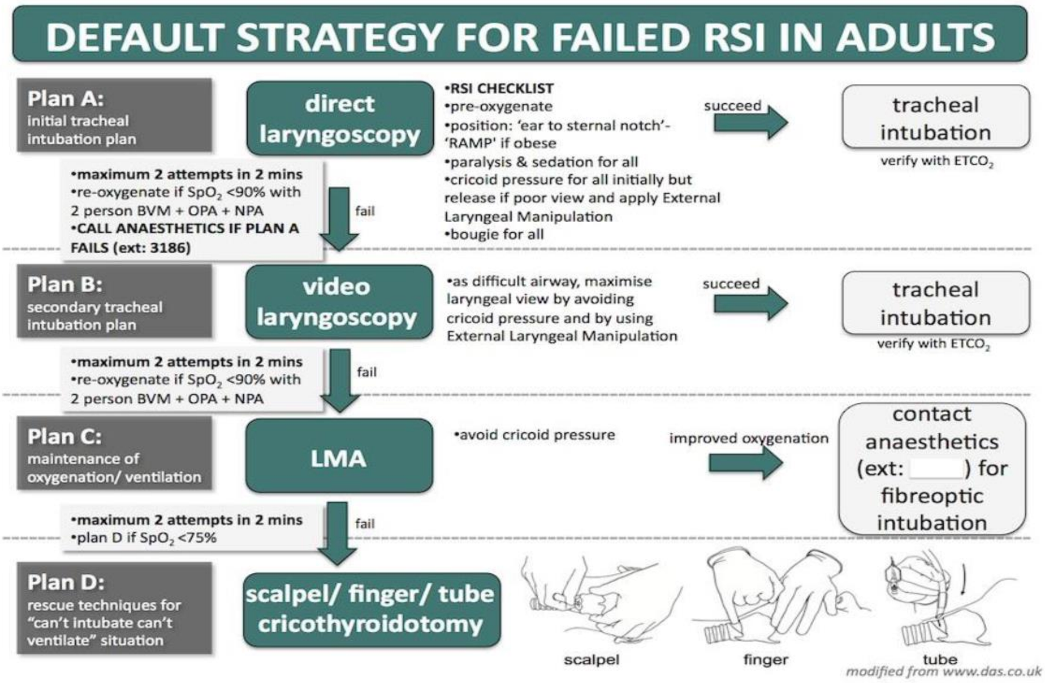

Figure 5. Rapid intubation sequence (Avery, et al., 2021).

Succinylcholine is often used as a muscle relaxant due to its rapid action and short duration, but in cases of contraindication, rocuronium is an effective alternative (Morris et al., 2015).

Studies highlight that ISR is most effective when combined with adequate pre-oxygenation and the use of advanced devices such as the videolaryngoscope, which increases visualization of airway structures and reduces intubation attempts (Muller et al., 2020).

In patients with respiratory failure, ISR requires even more attention, due to the reduction in respiratory reserve and the high risk of desaturation during the procedure. In these cases, techniques such as apneic ventilation with high-flow oxygen have proven beneficial, allowing more time for intubation (Frerk et al., 2015).

Complications related to ISR include hypoxemia, upper airway injury, bradycardia and cardiorespiratory arrest. Studies show that the presence of a rescue plan, including supraglottic devices and surgical access to the airways, is essential to minimize the risks associated with intubation failure (Cook et al., 2011).

In addition, institutional protocols, such as those proposed by the American Society of Anesthesiologists (ASA), have been effective in standardizing the management of difficult airway situations, significantly reducing the associated morbidity and mortality (Apfelbaum et al., 2013).

The continuous training of teams in simulation has had a positive impact on the safety of airway management. Simulations of emergency situations, such as ISR in patients with severe respiratory failure, increase the confidence of professionals and improve decision-making in real scenarios. Studies suggest that the implementation of specific checklists and regular educational programs can increase the success rate of interventions and reduce adverse events (Panchal et al., 2018).

