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Airway management in oral and maxillofacial surgery

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Abstract

An open airway connecting the nose and mouth to the lungs is vital. Critically ill people often experience airway problems due to changes in consciousness, the use of sedating medications, and inflammatory changes in the airway, among other factors.

Airway management is therefore a core competency for any physician caring for the critically ill. This article provides a brief overview of airway anatomy and physiology before addressing the causes of airway obstruction.

A "look-listen-feel" approach to airway assessment is described, followed by a discussion of techniques used to expose, open, and maintain the airway. Commonly used airway devices, including oropharyngeal, nasopharyngeal, and supraglottic airways, are evaluated and their indications and insertion techniques are discussed.

Keywords: Preoxygenation, Nasopharyngeal, medications

Introduction

The "airway" is not merely a passive conduit of air; it serves a dynamic and important physiologic role in the human body. The air passages, starting from the nose and ending at the bronchioles, are necessary for the delivery of humidified and filtered respiratory gas to and from the alveoli. During clinical anesthesia, the anaesthesiologist uses these air channels to deliver anesthetic gasses to the alveoli while maintaining vital respiratory gas transport. Anaesthesiologists and other medical professionals often gain access to the airway by inserting an endotracheal tube (ETT) or other airway devices directly into the patient's upper or lower airway.

Functional anatomy of the airway

Nasal cavity

The respiratory tract functionally begins at the nostrils and mouth, where air first enters the body. The nasal septum consists mainly of the vertical plate of the ethmoid bone, which descends from the cribriform plate, the septal cartilage, and the vomer.[1]

Oral cavity

The hard palate, composed of portions of the maxilla and palatine bone, makes up the anterior two-thirds of the roof of the mouth; the soft palate (velum platinum), a fibromuscular tissue fold associated with the hard palate, makes up the posterior third of the roof of the mouth.[2]

Pharynx

The pharynx is a muscular tube extending from the base of the skull to the cricoid cartilage, connecting the nasal and oral cavities with the larynx and oesophagus.

The posterior wall of the pharynx consists of the fascia buccopharyngeal, which separates the pharynx from the retropharyngeal space.[3,4]

Trachea and bronchi

The trachea begins at the level of the cricoid cartilage and extends to the carina at the level of the fifth thoracic vertebra; this length is 10 to 15 cm in the adult. At the carina, the trachea bifurcates into the right and left mainstem bronchi.

Physiology of airway management

Preoxygenation

Preoxygenation, the process of replacing nitrogen in the lungs with oxygen, provides an increased length of time before haemoglobin desaturation occurs in a patient with apnoea.

- Two primary methods are used to perform Preoxy genation.
- The first method is 3-minute tidal volume ventilation through the face mask, which allows 95% of the gas to be exchanged in the lungs.
- The second method uses vital capacity breaths to achieve adequate preoxygenation more quickly .[5]

Airway reflexes and the physiologic response to intubation of the trachea

Laryngospasm is usually triggered by glossopharyngeal or vagal stimulation due to airway instrumentation or vocal cord irritation (e.g., by blood or vomit). Treatment of laryngospasm includes removal of airway irritants, deepening of the anesthetic, and the administration of a rapid-onset neuromuscular blocking drug (NMBD), such as succinylcholine.[6]

The tracheobronchial tree also possesses reflexes to protect the lungs as it activates a vagal reflex– resulting in bronchospasm.Treatment includes a deepening of anesthetic with propofol or a volatile agent and the administration of inhaled β2-agonist or anticholinergic medications.

Airway management after the induction of general anesthesia

The most common technique for the induction of general anesthesia is standard IV induction, which involves administration of a fast-acting IV anesthetic followed by NMBD.[7]

Propofol is the most commonly used anesthetic IV; other options include etomidate, ketamine, thiopental, and midazolam.Succinylcholine was the most commonly used NMBD for routine induction IV.[8]

The most commonly used nondepolarizing NMBDs in current practice-curcuronium, vecuronium, and Cisa tracurium-are characterized by a favourable safety profile with relatively few side effects.[9]

Rapid-Sequence Induction of Anesthesia and Intubation of the Trachea

Rapid sequence induction of tracheal anesthesia and intubation (RSII) (often referred to simply as rapid sequence induction [RSI] in the anesthesia literature) is a specific method of IV induction commonly used when there is a frequent risk of gastric regurgitation and pulmonary aspiration of gastric contents.

After adequate preoxygenation and with the application of cricoid pressure, an induction dose of the anesthetic IV is rapidly followed by 1 to 1.5 mg/kg succinylcholine IV, and the trachea is intubated without attempts at PPV while cricoid pressure is applied.[10]

Inhalational Induction of Anaesthesia

Halothane, is commonly used in developing countries. A major disadvantage of halothane is its high blood-gas coefficient, which results in relatively long induction times. In addition, it can cause cardiac arrhythmias, and myocardial depression.[11]

Intravenous Induction Without Neuromuscular Blocking

Propofol is the best suited for induction without muscle relaxation because of its unique ability to suppress airway reflexes and to produce apnea. Remifentanil is more effective than comparable doses of alfentanil; in combination with propofol 2 mg/kg, remifentanil 4 to 5 μg/kg can reliably provide good to excellent intubating conditions.[12]

Airway management in an awake (no anesthetized) patient

The most useful technique for awake intubation is flexible endoscope intubation (FSI), although other techniques have been used successfully, including video laryngoscopes (VLs), optical stylet, illuminated non optical stylet, intubating LMAs, and retrograde intubation (RI).Local airway anesthesia with local anaesthetics should be the primary anesthetic for awake airway management in most cases.

