Airway Management: The Basics Of Endotracheal Intubation

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Abstract

Airway management (AM) can be life-saving in certain emergency situations. Physician assistants may encounter patients requiring AM in virtually any clinical setting. Endotracheal intubation (EI) is indicated in several clinical situations including respiratory failure, cardiorespiratory arrest, upper airway obstruction, in patients at risk for aspiration, and for certain elective procedures. It is mandatory that a clinician responsible for airway management be familiar with airway anatomy and how it pertains to intubation. Ideally, prior to attempting EI, all necessary equipment, medications, emergency supplies, and support staff should be in place. Patients should be monitored before, during and after intubation. Proper technique of EI is reviewed, as well as assessment of proper endotracheal tube placement.

INTRODUCTION

Physician assistants (PAs) can encounter patients that require airway management (AM) in virtually any clinical setting. All PAs should therefore be familiar with the basics of these potentially life-saving procedures. This article is meant to serve as a general introduction to one of the techniques of AM, endotracheal intubation (EI) of the adult patient.

PAs who work in environments where patients are likely to need AM should obtain training and experience in the proper technique of EI, medications used for the procedure, as well as alternative methods of AM when EI is unsuccessful (see Table 1). A subsequent article in this series will review alternative techniques in AM, including those useful for the less experienced clinician in emergency situations.

TABLE 1: Alternative techniques to establish an airway

- Oral Airway
- Nasal Airway
- Mask Ventilation
- Transtracheal Jet Ventilation
- Retrograde Intubation
- Laryngeal Mask Airway
- Light Wand
- Blind Nasal Intubation
- Combitube
- Emergency Cricothyrotomy Devices

INDICATIONS FOR ENDOTRACHEAL INTUBATION

Endotracheal intubation is indicated in several clinical situations including acute hypoxemic or hypercapnic respiratory failure, or impending respiratory failure.[1 2 3 4] This procedure is also used to protect the airway in conditions of upper airway obstruction, either mechanical or from airway pathology.1-4 Patients at risk for aspiration, most commonly from central nervous system derangements may benefit from elective intubation.2-5In addition, elective EI is performed for many operative procedures; at times to facilitate certain diagnostic procedures (ex. computed tomographic scan); and to aid in respiratory hygiene.1-4 Another potential indication for EI includes the need to hyperventilate by mechanical ventilation, attempting to reduce intracranial pressure in patients with acute intracranial hypertension.[6]

AIRWAY ANATOMY

Endotracheal intubation can be performed either orally or

nasally, although oral intubation is the more commonly used technique.5The nasopharynx and oropharynx lead to the laryngopharynx (hypopharynx). At the base of the tongue, the epiglottis separates the larynx from the laryngopharynx. The epiglottis serves as a protective mechanism for preventing aspiration by covering the opening of the larynx (i.e. the glottis) during swallowing.

The larynx, composed of cartilages, connecting ligaments and muscles, establishes the boundary of the upper and lower airway. The glottis divides the larynx into a superior compartment (from the laryngeal outlet to the vocal cords) and an inferior compartment (from the vocal cords to the lower border of the cricoid cartilage), which leads to the trachea. In the adult, the airway is narrowest at the vocal cords and in small children at the cricoid cartilage ring.

The trachea begins at the level of the cricoid cartilage and extends to the carina. The carina (at the level of the angle of Louis, about T5)7is the point of airway bifurcation, leading to the left and right main stem bronchi. The right main stem bronchus is less angulated from the trachea than is the left main stem bronchus (25 versus 45 degrees)7and therefore is more prone to intubation if an endotracheal tube (ETT) is inserted too far.

EQUIPMENT

LARYNGOSCOPE

The laryngoscope is comprised of 2 separate parts; a handle which contains a light source and a blade. Blades are either curved (MacIntosh) or straight (Miller):

Figure 1

Photograph courtesy of Welch-Allyn)

MacIntosh blades come in sizes 1-4, with an average adult requiring a size 3.8 It is inserted anteriorly to the epiglottis into the vallecula. The advantage of this blade is that it minimizes trauma to teeth, does not come in contact with the epiglottis and allows more room in the oropharynx.8However, with this blade the epiglottis may be in the way of visualizing the vocal cords. Miller blades come in sizes 0-4 with sizes 2 and 3 fitting an average adult. 8Straight blades are inserted posterior to the epiglottis, thus providing better visualization of the larynx. 8

ENDOTRACHEAL TUBES

Endotracheal tubes (ETT) are sized by either the internal diameter (2.5 to 10 mm) or the external diameter with sizes 2-9 French (Fr).8Usually, adult EI is accomplished by using size 7 to 9 Fr ETTs. Smaller size ETTs are easier to insert, but larger size tubes have less airway resistance and allow for better suctioning and less work of breathing.3A stylet can be inserted inside the ETT to help the tube conform to the

airway and may facilitate insertion into the larynx and trachea. However, stylets have been associated with pharyngeal or laryngeal trauma.3,[5]

MEDICATIONS

Proper sedation should be used in all conscious and hemodynamically stable patients.3,4,8In addition, neuromuscular blockers are often used to facilitate EI. 2,3,4,8

EMERGENCY EQUIPMENT

Resuscitation equipment, medications, and alternative airway equipment should always be readily available during all intubation procedures.

