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Review Article

Airway Management of Suspected Traumatic Brain Injury Patients in the Emergency Room

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Abstract

The patients of trauma offers a special challenge because of the associated head injury, maxillofacial, neck and spine injuries, which puts the airway at imminent risk. The response time for the emergency team to initiate the airway management determines the outcome of the individual undergoing treatment. A judious implementatin of triage and ATLS guidelines are helpful in the allocation of resources in airway management of trauma patients. One must not get distracted with the severity of other organ systems because cerebral tissue permits a low threshold to the hypoxic insults. Adequate preparedness and a team effort result in better airway management and improved outcomes in trauma patients with variable hemodynamic response to resuscitation. All possible efforts must be made to secure a definitive airway (if required) and should be verified clinically as well as with the available adjuncts. The success of a trauma team depends on the familiarity to the airways devices and their discrete application in various situations.

Keywords
- airway management
- trauma
- emergency
- intubation
- ventilation
- oxygenation

Introduction

The emergency department is one of the most complex units in a hospital as it receives patients suffering from dysfunction of several different organ systems. One of these is patients with trauma, especially polytrauma. Some of these patients have impending airway compromise or need a stable airway to stabilize the process of trauma, such as severe traumatic chest or traumatic brain injury. Trauma patients are at the risk of hypoxia due to inadequate ventilation, oxygenation, or airway obstruction; therefore, airway management is an essential step for treating such patients.[1,2] The selection of patients is essential as not all trauma patients will need airway management. Any patients with risk of ventilatory failure and aspiration must be identified and the airway must be secured. Repeated airway evaluation must be done for trauma patients at risk

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of deterioration. A patient with a direct neck injury with expanding neck hematoma or inhalational injury can progress to complete airway obstruction/edema. Similarly, the patient with head injury with features of raised intracranial pressure may have decreased levels of consciousness and impaired airway reflex.[3] This chapter aims to provide evidence-based strategies for airway management in trauma patients in the emergency room including identifying and managing patients with or expected airway compromise.

Traumatic Brain Injury

The loss of consciousness from head injury leads to functional airway obstruction, which requires immediate intervention. Traumatic brain injury with GCS $\leq$ 8 must be intubated. As hypoxemia and hypotension worsen outcomes in traumatic brain injury, an appropriate drug selection for RSII is paramount to limit the hemodynamic consequences and adverse responses due to laryngoscopy/intubation. To minimize secondary brain injury, patient's comorbid condition, volume status, and associated injury should be considered while selecting induction agents.[4] Upper airway stimulation during laryngoscopy and intubation increased intracranial pressure (ICP) due to an increase in sympathetic adrenergic stimulation resulting in an elevation in the heart rate and blood pressure. Although succinylcholine causes transient and slight elevation in ICP, it has no clinical significance.[5] The use of intravenous lignocaine, fentanyl in addition to induction agents can be considered to blunt laryngoscopy response.[6]

Airway Management Technique

In conscious patients, airway patency can be evaluated by patients' ability to phonate, the signs of respiratory distress (tachypnea, use of accessory muscles, abnormal breathing pattern), signs of injury to face/neck/chest, etc. Remove any blood clot/mucus, foreign bodies such as broken dentures and teeth from the oral cavity under direct vision. Consider basic airway maneuvers such as jaw thrust, bag–mask ventilation, oropharyngeal airway (in unresponsive patients) or nasopharyngeal airway (contraindicated in fracture of base of the skull), and supraglottic airway device placement.[1] Though the emergency team does not have sufficient time for airway assessment, a simple mnemonic LEMON can be used for assessing the possibility of difficult intubation (►**Table 1**).[7,8] If the indication is straightforward or basic airway maneuvers fail, perform definitive airway management (orotracheal intubation/nasotracheal intubation/surgical airway). The choice of intubation technique depends on the extent of injury, physiological condition of the patient, urgency, availability of devices, and necessary expertise.[9] Rapid sequence induction and intubation (RSII) is a stepwise approach to secure the airway in trauma patients due to the risk of aspiration/vomiting during intubation. This involves the administration of an induction drug followed by neuromuscular blocking agents for the rapid loss of consciousness and paralysis of the patient to obtain optimal intubating conditions to reduce the risk of aspiration.[10,11] The selection of induction agents depends on the patient's general condition, which should provide reasonable intubating conditions with minimum adverse hemodynamic disturbance. The most commonly used induction agents are etomidate, ketamine, propofol, etc. Opioids (e.g., fentanyl), lignocaine, etc. are also being used to mitigate intubation response.[12] Succinylcholine or rocuronium can be used as neuromuscular blocking agents during RSII. Succinylcholine is a neuromuscular blocking agent of choice due to its rapid onset. The EAST recommends succinylcholine as a neuromuscular blocking agent but does not recommend a specific induction agent.[13] Always consider ongoing resuscitation such as fluid therapy and external control of bleeding while selecting induction drugs (►**Table 2**). Routine use of cricoid pressure (Sellick maneuver) to prevent aspiration during RSII is not advised as it does not reduce the incidence of aspiration of gastric content.[14,15] However, an "awake" intubation technique is done for trauma patients with known or anticipated difficult intubation. Topical airway anesthesia (e.g., lidocaine spray, airway nerve blocks, etc.) with/without mild sedation (e.g., propofol) is used during awake intubation. This technique preserves protective airway reflexes and the patient can

