Case Study
Patrick was in a motor vehicle accident and has been transported to a tertiary trauma center for stabilization. In addition to multiple blunt force trauma and a small laceration of his femoral artery, computer tomography revealed a cervical fracture with instability of C1-C2. Which airway management techniques are indicated in this situation? Which are contraindicated? What is your plan to secure Patrick’s airway and why?

We have a wide array of options to support airway management. In this objective, we’ll consider several that are common to clinical practice, with an emphasis on when to use them, when not to use them, and complications associated with their use.

Oropharyngeal Airway
An oropharyngeal airway relieves upper airway obstruction by displacing the tongue from the posterior wall of the pharynx. There are several types, including the Guedel, Berman, Williams, and Ovassapian. Notice the hole in the center of the Williams and Ovassapian airways? These openings are made to accommodate a fiberoptic scope and endotracheal tube to facilitate oral fiberoptic intubation.

What complications can be caused by an oral airway? Placing an OPA in a patient with intact upper airway reflexes can precipitate coughing, gagging, vomiting, and even laryngospasm. Withdrawing the OPA is the primary treatment. In some instances, the patient may benefit from deepening the anesthetic. In the setting of laryngospasm, the patient may benefit from CPAP, application of firm pressure at the laryngospasm notch (otherwise known as Larson’s maneuver), or a small dose of succinylcholine.

Iatrogenic injury includes dental damage, pinching the lips or tongue, and in extreme cases ischemia and tissue necrosis. Airway obstruction can occur when an OPA that is too large displaces the epiglottis towards the glottic opening.

Nasopharyngeal Airway
A nasopharyngeal airway is an alternative means of relieving soft tissue obstruction in the upper airway. It’s typically better tolerated in the patient with intact upper airway reflexes.

A nasopharyngeal airway should be avoided in the patient with a basilar skull fracture, as the device could penetrate the cranium causing brain injury. Other instances where an NPA should be avoided include LeFort II or III fracture, nasal fracture, and in the patient with a history of transsphenoidal hypophysectomy or a Caldwell-Luc procedure.

Epistaxis can result from traumatic insertion. This risk is minimized introducing the airway in line with the nasal passage (perpendicular to the face). Additionally, the risk of epistaxis is minimized by selecting the nasal passage of greater patency and administering an intranasal vasoconstrictor. Epistaxis is more likely during pregnancy and in the coagulopathic patient, and so a nasopharyngeal airway should not be used in these patients.
Direct Laryngoscopy

Direct laryngoscopy is the most common technique used for tracheal intubation. Most providers select from one of two blades. The curved (Macintosh) blade indirectly exposes the glottis by applying tension to the hyoepiglottic ligament which lifts the epiglottis. The straight (Miller) blade directly exposes the glottic opening by directly lifting the epiglottis. A multitude of modifications of these blades are on the market that include unique design features such as mirrors, levers, and hinges.

If glottic visualization is difficult, Backward, Upward, and Rightward Pressure on the thyroid cartilage (otherwise known as the BURP maneuver) may improve your view. Additionally, when using a Miller blade, the paraglossal technique may improve the rate of success when a standard technique has failed. With this technique, the Miller blade enters the right side of the mouth and is advanced between the right molars and the tongue. The tip of the blade is advanced towards the midline (where it will ultimately lift the epiglottis), while the proximal end remains at the right corner of the mouth. Note that the tongue resides entirely to left of the blade. Since this technique creates less room in the mouth, it may be helpful use a hockey-stick shaped stylet in the endotracheal tube and to have an assistant retract the right lip throughout laryngoscopy (1).

Video Laryngoscopy

Video laryngoscopy has revolutionized airway management by allowing the operator to see around corners, thereby visualizing structures outside of the line of sight. Indeed, a number of high-quality, randomized trials demonstrate a compelling record of success during complicated airway management (1, 2, 3).

On a macro level, video laryngoscopes can be classified as non-channeled or channeled. A non-channeled device is used to expose the glottic structures, but the endotracheal tube is passed into the trachea separate from the laryngoscope. Examples of non-channeled video laryngoscopes include the Glidescope, C-MAC, and McGrath. An attractive feature of these products is that they offer a selection of blades such as Macintosh-style blade or an acute-angle blade. The acute-angle blade facilitates glottic exposure of a more anterior glottic opening. Examples include the LoPro for the Glidescope, the D-blade for the C-MAC, and the X blade for the McGrath. Some scopes, such as the C-MAC offer a straight blade option for use with neonatal and pediatric patients.