PATIENT ASSESSMENT

Once it is determined that a patient requires EI, an assessment of the airway is necessary. Difficult intubation is a potentially serious complication of EI and patients should be examined for signs of a difficult airway. [9 10] Table 2 lists signs of potential airway difficulties. If a patient is suspected of having a difficult airway, an immediate consultation with an expert in airway management should be made. However, in an emergency situation or when a difficult airway is not anticipated, a clinician may be required to manage a patient's airway until appropriate help is available.

TABLE 2:Signs of potentially difficult airways. 2,4

- Difficulties with positioning of the neck: arthritis, trauma, or previous surgery
- Anatomical variations: small mouth, large tongue, bull neck, receding lower jaw, high arched palate, marked obesity
- Limitation of mouth opening
- Stridor or other signs of upper airway inflammation from epiglottitis, laryngeal infection or burn
- Trauma to the larynx or trachea
- Congenital malformation of face, head and neck

PREPARATION

Prior to performing EI, all equipment, medication, emergency supplies, and support staff should be in place. In addition, patients should be monitored before, during and after intubation for blood pressure, heart rate, and pulse oximetry. Continuous pulse oximetry has been shown to reduce the risk of hypoxemia associated with emergency intubation.[11] An ECG monitor should also be used, when available. 5

All equipment should be checked including assembling the laryngoscope to verify a proper light source. If a stylet is used it should be inserted into the ETT with a water soluble lubricant. The end should then be bent to facilitate intubation, ensuring that the style does not protrude the end of the ETT. The balloon should be checked by inflating 10 cc of air with a syringe. An additional ETT (one size smaller), stylet, and laryngoscope should be readily available prior to attempting intubation.

TECHNIQUE

The oral route for intubating is preferred since it can usually be performed more rapidly and provides for better visualization.3,4In addition, the mouth can accommodate a larger tube than the nose. Nasal intubation in certain emergency situations can be used with blind insertion to secure the airway. With known or suspected neck trauma or cervical spine instability, nasal bleeding, upper facial fractures, and certain skull fractures, the nasal route is contraindicated.3Instead, spine stabilization and use of a bronchoscope with cricoid pressure is preferred.4

The patient should be prepared by removing any dental appliances (ex. dentures). Then proper sedation (and neuromuscular blockers, if used) administered. The patient must be positioned so that easy access is obtained. The head is placed in the "sniffing position" with the lower portion of the cervical spine flexed. Preoxygenation is then performed with 100% oxygen for 2 to 3 minutes via bag-mask ventilation.

The laryngoscope must be held with the left hand. The patient's mouth opened with the right hand and the blade placed into the right side of the patient's mouth, sweeping the tongue to the left. The tip of the straight blade is inserted posterior to the epiglottis, while the tip of the curved blade placed anterior to the epiglottis into the vallecula. The handle is then raised up and away from the patient without leverage until the vocal cords are visualized. The clinician's wrist should not be bent as this may cause damage to the teeth. Once the vocal cords are seen, the ETT is passed through cords with the right hand and advanced to 20-26 cm, as measured at the teeth 3or with the cuff just below the vocal cords.5The laryngoscope is then withdrawn and the cuff is inflated.

If intubation is delayed, no more than 30 seconds should pass without ventilation.3Therefore, if intubation is not performed within this time period, the procedure should be stopped and the patient ventilated with bag-mask ventilation prior to reattempting the procedure.

The Sellick maneuver can be used to facilitate intubation and reduce the risk of aspiration.12The technique requires an assistant to apply pressure to the cricoid member posteriorly. The cricoid cartilage is held firmly between the finger and thumb. It is then pressed posteriorly so that the esophagus can be compressed between the horizontal portion of the cartilage and cervical spine.

To assess proper placement of the ETT, the chest and abdomen are inspected for movement. If the tube is properly placed, symmetric movement of the thorax with minimal movement of the abdomen should be seen with each ventilation. Breath sounds should first be assessed over the epigastric area and then over left and right lung fields. Equal breath sounds are typically heard bilaterally with proper endotracheal intubation. If breath sounds are heard over the epigastric area only, it is likely that an esophageal intubation has occurred.

If breath sounds are heard over one hemithorax, but are diminished or absent over the other hemithorax, the tube should be left in place. The ETT should be withdrawn 2-3 cm and chest auscultated to check breath sounds again. A common complication of EI is right main stem intubation.9Since the right main stem bronchus has a straighter alignment with the trachea than the left main stem bronchus, an ETT advanced too far will typically enter the right main stem bronchus. In this situation, breath sounds may be heard more prominently or exclusive over the right lung field. Although a deep ETT placement is the most common case of unequal breath sounds, it is important to remember that other clinical conditions can cause unequal breath sounds including consolidation, obstruction, pneumothorax, hemothorax, and pleural effusion.

ETT placement can also be confirmed by use of an end-tidal CO2monitoring.[13] [14]A chest radiograph should always be done in emergency intubations to confirm ETT placement since equal breath sounds can be heard in up to 60% of right main stem intubations.15Fiberoptic bronchoscopy has been suggested as a more reliable means of confirming ETT position over clinical assessment. [16]

COMPLICATIONS

As with any medical procedure, complications can occur. Table 3 lists potential complications of endotracheal intubation. Any clinician performing this potentially life-saving procedure, must be able to recognize and manage any possible complications.

TABLE 3: Complications of endotracheal intubation

- Esophageal Intubation
- Mainstem Intubation
- Perforation or laceration of upper esophagus, vocal cords, larynx
- Laryngospasm or bronchospasm
- Dental and soft-tissue trauma
- Dysrhythmias
- Hypertension/Hypotension
- Aspiration of oral or gastric contents

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