In addition to training, technological advances such as videolaryngoscopy and ultrasound have contributed significantly to clinical practice. The videolaryngoscope, for example, has shown substantial benefits in cases of difficult intubation, improving visualization and reducing the time it takes to place the tube (Muller et al., 2020).

Ultrasound, in turn, is a complementary tool for assessing airway anatomy, identifying obstructions and guiding emergency procedures such as cricothyroidostomies (Frerk et al., 2015).

Finally, the integration of evidence-based protocols, continuous training and emerging technologies is key to the effective management of the difficult airway and ISR. Future studies should focus on the validation of new predictive tools, as well as strategies to improve adherence to international guidelines in low- and medium-complexity settings.

Respiratory failure is a clinical condition in which the respiratory system fails to perform adequate gas exchange, resulting in hypoxemia (reduced oxygen in the arterial blood), hypercapnia (increased carbon dioxide in the blood) or both. This condition can be classified as hypoxemic (type I), hypercapnic (type II) or mixed, depending on the underlying cause and the pathophysiological mechanism (Bellani et al., 2016).

The most common causes of respiratory failure include acute lung diseases such as pneumonia, acute respiratory distress syndrome (ARDS), upper airway obstruction and exacerbations of chronic respiratory diseases such as chronic obstructive pulmonary disease (COPD) and asthma. In cases of ARDS, for example, there is a diffuse inflammatory process that results in increased vascular permeability and the formation of non-cardiogenic pulmonary edema, leading to refractory hypoxemia (Ranieri et al., 2012).

Hypercapnic respiratory failure, on the other hand, is often associated with respiratory muscle failure in conditions such as COPD or drug-induced respiratory depression (Global Initiative for Chronic Obstructive Lung Disease, 2023).

The diagnosis of respiratory failure is made on the basis of clinical findings such as dyspnea, tachypnea, use of accessory muscles, cyanosis and mental confusion, as well as arterial gas analysis. Hypoxemia is defined by an arterial oxygen partial pressure (PaO_2) below 60 mmHg, while hypercapnia is characterized by an arterial carbon dioxide partial pressure ($PaCO_2$) above 45 mmHg (Gattinoni et al., 2020). These parameters are essential for determining the severity of respiratory failure and guiding therapeutic management.

The treatment of respiratory failure depends on the underlying cause and the severity of the condition. In severe hypoxemic cases, the administration of supplemental oxygen is the first line of treatment, with the option of non-invasive ventilatory support (NIV) in stable patients. For those who do not respond to NIV, invasive mechanical ventilation may be necessary to ensure adequate gas exchange and relieve respiratory work (Bellani et al., 2016).

ARDS patients often require protective ventilatory strategies, such as low tidal volumes and limited inspiratory pressures, to minimize the risk of ventilator-induced lung injury (ARDS Network, 2000).

In hypercapnic cases, treatment should focus on reversing the underlying cause, such as bronchodilation in COPD patients and normalization of respiratory mechanics. Studies show that NIV reduces the need for intubation, improves outcomes and reduces mortality in patients with exacerbated COPD (Global Initiative for Chronic Obstructive Lung Disease, 2023).

In addition, continuous arterial gas monitoring and hemodynamic assessment are essential to adjust therapy and prevent complications.

The prognosis of respiratory failure varies widely depending on the etiology, severity and associated comorbidities. Patients with ARDS have a mortality rate of around 30% to 40%, depending on the severity of hypoxemia and the response to treatment (Gattinoni et al., 2020).

However, advances in mechanical ventilation, hemodynamic support and infection management have improved outcomes in many critical patient populations.

Thus, respiratory failure remains one of the leading causes of morbidity and mortality in emergency and intensive care settings. Future studies should focus on innovative strategies for prevention, early diagnosis and personalized management, especially in vulnerable populations.

