COMMENTARY ARTICLE

Physiological difficult airway management in the emergency department

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Abstract

The current study was planned to discuss the importance of endotracheal intubation in airway management, focusing on the less explored concept of physiologically difficult airways in patients with unstable physiological states. Addressing three key physiological challenges is central to successful airway management. These are: refractory hypoxia, refractory hypotension, and metabolic acidosis. Refractory hypoxia occurs when individuals are unable to sustain sufficient oxygen saturation levels even with the administration of high-flow oxygen. Interventions include proper patient positioning, using positive end expiratory pressure through non-invasive positive pressure ventilation, and inhaled pulmonary vasodilators. Refractory hypotension is defined as low blood pressure despite adequate fluid resuscitation or vasopressor support. Strategies include aggressive volume resuscitation, initiating norepinephrine infusions, preparing for peripherally administered vasopressor boluses, and using diluted phenylephrine when blood pressure drops post-intubation. Metabolic acidosis relates to severe acid-base disturbances that increase the risk of complications during intubation. Intubation should be avoided when possible, and a short trial of non-invasive positive pressure ventilation may help support respiratory work. For awake intubations, topical anaesthesia is crucial. Implementation of a difficult physiological airway algorithm as part of a quality initiative is critical, with a focus on simulation-based training. The algorithm incorporates anatomical and physiological predictors of difficult airways to empower emergency physicians to make timely interventions and prevent adverse outcomes. Recognising and addressing physiological challenges during intubation is essential in critically ill patients presenting to the emergency department.

Keywords: Difficult airway, Physiological difficult airway, Refractory hypoxia, Refractory hypotension, Metabolic acidosis, Emergency intubations.

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Introduction

Endotracheal intubation is the most important resuscitation skill in airway management. The term 'difficult airway' was conceptualised in the guidelines developed by the American Society of Anaesthesiologists in 2022 on how to manage these difficult situations. It defines circumstances where an experienced anaesthetist faces unexpected or anticipated failures or difficulties when trying to perform some or all procedures, which include but are not limited to face mask ventilation, laryngoscopy, supraglottic ventilation, intubation of the trachea, extubation, and other advanced airway access techniques.[1] With the advent of newer devices, such as video laryngoscopes and flexible bronchoscopes, the availability of guidelines, and improvements in techniques for oxygenation during the peri-intubation period-intubation period, many of the challenges posed by difficult airways have been addressed.[1-3] Severe physiologic derangements in critically ill patients make the induction and intubation process as hazardous as anatomically difficult airways. Thus, these circumstances also require as much meticulous planning and thoughtful thinking to safeguard the patients.

Although the term "a physiologically difficult airway" is less frequently described in the current literature, it defines a patient in an unstable physiological state or with diminished physiological reserve, who is at high risk for cardiovascular failure and death during attempts at definitive airway management.[4]

A retrospective study conducted in an academic emergency department (ED) based in Arizona found that physiologically challenging airways were similarly associated with a decrease in first-pass success rates and an increase in adverse events, like those seen with anatomically challenging airways.[5]

To manage a physiologically challenging airway efficiently, it is important to consider the patient's medical condition and appropriately modify strategies. While many airway organisations present algorithms with specific procedures

for overcoming anatomical obstacles, these protocols often fail to address the physiological challenges typically encountered in critically ill patients presenting to the ED.

The current review of practices was planned to offer a clinical algorithm for dealing with challenging airways, including suggested interventions through each phase. The approach breaks down complex tasks into structured, manageable steps, designed to help emergency physicians succeed in securing the airway.