Ventilation via mask

Mask ventilation is a straight forward, non-invasive airway management technique that can be used as the primary method of ventilation during a short anesthetic or as a bridge until a definitive airway is established.[13]

Supraglottic airway

The term supraglottic airway (SGA) or extra glottic airway refers to a diverse family of medical devices that are blindly inserted into the pharynx to provide a patent conduit for ventilation, oxygenation, and delivery of anesthetic gases without the need for tracheal intubation.[14]

Endotracheal intubation

The modern, standard ETT is a disposable, single-use, cuffed, plastic tube that is designed to be inserted through the nose or mouth and sit with its distal end in

the mid trachea, providing a patent airway to allow for ventilation of the lung.[15]

Orotracheal versus nasotracheal intubation

Nasotracheal intubation is generally indicated when the orotracheal route is not possible (e.g., when the mouth opening is severely limited) or when the need for surgical access precludes an orotracheal route. In addition, certain intubation techniques, such as blind intubation, awake intubation, and FSI, are significantly easier when performed through the nose. When the nasotracheal route is not specifically indicated, however, the orotracheal route is usually preferred for several advantages. The orotracheal route is potentially less traumatic and presents a lower risk of bleeding, it usually allows for the placement of a larger ETT, and it provides for more options in terms of airway management techniques. The major disadvantages include the potential for damage to the teeth and stimulation of the gag reflex during awake intubation, requiring denser airway anesthesia and potentially being less comfortable for the patient.[16]

Direct laryngoscopy

The most commonly used technique for endotracheal intubation is DL, in which the glottis is directly visualized using a laryngoscope. The ETT is inserted through the glottic opening into the trachea under constant observation.[17]

Nasotracheal Intubation

The nasal ETT should be lubricated and inserted into the nasal meatus with the bevel away from the midline to reduce the risk of tearing a turbinate. When advancing the ETT through the nasal meatus, a cephalad traction should be applied to ensure a trajectory along the floor of the nose below the inferior turbinate.

Indirect laryngoscopy

Indirect laryngoscopy entails the indirect visualization of the glottis by way of optical aids, such as fibreoptic bundles, video cameras, mirrors, prisms, or lenses. Various different devices that use indirect laryngoscopy are available, including FISs, VLs, and intubating optical stylets.

Flexible Scope Intubation of the Trachea

The flexible fiberoptic bronchoscope (FOB) is the most widely used versatile device for indirect laryngoscopy in awake, spontaneously ventilated patients.

Rigid Indirect Laryngoscopes

Indirect laryngoscopes based on the design of a direct laryngoscope and using optical lenses to project a refracted image of the glottis include the Viewmax (Ruesch, Duluth, GA) and the TrueView EVO2 (Truphatek, Netanya, Israel).

Lighted Optical Stylets

Lighted optical stylets are rigid or semirigid fiberoptic devices that incorporate the optical and light-transmitting components, use of these optical stylets in patients with limited neck mobility, small mouth opening, abnormal airway anatomy, or anticipated difficult laryngoscopy.

Video laryngoscopy

Video laryngoscopy is now included in the ASA "Difficult Airway Algorithm" as an alternative approach to intubation and should be considered for patients with a known or predicted difficult airway.[18]

Tracheal intubation through a supraglottic airway device

The ILMA was designed as a conduit for tracheal intubation to facilitate ventilation between attempts at tracheal intubation. The rigid handle and airway tube enable a rapid and precise control of mask position.

Retrograde intubation

RI is a well-described technique for orotracheal or nasotracheal intubation that involves guiding an ETT into the trachea with a narrow, flexible guide that has been percutaneously placed through the CTM into the trachea and passed retrograde through the larynx and pharynx, exiting the mouth or nose.[19]

Percutaneous airways

Percutaneous (invasive) airways are indicated as a rescue technique when attempts to establish a non-invasive airway fail. Options for invasive airway access include transtracheal jet ventilation (TTJV), cricothyrotomy, and tracheostomy.

Transtracheal jet ventilation

TTJV is widely regarded as a life-saving procedure that can provide adequate, temporary oxygenation and ventilation with less training and complications than a surgical airway, a last resort for obtaining an airway in the algorithm.Occasionally, it is used on an elective basis for laryngeal surgery[20]

Cricothyrotomy

Cricothyrotomy included in the ASA "Difficult Airway Algorithm" as an emergent invasive technique after other rescue maneuvers have failed or are not feasible. Cricothyrotomy equipment should be included in all emergency airway storage units and readily available. Cricothyrotomy is not considered a permanent airway.[21]

Extubation of the trachea

Extubation during a light plane of anesthesia (stage II) can increase the risk for laryngospasm and other airway complications and should be avoided. General preparations for extubation should include ensuring adequate reversal or recovery from neuromuscular blockade, hemodynamic stability, normothermia, and adequate analgesia. Patients should be preoxygenated with a 100% fraction of inspired oxygen concentration (Fio2), and alveolar recruitment maneuvers should be considered if appropriate.[22]

Suctioning of the pharynx (and the trachea, if indicated), the removal of throat packs, and the placement of a bite block should be performed while the patient is under deep anesthesia.

The lateral decubitus position may be the preferred option when the risk for pulmonary aspiration is high. Application of positive pressure immediately before cuff deflation may help expel secretions that have collected above the ETT cuff. Inspection of the pilot balloon to ensure complete cuff deflation before extubation is essential; extubation with an inflated cuff can cause vocal cord injury or arytenoid dislocation.[23]

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