The difficult airway in critical care

Robert E Fromm, Joseph Varon, Zaida Bisbal, Blanca Vargas

Abstract

Airway management with orotracheal intubation is one of the basic skills of a critical care practitioner. The oral route is the most common and easily mastered approach for tracheal intubation. Routinely, this technique involves visualization of the glottis, the use of a laryngoscope, and passage of the endotracheal tube into the trachea under direct vision. In many instances, this technique cannot be accomplished and the clinician needs to access the airway utilizing a variety of techniques.

The patient with a difficult airway represents a significant problem for health care providers dealing with critical situations. This article describes some of the common approaches that can be used when a difficult airway is present.

Keywords: Airway management, laryngoscopy, bronchoscopy, laryngeal airway mask, tracheotomy

Introduction

The initial treatment of the critically ill patient begins with the “ABCs”- Airway, Breathing and Circulation. These principles are espoused in the early training of clinicians and through standardized training programs for professionals promulgated by organizations like the Society of Critical Care Medicine and the American Heart Association [1,2]. These clinical principles merely echo what man likely recognized long before recorded history- a patent airway is paramount to survival.

In the clinical setting, management of the airway may take many forms; from the spontaneously breathing patient requiring no intervention, to surgical placement of an artificial airway. The critical care practitioner should be comfortable with a number of airway techniques to provide alternatives when faced with difficulty. The purpose of this article is to review some of the common alternative techniques and devices that can be used in the management of a patient with a difficult airway in the critical care setting.

Definitions and classifications

The term “difficult airway” does not describe a single condition. As noted in the American Society of Anesthesiologists (ASA) guidelines, several different areas of difficulty may arise [4]. The ASA task force recognizes difficult face mask ventilation, difficult laryngoscopy, difficult tracheal intubation as well as failed intubation all as difficult airway situations. Specific definitions have also been applied to some of the situations. For example, difficult intubation has been defined as an inability to place an endotracheal tube within 10 minutes or three failed attempts. For most critical care practitioners, the term difficult airway likely is construed as difficulty in translaryngeal endotracheal intubation no matter the cause.

Endotracheal intubation is a traditional and preferred artificial airway for mechanical ventilation and may provide airway protection and relief of airway obstruction in many circumstances [4]. For most cases of difficult intubation, poor visualization of the glottis is the underlying cause. Cormack and Lehane proposed a classification scheme for grading the laryngeal inlet in a paper describ-
ing the likelihood of difficult intubation in obstetrical patients [5]. Their scheme included four grades of glottic visualization, including:

- Grade I - All or most of the glottis is seen
- Grade II - Only the posterior portion of the glottis is seen
- Grade III - Only the epiglottis is visualized
- Grade IV - Inability to visualize the epiglottis or glottis at all

This scheme has become a standard for communicating glottic view during laryngoscopy.

Other techniques have been utilized for describing glottic exposure such as the POGO (Percentage of Glottic Opening) score. A more complete description of the difficulty encountered during intubation has been proposed by Adnet and coworkers using seven parameters including, the number of attempts made to pass the tube, the number of operators who made attempts, the force required to lift the jaw and the glottic exposure [6]. This scoring system has been labeled the “Intubation Difficulty Scale” and correlates well with the time of intubation as well as operator assessment of difficulty using a visual analogue scale instrument.

The frequency in which difficult airway is encountered in critical care practice has not been well characterized. However, considerable data on perioperative intubations has been published. When all types of operative patients are included, grade III laryngoscopies requiring multiple airway attempts occur in 1% to 4% of cases [5,7]. The inability to intubate due to severe impairment of glottic visualization occurs in less than 0.5 of operating room cases [5,7,8]. The frequency of poor glottic visualization requiring multiple intubation attempts for obstetrical cases is significantly less (approximately 1 in 2000) presumably due to relatively normal necks and mobility.

Describing the difficulty encountered in intubation, although useful in studying the problem, has little usefulness to the critical care practitioner at the time of airway management. More promising would be tools for predicted difficulty in achieving an airway and ventilating the patient.