The Difficult Airway Algorithm

A critically ill patient presenting to the ED and requiring airway control must be thoroughly evaluated before the decision to intubate is made. This is followed by difficult airway assessment, which must include simultaneous assessment of anatomical and physiological factors. The algorithm presented below (Figure) is based on evidence derived from an extensive literature review.[6]

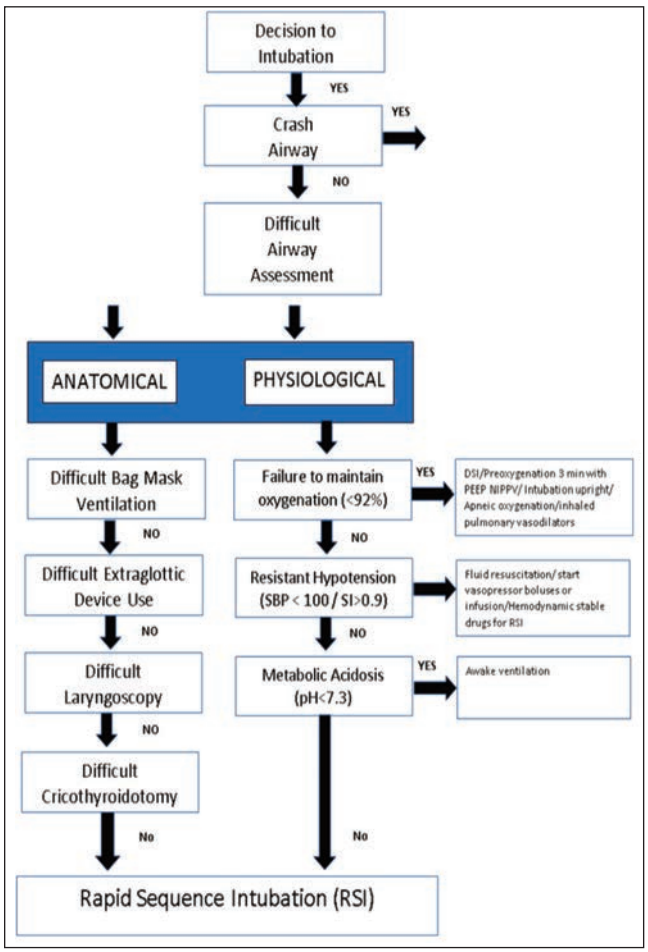

Figure: An algorithmic approach to difficult airway (anatomical and physiological) management in the Emergency Department. DSI: Delayed Sequence Intubation; PEEP: Positive End Expiratory Pressure; NIPPV: Non Invasive Positive Pressure Ventilation.

Hypoxaemia

Hypoxemic respiratory failure occurs when the body is unable to sustain sufficient arterial oxygen levels, typically as a result of intrapulmonary shunting and ventilation/perfusion (V/Q) mismatch. Consequently, patients with pre-existing hypoxaemia are at increased risk of complications during tracheal intubation, including desaturation, hypoxic brain injury, cardiac dysrhythmias, and cardiac arrest.[7]

Recommendations

1-Positioning: Patients should be intubated in an upright or ramped position as much as possible. The use of a ramped position is encouraged to enhance the resolution of the visual field, to support the preservation of oxygen saturation, and to minimise the possibility of aspiration. For patients intubated by ED residents, first-attempt success rates were higher with ramped positioning compared to the supine position.[8] It was found that intubation with the head of the bed elevated >30° was linked to a reduction in peri-intubation complications, especially with lower rates of hypoxaemia and aspiration.[9]

2-Pre-oxygenation with non-invasive positive pressure ventilation (NIPPV): Pre-oxygenation should be done with positive end-expiratory pressure (PEEP) via non-invasive positive pressure ventilation (NIPPV) if a patient has significant shunt physiology or decreased functional residual capacity (FRC) due to conditions, such as pregnancy, obesity or acute respiratory distress syndrome (ARDS). A prospective randomised study performed in two surgical/medical intensive care units (ICUs) showed that in critically ill patients, non-invasive ventilation (NIV) applied 3min before endotracheal intubation (ETI) ensured better peripheral oxygen saturation (SpO_2) and partial pressure of oxygen in arterial blood (PaO_2) values during tracheal intubation compared to the usual pre-oxygenation method.[10,11]

3-Suitable measures like a nasal cannula/high-flow nasal cannula to ensure oxygenation is maintained even during the apnoeic period.

4-In patients with severe hypoxaemia, defined as ratio between PaO_2 and fraction of inspired oxygen (FiO_2) ≤100mmHg, the use of inhaled pulmonary vasodilators before intubation may enhance ventilation-perfusion matching.

