

Chapter 19

# MANAGEMENT OF DIFFICULT AIRWAY IN THE TRAUMATIZED PATIENT

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Airway management is a crucial aspect in the treatment of critically ill patients, especially in trauma situations, serving as a cornerstone for emergency medical care (Jarvis et al., 2023). The need for rapid and effective interventions can mean the difference between life and

death. In this context, understanding the complications and best practices in managing difficult airways is fundamental to improving clinical outcomes. Traumas, especially those involving the head, neck, and chest, can lead to complications in maintaining a patent airway, which is essential for adequate ventilation and oxygenation of the patient. In traumatized patients, the importance of correcting hypoxemia and hypotension to reduce morbidity and mortality is emphasized (Jain *et al.*, 2016). The combination of hypoxemia and hypotension is additive, with an adjusted probability of death twice as high as the increase in mortality associated with either event alone (Spaite *et al.*, 2017). It is noteworthy that difficulty in airway management can be unpredictable and influenced by anatomical and physiological factors (Kovacs; Sowers, 2018).

There is controversy about the effectiveness of early airway management in trauma, presenting conflicting evidence about the benefits and risks of prehospital endotracheal intubation. Therefore, it is necessary to consider the specific context of each patient, the skills of the medical team, and the ability to anticipate and respond to complications (Jain *et al.*, 2016). If oxygenation and ventilation can be maintained, prehospital establishment of a definitive airway may not be necessary and sometimes detrimental (Hussmann *et al.*, 2011). A non-critical airway intervention should not delay transport to the hospital. However, if travel time is long, definitive airway management may be performed as soon as indicated (Kummer *et al.*, 2007). The Advanced Trauma Life Support Manual advocates three underlying concepts: (1) treat the greatest threat to life first, (2) lack of a definitive diagnosis should never impede the application of an indicated treatment, and (3) a detailed history is not essential to begin the evaluation of a patient with acute injuries.

Emergency airway management in critically ill patients, whether in the field or the Emergency Department (ED), is often associated with adverse events and complications such as hypoxemia, esophageal intubation, and hypotension. Inadequate oxygenation and ventilation can lead to unfavorable outcomes, making airway management a priority in the resuscitation of these patients (Bernhard *et al.*, 2019). Given the above, it is worth emphasizing the importance of prehospital airway management nowadays, so that ventilation with just a BVM (bag-valve-mask) or ETI (endotracheal intubation) can be used in airway management in adult trauma patients, recognizing that the goal is to optimize oxygenation and ventilation, avoiding hypoxia, hypotension, and hyperventilation (Jarvis *et al.*, 2023).

In recent years, there have been significant advances in the techniques and devices used for difficult airway management, including the introduction of videolaryngoscopes and supraglottic devices. The concept of a difficult airway is not limited to anatomical difficulties but also includes factors such as the presence of blood, secretions, or vomit that can obstruct visualization and make intubation difficult. Updates in guidelines emphasize the importance of adequate preparation, continuous training, and the use of structured algorithms to guide clinical decisions in trauma situations. Additionally, interprofessional collaboration and the use of realistic simulations have proven effective in preparing emergency teams for

these complex challenges. Current guidelines also highlight the importance of continuous evaluation and adaptation of management strategies based on patient responses and the specific circumstances of the trauma (Hall *et al*, 2023).

The prevalence of airway management in emergencies is significant, with studies showing that success in the first intubation attempt is directly related to a reduction in complications (Bernhard *et al.*, 2019). Furthermore, airway obstruction was the second most common cause of potentially preventable death in all combat casualties in the US from October 2001 to June 2011 (Kovacs; Sowers, 2018). The incidence of difficult airway in trauma patients varies widely depending on the type and severity of the trauma, as well as the care environment. Studies indicate that up to 20% of traumatized patients may present some degree of difficulty in airway management (Hall *et al*, 2023). Craniofacial traumas, cervical injuries, and thoracic injuries are often associated with an increased incidence of difficult airway. Mortality associated with failures in airway management can be high, highlighting the need for effective management strategies. Epidemiological data also suggest that the presence of a difficult airway is correlated with a significant increase in prehospital care time and the risk of in-hospital complications. Early recognition and appropriate intervention are crucial to mitigating these risks (Hall *et al.*, 2023).

Identifying a difficult airway is essential for effective management, using parameters such as the LEMON law and the Cormack/Lehane classification (Bernhard *et al*, 2019). In the context of trauma, rapid and systematic patient evaluation includes visual inspection of deformities and assessment of the level of consciousness. Tools like the modified Mallampati scale and the 3-3-2 rule are useful, but trauma requires flexibility and clinical judgment. Radiological imaging and portable devices like ultrasounds improve diagnostic accuracy and emergency decision-making. Collaboration with specialists, such as anesthesiologists, may be necessary in complex cases. Additional complications, such as hematomas and facial fractures, make the evaluation more complex, and advanced imaging methods and techniques like videolaryngoscopy are particularly useful (Hall *et al.*, 2023).