Table 1 Lemon

L: Look	Look externally for facial and neck injuries
E: Evaluate 3–3-2	Mouth opening = 3 finger Hyoid to metal distance = 3 finger Thyroid notch to hyoid =2 finger *Remove cervical collar while assessments.
M: Mallampati	Class I: Soft palate, uvula, and pillars are visible Class II: Soft palate and the uvula are visible Class III: Only the soft palate and base of the uvula Class IV: Only the hard palate is visible *This is difficult to assess in trauma patients. Thus, Mallampati has been dropped from "Modified Lemon"
O: Obstruction	Any obstruction in the airway such as hematomas or soft tissue edema.
N: Neck mobility	Restricted

Table 2 Drugs used for rapid sequence induction and intubation

Class	Drugs	Dose	Remark
IV induction agents	Propofol	1–2 mg/kg	Avoid in hypotensive patients
	Thiopentone	3–5 mg/kg	Use cautiously in hypotensive patients
	Ketamine	1 mg/kg	Useful in patients with hemorrhagic shock
	Etomidate	0.3 mg/kg	Does not cause hemodynamic disturbances.
Neuromuscular blocking agents	Succinylcholine	1–2 mg/kg	Rapid action and short duration of action
	Rocuronium	1 mg/kg	Rapid action but prolonged duration of action.

breathe spontaneously during airway management. However, it may be poorly tolerated, requiring time for preparation and longer time for intubation. The emergency team must consider the risk and benefit of both techniques in an individual patient.[16,17] All trauma patients must be considered to have cervical spine injury unless proved otherwise. During endotracheal intubation, the flexion at lower cervical joints and extension at atlantooccipital joints is achieved to align the oropharyngeal and laryngeal axes to visualize the vocal cord. This maneuver is not recommended in patients with a suspected cervical spine injury.[18] Manual in-line stabilization (MILS), cervical collar, traction, etc., are used to immobilize the neck to prevent injury in an unstable spine. For cervical immobilization, manual inline stabilization is a favored technique (►**Fig. 1**: Manual in-line stabilization). The anterior of the cervical collar should be removed as it hinders mouth opening while manual in-line stabilization is maintained during bag–mask ventilation and intubation.[19,20] Direct laryngoscope, video laryngoscope, and intubating LMA, can be used for tracheal intubation, depending on the situation, device availability, and the presence of an operator with the necessary expertise. Endotracheal tube position must be confirmed because undetected oesophageal intubation can be devastating. Clinical indicators such as auscultation of breath sound over the chest, visualization endotracheal tube through the vocal cords, fogging of the tube during ventilation, are not reliable. Waveform end-tidal CO_2 ($ETCO_2$ or capnography) measurement is an accurate and recommended method of confirmation of endotracheal tube placement. Bedsides, ultrasound is useful for endotracheal tube placement.[21]

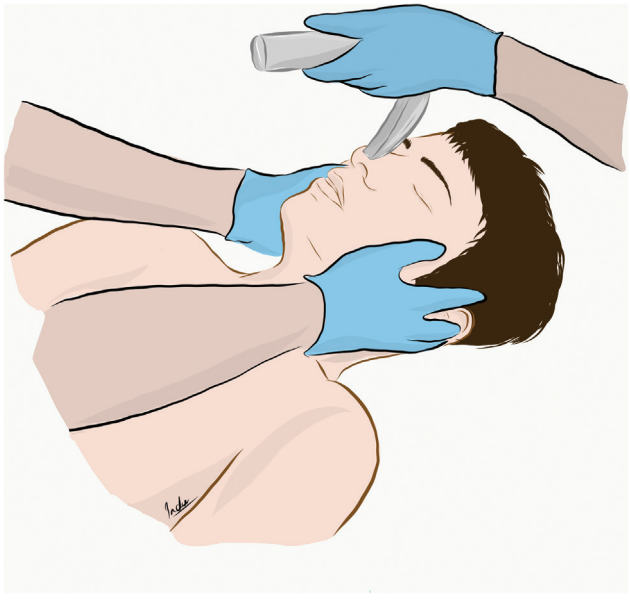

Fig. 1 Manual in-line stabilization.