5-The NIPPV mask is intolerable to patients when they suffer from delirium; and other interventions, like analgesia, control of anxiety, or delayed sequence intubation (DSI) could make pre-oxygenation much

better. While procedural sedation may be added during pre-oxygenation, one needs to be ready to begin with intubation if necessary during DSI. Such readiness would be based on case reports of cardiac arrest, laryngospasm and apnoea, associated with the use of ketamine. Weingart et al. reported an improved saturation from a mean of 89.9% to 98.8% after DSI.[12]

Hypotension

Pre-intubation hypotension (PIH) is a significant predictor of cardiovascular collapse and cardiac arrest during the peri-intubation period.[13] There is no consensus definition of PIH. Haemodynamic criteria for hypotension are typically defined as a systolic blood pressure (SBP) <90mmHg or a mean arterial pressure (MAP) <65mmHg. Griesdale et al. reported that an SBP <70mmHg complicates 10% of intubations in critically ill patients. [14]

Pre-existing hypotension and shock index, i.e., heart rate/SBP of >0.8 increase the risk of both PIH and cardiac arrest.[15]

Recommendations

1-Haemodynamic optimisation before intubation: Aggressive volume resuscitation may be in order if the patient is likely to improve with fluids. However, not much empirical evidence exists, so far, to conclude that intravenous (IV) fluids prevent consequent cardiovascular complications during the process of intubation.[16]

2-If volume resuscitation fails to elicit a response in unresponsive patients, starting a norepinephrine infusion should be considered. Norepinephrine is recommended as a first-line vasopressor agent for infusion in any patient with PIH.[17]

3-When pre-intubation resuscitation is not possible because the shocked patient is about to undergo cardiopulmonary arrest, peripherally administered vasopressor boluses can be prepared at the bedside.

4-In cases in which patients do not develop shock, but have an initial blood pressure drop following intubation, this is attributed to the vasodilatory effect of induction agents, such as propofol. It is best to use haemo-dynamically neutral induction agents, such as etomidate, which is a non-benzodiazepine sedative. This has been shown to have relative haemodynamic neutrality: it does not require adjustment of doses in patients who are in shock. Ketamine is an attractive induction agent in hypotension because of its sympathomimetic effects, and it has an equivalent complication rate to etomidate. In 2009, Jabre et al. compared etomidate with ketamine, and reported no differences in serious complications in emergency intubations of septic patients.[18,19]

Metabolic Acidosis

Critically ill patients in ED frequently experience significant acid-base imbalances, which significantly elevate the risk of adverse events during the peri-intubation period. The most common acid-base disorder causing deterioration during intubation is metabolic acidosis. The current algorithm defines metabolic acidosis as potential of hydrogen (pH) <7.3. Apnoea, intentionally caused by sedation and paralysis, can lead to acute drops in pH, and potentially worsen outcomes.

Recommendations

1-Intubation should be avoided in patients suffering from severe metabolic acidosis with a minute ventilation need that is unlikely to be served by the mechanical ventilator despite a low pH.

2-A brief trial of NIPPV will support the respiratory work of breathing until the underlying metabolic acidosis correction can take place.

3-In a patient who has severe metabolic acidosis and is undergoing awake intubation, an adequate amount of topical anaesthesia should be administered.

4-An awake intubation involves a three-step process: drying secretions, topical anaesthesia, and sedation followed by intubation. An awake intubation is simply the placement of the endotracheal tube while the patient continues to breathe spontaneously. The primary benefit of an awake intubation over rapid sequence induction (RSI) is that one does not remove the patient's airway reflexes and spontaneous respirations.[20]

Implementation in clinical practice

The parallel assessment of both anatomical and physiological predictors of difficult airway in critically ill patients presenting to the ED will help physicians undertake timely interventions and prevent morbidity or mortality. To avert catastrophic events in critically ill patients with physiological instability, it is essential for ED physicians to adopt the algorithm-based strategies. These strategies encompass proper pre-oxygenation, addressing hypotension, optimising patient positioning, arranging the room setup, selecting and administering the right doses of RSI medications, and considering awake intubation for certain patients.

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