A common tool used in anesthesia practice is the Mallampati classification of posterior pharyngeal exposure [9]. In this schema, the relationship of the size of the tongue and the oropharynx is characterized by visualizing through the opened mouth. The original Mallampati classification had three grades ranging from the absence of the pharyngeal opening impairment from tongue and palatal tissues (Class I), to total or near total obliteration of the pharyngeal aperture when viewed from the mouth (Class III). Other tools commonly used include examining mouth opening, measuring thyromental distance and assessing cervical mobility [10]. A “rule of threes” has been advocated by some clinicians as an easy mnemonic to ascertain the possibility of airway difficulties. This rule includes the ability to place three fingers between the teeth, between the mandible and the hyoid bone and between the thyroid cartilage and the sternal notch predicts a successful intubation.

The 2003 revised ASA guidelines list eleven components of the preoperative airway physical examination which may help predict difficulty in establishing an artificial airway but conclude that no scoring system is “failsafe” [3]. The critical care practitioner should consider that these clinical assessment tools have been developed from populations of cooperative patients evaluated preoperatively and may not be valid or reliable in the setting of emergent airway management.

Emergency department experience may more closely approximate the critical care environment. Bair and associates have recently reported an analysis of failed intubation attempts in the National Emergency Airway Registry Database [11]. This database included 7,712 patients who underwent emergency intubation during the study period. Two hundred and seven (2.7%) were deemed to have a failed intubation, defined as requiring adoption of a second method for securing the airway. A number of secondary techniques were used to secure the airway in these cases of primary failure including rapid sequence induction of anesthesia, surgical airways, fiberoptic assisted intubation, the use of controllable tip endotracheal tubes, laryngeal mask airways and retrograde intubation techniques.

The difficult airway approach: Which position?

When faced with a difficult airway situation, the critical care practitioner should assure himself/herself that he/she has stacked the deck in his/her favor. We are fond of telling our airway students that intubation is like porcupines making love: “Position is everything.”

Traditionally the sniffing position has been advocated for intubation of an orally placed translaryngeal endotracheal tube. The term “sniffing position” comes from Magill’s 1936 paper in which he describes the optimal positioning of the patient for endotracheal intubation [12]. Although this position may facilitate intubation, this assertion has recently been questioned in a study published by Adnet and collaborators [13]. In their study, 456 patients were subjected to two sequential laryngoscopies.
The first for topical anesthesia of the glottis and the second for endotracheal intubation. Glottic visualization was assessed at each laryngoscopy. The authors noted that the sniffing position improved glottic exposure in 18% of patients but worsened it in 11%. Reduced neck mobility and obesity were independently associated with an improvement in the sniffing position. The authors concluded that routine placement in the sniffing position offers no advantage over simple head extension.

In the authors’ experience there are a variety of alternative positions that can achieve reasonable airway visualization, such as allowing the head of the patient to “hang” from the edge of the bed while attempting intubation. Clearly, some positions can not be used in particular patient populations (i.e., cervical spine injuries).

**Adjuncts for direct laryngoscopy**

A number of modifications to laryngoscope blades have been introduced as adjunct for direct laryngoscopy. Some of these modifications include prisms, mirrors to improve visualization and bougies or stylets to aid in tube placement. The use of prisms is quite old but received little clinical use. The prism described by Huffman was made from Plexiglas and was attached to the vertical flange of the laryngoscope [14]. It provided 20 degrees of refraction to allow greater viewing of the glottic opening in grade III or IV situations. Similarly, mirrors have been attached to laryngoscopes to aid visualization [15]. These devices result in an inverted image, which may cause some difficulty and may fog up as may also occur with the previously discussed prism devices. Neither of these technologies has seen frequent use in the clinical setting.

Bougies or guiding catheters may be inserted through the glottis under less than ideal conditions and an endotracheal tube inserted blindly over the guiding catheter after laryngoscope removal. Various types of stylets and guiding catheters have been described including stylets with optical fibers for viewing the structure at the tip of the tube as it is inserted [16,17]. Numerous case reports have appeared touting the utility of these devices.