Choice of Intubation Technique

The emergency team can choose direct laryngoscope, video laryngoscope, fiber optic intubation, intubating LMA, etc. for tracheal intubation. With direct laryngoscopy, visualization is not hampered in the presence of blood/secretion. The bougie or intubating stylet along with direct laryngoscopy provide optimal glottic view for intubation. Direct laryngoscopy might be difficult in trauma patients whose necks cannot be manipulated due to suspected cervical injury. Video laryngoscopes such as C-MAC, GlideScope, and Truview, give a real-time laryngeal view on a screen. It also helps assist during external laryngeal manipulation to get adequate vision during intubation. Video laryngoscopes provide a better view of the vocal cord with lesser movement neck in the trauma patient.[22,23] Video laryngoscope have an overall higher success rate, low incidence of esophageal intubation, and comparable intubation time. However, video laryngoscopy is susceptible to contamination from secretions; thus, blurring of laryngeal view in the presence of blood and secretions.[24,25] Flexible fiberoptic tracheal intubation is indicated for a trauma patient with an anticipated difficult airway, an unstable cervical spine, etc. This technique is associated with minimal movement at the cervical spine joint. The awake technique is a favorable choice as it allows the patients to breathe spontaneously with intact airway reflexes and is also helpful for neurological assessment immediately the following intubation.[18,26] Flexible fiberoptic intubation requires skill, time for airway/patient preparation. An uncooperative/combative patient, presence of blood/secretions in the airway, and vomitus can make fiberoptic laryngoscopy difficult.[27] Supraglottic devices such as the laryngeal mask airway (LMA), I gel, Combitube, or laryngeal tube may be used to establish an airway without entering the trachea as primary airway devices (in pre-hospital settings, during cardiopulmonary resuscitation) or rescue devices for failed airways. In patients with cardiac arrest, a supraglottic device

can be placed without interrupting ongoing chest compressions. Following failed intubation, early placement of an appropriate supraglottic device allows oxygenation, thus obviating the need for emergency cricothyrotomy. However, a supraglottic device is not a definitive airway, thus endotracheal intubation or surgical airway should be considered as soon as possible. These devices should not be used in patients with significantly distorted airway anatomy, presence of a gag reflex, trauma oropharynx or proximal esophagus (risk of perforation or hemorrhage), etc.[28,29]

The Difficult Airway in Trauma Patients

The emergency trauma team may face difficult intubation due to multiple reasons such as facial trauma with swelling, distorted airway, soiled upper airway due to blood/vomitus and morbidly obese patients.[30] If initial intubation attempts are unsuccessful, an emergency surgical airway (front of neck access) should be considered. Either cricothyroidotomy or surgical tracheostomy is used as a method of securing the airway in an emergency. The Difficult Airway Society recommends scalpel cricothyroidotomy using the three-step "scalpel, bougie, tube" technique, which is a relatively reliable and simple technique.[31] Severe trauma to the head and neck region may require a surgical airway during early airway management attempts.[30] However, it requires expert operators and specific equipment as the tracheal lies in a deeper plane in the neck, and there is the risk of major vascular injury. The final decision for the selection of optimal technique for rescuing the airway in an emergency depends on the operator's choice and clinical situation.

Patients Intubated in Prehospital Settings

The emergency team must assess an in-situ airway device (supraglottic device, endotracheal tube, etc.) placed in pre-hospital settings and consider an exchange if indicated.[32,33] All intubations should be confirmed using the presence of breath sounds, chest movement, capnometry, and or direct/video laryngoscopy. If there is adequate ventilation, replacement of the supraglottic device can be delayed during evaluation. However, it should be exchanged for the endotracheal tube as soon as possible.

Maxillo-facial Trauma

Maxillofacial trauma results in complex injury patterns in the form of unilateral or bilateral Le Fort I, II, or III and associated fractures.[34] Injuries, where the force has been more than 50 times the force of the gravity, are usually classified as high impact, and these injuries result in pan-facial fractures with airway compromise. While assessing a patient with maxillofacial injuries, following advanced life trauma support principles is essential.[30,34] The mechanism of injury and detailed evaluation of distorted anatomy reveal the extent of injury to the airway. In contrast, low-impact injuries affect the nasal bone and zygoma without airway compromise. There is no universal way of airway management in maxillofacial injuries because maintaining a patent airway is a priority, but at the same time, it is essential to prevent any iatrogenic injuries.

Conclusion

Airway management for trauma patients needs preparedness and a coordinated team approach. A trauma patient with airway compromise must be identified, and the airway must be secured early to ensure ventilation and oxygenation. RSI with DL is the most common method for tracheal intubation for trauma patients. The use of rescue devices such as a stylet, bougie, and video laryngoscope, can facilitate intubation in a difficult situation. Front of neck access or surgical airway may be needed if an intubation attempt fails or as the first step in selected patients.

Conflict of Interest
None declared.

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