Airway management can be performed in both prehospital and hospital settings. In prehospital care, 52.4% of patients were treated by Emergency Medical Services (EMS) with techniques such as endotracheal intubation and supraglottic devices (SAD). In the hospital, 47.6% were managed by the emergency department team using direct laryngoscopy, videolaryngoscopy, SADs, cricothyroidotomy, and tracheostomy (Bernhard *et al.*, 2019). Endotracheal intubation is preferred for its efficacy, but SADs, such as laryngeal masks, are alternatives in cases of intubation failure. Videolaryngoscopy improves vocal cord visualization, increasing success rates and reducing complications (Bernhard *et al.*, 2019).

Managing the difficult airway in trauma requires a stepwise approach, starting with less invasive techniques and progressing to more invasive interventions as necessary. In extreme situations, surgical cricothyroidotomy may be necessary, being a last resort

that requires significant technical skill. Percutaneous cricothyroidotomy is a less invasive alternative in some cases (Hall *et al.*, 2023). Current trends in managing the difficult airway focus on minimizing intubation attempts to reduce complications, with success on the first attempt being crucial (Bernhard *et al.*, 2019). The use of videolaryngoscopy is becoming more common, improving airway visualization and increasing success rates, while reducing trauma and complications (Bernhard *et al.*, 2019). Emphasis on interprofessional training and the use of realistic simulations is highlighted to prepare care teams. The development of new devices and techniques aims to increase safety and efficacy, with customized algorithms for each trauma scenario and the use of artificial intelligence to predict difficulties and suggest interventions in real-time (Hall *et al.*, 2023). Studies highlight the need for improved practices and well-defined protocols to reduce complications and improve clinical outcomes. Establishing a national airway registry can continuously improve outcomes in emergency airway management (Bernhard *et al.*, 2019).

## EPIDEMIOLOGY

Epidemiological data on the management of difficult airways in trauma reveal the importance and frequency of this challenge in emergency settings. The mortality associated with failures in airway management is significant, emphasizing the need for rapid and effective interventions. Data also show that the use of advanced techniques, such as videolaryngoscopy, has increased, improving success rates in intubation in difficult cases. Continuous education and simulation training for healthcare professionals are identified as critical factors for improving outcomes in these cases (Nakao *et al.*, 2015). Additionally, the baseline characteristics and primary indications in patients requiring airway management due to trauma include an average age of 56 years, with two-thirds of the patients being male. The primary reason was traumatic cardiac arrest, which prompted intubation in 32.6% of all traumatized patients, while traumatic brain injury accounted for 30.4% (Nakao *et al.*, 2015). Furthermore, rapid sequence intubation (RSI) is the initial method of emergency airway management in most trauma patients, chosen in 23.9% of all trauma patients and 35.5% of patients without cardiac arrest. Cricothyroidotomy was performed as the initial airway management strategy in 2.2% of all trauma patients and 0.4% of patients without cardiac arrest. Direct laryngoscopy was used in most intubations (90.5%), with the remaining performed using videolaryngoscopy (4.1%), bronchoscopy (2.4%), or lighted stylet (0.1%) on the first attempt (Nakao *et al.*, 2015).

Emergency medicine (EM) physicians are primarily responsible for intubations in 81% of the surveyed institutions. In trauma wards, EM physicians were responsible for 61.4% of intubations. Thus, EM physicians were solely responsible for intubations in the emergency department in 81% of the surveyed institutions, while members of the anesthesiology and trauma surgery departments were responsible in 6.7% and 1.7% of

the institutions, respectively (Chiaghana *et al.*, 2019). In the trauma area, EM physicians are the primary providers of airway intubation in 61.4% of the institutions, while members of the anesthesiology and trauma surgery departments occupied the second and third places (20% and 6.8%, respectively). This was a much higher percentage of care provided by anesthesiologists and surgeons in trauma wards compared to EDs. The EM and anesthesiology departments were considered managers in 7.7% of the institutions, while the emergency and trauma surgery departments were the primary intubation team in 1.8% of the institutions (Chiaghana *et al.*, 2019).

## MANAGEMENT

Successful airway management is crucial in emergency medicine, being one of the main survival factors in trauma patients (Lentz *et al.*, 2020). Rapid identification and intervention are essential to prevent organ decompensation, requiring a careful and flexible plan (Estime; Kuza, 2019; Lentz *et al.*, 2020). In trauma, the initial therapeutic approach consists of a broad assessment of mortality predictors, such as hypoxemia, upper airway obstruction, level of consciousness, and hemodynamic instability, using mnemonics like ROMAN and LEMON to predict difficult airways (Estime; Kuza, 2019).

Clinical assessment should precede airway management, being thorough in elective contexts or abbreviated in emergencies to avoid injuries secondary to tracheal intubation (Goto *et al.*, 2019). After clinical judgment, the patient should be prepared, explaining the procedure and obtaining consent, and verifying the necessary equipment and materials for intubation. Optimal patient positioning, such as the «Sniffing» or «Ramp» position, is fundamental for better glottic visualization, especially in patients with cervical trauma or morbid obesity (Brown III *et al.*, 2020).