**Rigid fiberoptic laryngoscopy**

An alternative to direct laryngoscopy is the use of a rigid fiberoptic laryngoscope such as the Bullard laryngoscope. These devices require little manipulation of the head or neck and can be used when mouth opening is severely restricted [18,19]. The scope is inserted in through the mouth and advance to the larynx. The operator, either viewing through an objective lens at the end of the scope or a video screen, may intubate the trachea over a stylet. These rigid devices may be easier and quicker to use than flexible fiberoptic scopes. Setup time, expense and the need for light sources are all potential detractors from these devices.

**Flexible bronchoscopy**

Fiberoptic bronchoscopes have been used in clinical medicine for decades. Fiberoptic bundles carry illuminating light as well as permit viewing of the upper and lower airways. These devices vary in size and configuration according to their intended use. The operator can deflect the tip of the scope with a lever on the proximal end that permits directing the scope in the direction desired. Control is only available in a single “forward/backward” axis and the scope must be rotated as a unit to manipulate the end in other directions. Older devices had an objective lens on the proximal end of the scope through which the operator looked; but newer devices display images on a video screen and incorporate integral micro video cameras [20].

In the setting of elective intubation with suspected difficult airway, the bronchoscope can be a valuable tool. Adequate time for preparation can be allocated and an awake procedure can be planned. Nearly universal success can be expected under these circumstances [21]. The emergent situation may be more difficult. Secretion or blood may limit visibility and negotiating the nasal and oropharyngeal anatomy may be difficult and time-consuming. The scope is typically passed through the endotracheal tube before it is introduced into the patient either nasally or orally. The scope is advanced into the trachea, observing the image from the distal tip of the device. The endotracheal tube is then advanced over the scope into position in the trachea. In approximately 10% of cases, the tube cannot be advanced despite manipulation and a smaller tube or other technique is required [22]. One advantage of the bronchoscopic technique is immediate confirmation of tube placement by visualizing its tracheal position.

**“Blind” intubation**

When the airway cannot be visualized because of secretions or other difficulties, an alternative is not to visualize the airway. Blind nasal intubation is a technique in which the endotracheal tube is advanced through the nose of a spontaneously breathing patient and directed into
the trachea by observing ventilation through the tube as it is advanced [4]. Endotracheal tubes with guiding devices that permit the tip of the tube to be deflected anteriorly (i.e. EndotrolTM tube), may aid in placement. Whistles have also been developed for placement on the proximal end of the tube.

Another alternative is to place the tube with tactile guidance, the digital intubation [23]. The operator introduces his/her fingers into the mouth of the anesthetized or unconscious patient, the landmarks are identified with the tips of the fingers, and the tube guided between the 2nd and 3rd fingers as it is advanced into the glottic opening. This procedure can be practiced on several commercially available airway mannequins.

Lighted stylets

Lighted stylets use the principle of transillumination to aid in blindly intubation both in the difficult or normal airway [24]. Several different devices have been introduced into clinical practice. The simplest devices are semi-rigid with a bright light at the end of the stylet. The stylet is passed through the endotracheal tube which is commonly secured to the proximal stylet. The stylet is advanced blindly through the mouth and curved anteriorly. A distinct glow is encountered as the tip of the stylet enters the glottic opening confirming proper position. The endotracheal tube is advanced over the stylet and the stylet is removed.

The success of the lighted stylet in the controlled setting of the operating room has been documented. In hundreds of patients, lighted stylets have been nearly universally successful in achieving intubation [24,25].

Other airway devices

The laryngeal mask airway (LMA) has been used in anesthesia practice for several decades. The LMA consists of a roughly triangular “mask component” attached to a semi-rigid tube. The device is inserted blindly until it rests above the larynx. The cuff is inflated anchoring the airway and providing a seal over the glottic opening. Experienced operators can typically place an LMA in 20 seconds and less experienced paramedics have achieved near total success rates requiring less that 40 seconds [26,27]. Its ease of use and speed of insertion lead the American Heart Association (AHA) to accept the LMA as an alternative airway to endotracheal intubation in its 2000 Advanced Cardiac Life Support (ACLS) guidelines [2]. The LMA is also included as an alternative airway in the ASA guidelines for the management of the difficult airway [3]. The LMA may not provide an adequate seal at higher airway pressures leading to loss of tidal volume in some circumstances.