DISCUSSION:

Approaching patients with a difficult airway remains one of the greatest challenges in anesthesiology, emergency and intensive care medicine. The identification and appropriate management of these situations are essential to prevent serious complications. A difficult airway is characterized by difficulty in performing face mask ventilation, tracheal intubation or both. Studies indicate that the prevalence of this condition in anesthetic procedures varies between 1% and 5%, and may be even higher in emergency scenarios, where factors such as trauma, edema and obesity complicate prior assessment (Cook et al., 2011).

Despite the various predictive tools available, such as the Mallampati test and thyromental space measurements, their accuracy alone is limited, requiring the application of multiple parameters for more reliable estimates (Heffner et al., 2013).

Rapid sequence intubation (RSI) represents a significant advance in airway management in patients at high risk of aspiration or respiratory compromise. The technique combines simultaneous administration of a sedative agent and a fast-acting neuromuscular blocker, with the aim of minimizing the time between loss of consciousness and insertion of the endotracheal tube. The most commonly used pharmacological agents include succinylcholine and rocuronium, with the choice based on contraindications and the patient's hemodynamic profile (Morris et al., 2015).

Studies show that the use of ISR in hospital emergencies results in a higher success rate on the first intubation attempt, especially when associated with advanced devices such as videolaryngoscopes (Apfelbaum et al., 2013).

In cases of acute respiratory failure, airway management requires an even more careful approach, due to the reduction in respiratory reserve and the high risk of hypoxemia during intubation. Diseases such as severe pneumonia, acute respiratory distress syndrome (ARDS) and mechanical airway obstructions are common causes of this condition. Studies indicate that the use of optimized pre-oxygenation, apneic ventilation with high-flow oxygen and rescue techniques, such as supraglottic devices, increase safety during intubation in critically ill patients (Frerk et al., 2015).

In addition, bedside ultrasound has been recommended as a complementary tool to assess airway anatomy and facilitate guided interventions (Muller et al., 2020).

Failure to properly manage the airway can result in serious complications such as hypoxemia, pulmonary aspiration and cardiorespiratory arrest. Studies highlight that the presence of an alternative plan, including the use of supraglottic devices and emergency cricothyroidostomy, reduces adverse events related to intubation failure (Cook et al., 2011).

The implementation of institutional protocols based on international guidelines, such as those proposed by the American Society of Anesthesiologists (ASA), has been shown to be effective in reducing complications and mortality (Apfelbaum et al., 2013). Even so, barriers such as lack of training and availability of advanced equipment continue to be challenges in low and medium complexity scenarios.

Another important point is education and simulation training to improve professionals' skills in airway management. Difficult airway courses and simulations of ISR scenarios have been shown to be effective in increasing the confidence and technical ability of the doctors and nurses involved. Studies suggest that well-trained teams using specific checklists have a higher success rate in interventions, as well as a significant reduction in adverse events (Panchal et al., 2018).

However, adherence to these programs varies widely between institutions, and global initiatives to standardize airway management training are needed.

Finally, emerging technologies such as video laryngoscopy and advanced optical devices have revolutionized the practice of airway management. Compared to the conventional laryngoscope, the videolaryngoscope increases visualization of the vocal cords and reduces the number of intubation attempts, especially in obese patients or those with challenging anatomical conditions (Muller et al., 2020).

In addition, the use of high-flow oxygenation during the procedure, known as apneic ventilation, has shown benefits in terms of maintaining oxygen saturation, even in patients with severe respiratory failure (Frerk et al., 2015).

Therefore, the management of the difficult airway, rapid sequence intubation and respiratory failure requires a multidisciplinary approach, judicious use of technologies and adherence to evidence-based protocols. The integration of technological advances, simulation training and ongoing clinical research are key to ensuring safety and efficacy in the management of these critically ill patients.

FINAL CONSIDERATIONS:

Management of the difficult airway, rapid sequence intubation (RSI) and respiratory failure are fundamental pillars in anesthesiology, emergency and intensive care practice. These issues present considerable challenges, given the need for rapid and precise interventions to prevent serious adverse outcomes. Early identification of patients at risk, the application of predictive tools and the use of advanced devices such as video laryngoscopes and high-flow ventilation systems are crucial strategies for optimizing care.