Hemodynamic monitoring and oximetry are essential during intubation, with capnography ensuring the correct placement of the tracheal tube. Pre-oxygenation is mandatory, performed with a face mask and 100% oxygen for 4 to 6 minutes before anesthesia, especially benefiting obese and pregnant patients due to the reduction of functional residual capacity (FRC). General anesthesia precedes laryngoscopy, using analgesic, hypnotic, and neuromuscular blocking drugs, individualized for each clinical context (Goto *et al.*, 2019).

The classic orotracheal intubation technique is performed with laryngoscopy or videolaryngoscopy, introducing the blade at the patient's right labial commissure until visualization of the vocal cords. Videolaryngoscopy associated with the bougie is especially useful in managing difficult airways, such as in cervical trauma and morbidly obese patients (Brown III *et al.*, 2020). Prehospital intubation (PI) is more common in patients with severe head injuries (GCS  $\leq$  8). Most prehospital PIs were performed without medications, while most PIs in the emergency department (ED) used medications (Renberg *et al.*, 2023). The

overall first-pass success (FPS) intubation rate in emergency departments is 84.1%, with regional variations and types of intubations (Park *et al.*, 2016). Trauma-related intubations have a lower FPS rate (81.8%) due to the inherent complexities and challenges of these cases, such as anatomical interruptions and unexpected airway obstructions.

In the USA, the overall success rate of advanced airway management (AAM) is 89.1%, with variations according to the technique used, such as conventional endotracheal intubation (cETI) with 76.9% success and neuromuscular blockade-assisted intubation (NMBA-ETI) with 89.7%. The practice of rapid sequence intubation (RSI) varies significantly across continents: in Asia, the proportion of intubations performed by RSI is relatively low (21.4% to 49.6%) compared to higher rates in Europe, North America, and Australia (73.0% to 85.0%). These variations suggest that demographic and geographic factors significantly influence intubation practices and success rates (Nwanne *et al.*, 2020).

Emergent cricothyrotomy (EC) is a critical procedure used as a last resort when other airway management techniques fail or are inadvisable. It is most commonly necessary in patients with severe maxillofacial injuries, oropharyngeal obstructions, or those who cannot be intubated by standard methods. The procedure is rare, with published data on its incidence being scarce. However, it is estimated that EC occurs in nearly 1-3% of trauma treatment cases, 0.4% in non-traumatic emergency conditions, and 0.003% in operating room scenarios (George *et al.*, 2022). EC is associated with significant risks, including bleeding, infection, and injury to nearby anatomical structures. These complications can lead to long-term problems, such as laryngeal scarring or stenosis, which can affect speech and breathing. A meta-analysis found a 3.9% rate of laryngotracheal sequelae requiring additional intervention, with chronic subglottic stenosis occurring at a rate of 1.7%. The study conducted at Arrowhead Regional Medical Center over a decade identified that only 0.17% of patients required EC, highlighting its rarity even in a trauma center (George *et al.*, 2022).

There has also been a significant increase in the use of supraglottic airways (SGA) over the studied period, with a statistically significant trend, although the success rates of intubation and SGA insertion have not changed significantly (Nwanne *et al.*, 2019).

Upper airway ultrasound is an emerging and valuable tool, being non-invasive, simple, and portable (Osman; Sum, 2016). It allows the identification of important anatomies and the prediction of airway size and endotracheal tube size. Studies show that ultrasound can accurately predict endotracheal tube size and anticipate difficult intubations (Osman; Sum, 2016). Videolaryngoscopy is establishing itself as the first-line technique in managing upper airways in emergencies, providing better glottic visualization and greater first-attempt intubation success, reducing peri-intubation adverse events (Brown III *et al.*, 2020). In cervical spine injuries, videolaryngoscopy minimizes neck movements, reducing the risk of secondary neurological injury (Coppola *et al.*, 2015). Managing difficult airways in trauma is challenging due to the unpredictable and potentially severe nature of injuries, such as

fractures, hemorrhages, and edema that hinder airway visualization and manipulation. Significant hemorrhages and vomiting obstruct vision during laryngoscopy and increase the risk of aspiration (George *et al.*, 2022).

Patients with suspected cervical spine injury should be immobilized, limiting head and neck manipulation during intubation, increasing the difficulty of airway management. Efficient airway management is crucial in emergency medicine, with proper identification and understanding of the underlying physiology, careful preparation, and post-intubation management being fundamental (Lentz *et al.*, 2020).

Adverse events during airway management in emergencies are common, including post-intubation cardiac arrest. Many of these events can be avoided with proper identification and careful management. Patients with high-risk characteristics, such as trauma and morbid obesity, should be managed by experienced airway professionals (Lentz *et al.*, 2020).

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