Another blindly inserted airway device is the esophageal-tracheal combitube (ETC). This device was initially developed by Frass and coworkers as an improvement over the esophageal obturator airway [28]. It was introduced into clinical practice in 1987. These devices are available in 2 sizes. The original 41 French for use in patients taller than 6 feet and the 37 French size. For its successful use in taller patients, some authors have recommended general use of the 37 French ETC in all patients greater than 12 years of age and 4 feet in height.

The ETC consists of two tubes fused together. An esophageal lumen with a blind distal end and perforations along its shaft and a tracheal lumen that has an open distal end. Each of these lumens has its proximal end a standard 15 mm connector. Distal and proximal cuffs are present.

The ETC is inserted blindly or guided by the use of a Mackintosh laryngoscope blade and most of the time enters the esophagus. The distal and proximal balloons are inflated and the patient ventilated through the esophageal lumen with the administered gas exiting the side holes between the two balloons. In a small proportion of cases, the tube will be inserted blindly into the tracheal. In this circumstance the patient is ventilated through the tracheal lumen with its open distal end. Because of success rates are quite high and like the LMA, the ETC is accepted as an alternative to endotracheal intubation in the AHA ACLS guidelines [2].

Invasive airway management techniques

In the situations where the upper airway anatomy is distorted or blood and secretions preclude glottic visualization, the invasive technique of retrograde intubation may be successful. In this technique, a needle puncture of the cricoid membrane is typically performed and a guidewire placed retrograde to exit the mouth or nares. A guiding catheter may be placed over the wire before advancing the endotracheal tube into the trachea. The technique has a reported success rate of 98.5% [29]. Bleeding diathesis and laryngeal injury are sited as relative contraindications. In the authors’ experience, this is a reasonable emergent approach.

Transtracheal jet ventilation is another invasive technique that can be used in difficult airway situations. In this technique, a catheter introduced through the cricoid membrane and then connected to a high-pressure oxy-
gen source that oxygenates and ventilates the patient [30,31]. A resuscitation bag may also be adapted to connect to the airway-inserted catheter. Exhalation occurs via the upper airway and sufficient exhalation time must be afforded to prevent breath stacking. This technique has been effectively used in the setting of cardiac arrest as well as in the operating room and is favored by many anesthesiologists.

The acute surgical approach to the difficult airway is usually cricothyrotomy [4]. This traditional emergency surgical technique begins with a vertical incision in the anterior neck at the midline over the cricoid membrane. The trachea is then entered through a transverse incision over the cricoid membrane and a tracheostomy tube or endotracheal tube is placed. Complications include injury to the tracheal cartilaginous structures and bleeding.

The “catheter technique” can also be used in this setting. Form a clinical standpoint in an emergency situation, the cricothyroid membrane can be identified by palpation below thyroid cartilage. A large bore (14 or 16 gauge) catheter may be placed through the cricothyroid membrane into the trachea and used to ventilate and oxygenate patients. Free release of air from the catheter will confirm tracheal position. The tip of the catheter should be angled inferiorly and after tracheal penetration with the plastic cannula, it should be advanced. The cannula may be adapted to fit the 15 mm opening of a standard Ambu bag or alternatively, a portable high frequency jet ventilator device may be used to provide oxygenation to the patient.

Surgical cricothyrotomy may also be performed via utilizing a guide wire technique in which a series of dilators are advanced into the trachea until a large-enough entry is made to allow safe passage of a tube or cannula. This technique has become accepted among critical care practitioners around the world.

Conclusions

The difficult airway represents a complex interaction between patient factors, the clinical setting and the skills of the clinician. The critical care practitioner should develop skills in a number of complementary airway techniques to facilitate airway management in difficult settings. The decision in which devices or techniques should be used, it will depend on the clinical circumstances and the skills of the operator. Although guidelines for the management of the difficult airway are published in the anesthesia literature, these guidelines reflect the generally elective characteristic of the operating room case and are not readily adopted to the critical care setting.

References