ISR has proven to be an effective technique for safe airway management in emergency situations, reducing apnea time and aspiration rates. However, its success depends on rigorous technical execution, appropriate choice of pharmacological agents and a well-structured contingency plan for cases of intubation failure. Similarly, the management of respiratory failure requires an individualized approach, with ventilatory support adjusted to the patient's needs, whether invasive or non-invasive.

The integration of continuous training, standardized protocols and emerging technologies has contributed significantly to reducing complications and improving outcomes. However, challenges remain in low- and medium-complexity settings, where the availability of equipment and specialized training can be limited. The implementation of simulation training programs and the adoption of evidence-based guidelines are essential steps to overcome these barriers.

We conclude that progress in the management of these critical conditions depends not only on technological advances, but also on a multidisciplinary approach, ongoing education and continuous clinical research. Future studies should focus on validating new predictive strategies, developing less invasive techniques and standardizing protocols adapted to different clinical realities, ensuring that all patients receive the best possible care, regardless of the context.

REFERENCES:

1. Apfelbaum, J. L., et al. (2013). "Practice guidelines for management of the difficult airway: an updated report." *Anesthesiology*, 118(2), 251-270.
2. Ards Network. (2000). "Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome." *New England Journal of Medicine*, 342(18), 1301-1308.

3. Avery, Pascale et al. Rapid sequence induction: where did the consensus go?. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, v. 29, n. 1, p. 64, 2021.
4. Bellani, G., et al. (2016). "Epidemiology, patterns of care, and mortality for patients with acute respiratory distress syndrome in intensive care units in 50 countries." *JAMA*, 315(8), 788-800.
5. Cook, T. M., et al. (2011). "Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society." *British Journal of Anaesthesia*, 106(5), 617-631.
6. Çelik, Fatma; Aydemir, Emrah. Prediction of difficult tracheal intubation by artificial intelligence: a prospective observational study. Duzce Medical Journal, v. 23, n. 1, p. 47-54, 2021.
7. Frerk, C., et al. (2015). "Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults." *British Journal of Anaesthesia*, 115(6), 827-848.
8. Gattinoni, L., et al. (2020). "COVID-19 pneumonia: different respiratory treatments for different phenotypes?" *Intensive Care Medicine*, 46(6), 1099-1102.
9. Global Initiative for Chronic Obstructive Lung Disease (GOLD). (2023). *Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease*. Retrieved from www.goldcopd.org.
10. Heffner, A. C., et al. (2013). "Predicting complications in emergency airway management: beyond difficult intubation." *Critical Care Medicine*, 41(3), 874-885.
11. Lee, J.; Cho, Y.; Kim, W.; Choi, K.-S.; Jang, B.-H.; Shin, H.; Ahn, C.; Kim, J.G.; Na, M.K.; Lim, T.H.; et al. Comparisons of Videolaryngoscopes for Intubation Undergoing General Anesthesia: Systematic Review and Network Meta-Analysis of Randomized Controlled Trials. *J. Pers. Med.* **2022**, *12*, 363. https://doi.org/10.3390/jpm12030363
12. Morris, C., et al. (2015). "Rapid sequence induction: a guide for the novice." *British Journal of Hospital Medicine*, 76(6), C109-C112.
13. Muller, M. P., et al. (2020). "Impact of video laryngoscopy on complications and success rates of endotracheal intubation in critically ill patients." *Critical Care*, 24(1), 1-11.
14. Panchal, A. R., et al. (2018). "Airway management and out-of-hospital cardiac arrest outcome: a review of the evidence." *Resuscitation*, 132, 21-29.
15. Phero, James C., Morton B. Rosenberg, and Joseph A. Giovannitti. "Adult airway evaluation in oral surgery." *Oral and Maxillofacial Surgery Clinics* 25.3 (2013): 385-399.
16. Ranieri, V. M., et al. (2012). "Acute respiratory distress syndrome: the Berlin Definition." *JAMA*, 307(23), 2526-2533.