By contrast, a channeled video laryngoscope integrates a channel for the endotracheal tube into the device. Why is this important? Think of the times you’ve been able to visualize the glottic opening, but for whatever reason you were unable to navigate the endotracheal tube through the vocal cords. A channeled design solves this problem, since the channel automatically directs the tip of the endotracheal tube through the vocal cords for you. The Airtraq Avant is a common example of a channeled design, and the King Vision gives you the option of using a channeled or non-channeled blade.

Aside from being a useful tool in the setting of difficult or failed intubation, video laryngoscopes confer a variety of benefits. They may limit, or even eliminate, cervical spine movement in cases where such movement could conclude in catastrophe. When compared to traditional laryngoscopy, some authors assert that video laryngoscopy may reduce the stress response, since less force is required to expose the glottic opening (4). Having said this, there’s also data that illustrates that the hemodynamic response to intubation is similar to traditional laryngoscopy.

Some devices are equipped with an external screen. If an external screen is present, other providers can see what the operator sees. This is useful when teaching the novice, helping an experienced operator work through problems in real-time, recording intubation for documentation, and even through remote broadcast of the video feed to a consultant, which may be beneficial in pre-hospital care. Do video laryngoscopes increase the speed or success rate of intubation? At this time, a look at the literature yields mixed results likely as a function of whether patients with difficult airways were included in the study samples, variance in operator experience, and differences in patient populations studied.

What complications can arise with the use of a video laryngoscope? Similar to traditional laryngoscopy, there’s always a risk
Optical Stylet

Like the video laryngoscope, the optical stylet allows the provider to see around corners during airway management. An endotracheal tube is loaded on the stylet, and the operator can view the laryngeal structures through an eyepiece or camera. The optical stylet can be used independent of, or in conjunction with, a device to retract the tongue, such as a laryngoscope. With either approach, a jaw thrust will facilitate glottic exposure.

This device offers the benefit of ease of use in the patient with limited mouth opening, but this comes at the expense of a smaller visual field afforded by the device. Optical stylets common to clinical practice include the Bonfils Retromolar Intubation Fiberscope, the Levitan FPS, and the Clarus Video System. These devices are highly susceptible to fogging, and this can be solved by using an anti-fog solution as well as keeping the device warm prior to use. As with the video laryngoscope, airway trauma can occur.

Intubating Stylet

Sometimes called the gum elastic bougie or Eschmann introducer, the intubating stylet has an angled tip that’s used to facilitate tracheal intubation. This device is most commonly used when a grade 3 view is obtained during laryngoscopy. There’s an unacceptably low success rate when a grade 4 view is obtained.

After the epiglottis is identified, the angled tip is directed underneath the epiglottis and passed through the vocal cords to a total depth of about 23 – 25 cm. Feeling the clicks of the tracheal rings confirms placement, and the rings are most likely to be appreciated when the tip of the intubating stylet is oriented anteriorly. If clicks are not felt, it’s still possible that the intubating stylet resides in the trachea. In this situation, the intubating stylet is advanced to 35 – 40 cm. At this point, the operator should feel resistance as the tip abuts the carina. This is called the “hold-up” sign. If the intubating stylet is in the esophagus, then resistance will not be encountered at this depth. It’s important to understand that assessing for the “hold-up” sign increases the risk of tracheal and bronchial trauma, so care must be taken during this procedure.

After confirming tracheal placement, the endotracheal tube is advanced over the intubating stylet and directed into the trachea. This may require an assistant to thread the endotracheal tube over the distal end of the intubating stylet. If the endotracheal tube catches on the soft tissue of the larynx, then the endotracheal tube is rotated 90-degree counterclockwise. This maneuver orients the bevel posteriorly, allowing it to more easily glide over the posterior laryngeal aperture. It’s important to note that the laryngoscope should be held in place throughout the entire procedure, as premature removal allows pharyngeal soft tissue to displace the intubating stylet and endotracheal tube posteriorly, causing it to catch on the posterior laryngeal aperture. The intubating stylet is also useful for nasotracheal intubation, during video laryngoscopy, and for orotracheal intubation through a supraglottic airway device.

In the emergency medicine literature, there’s data to suggest that, when compared to tracheal intubation with a standard stylet, the use of the intubating stylet is associated with a higher first attempt intubation success rate in patients with at least one difficult airway characteristic. The authors noted that we must be careful to generalize these findings to other types of
providers in settings outside of the emergency department (1).

**Lighted Stylet**

The lighted stylet is a blind intubation technique that transillumines the anterior neck to facilitate endotracheal intubation. When the patient is supine, the trachea is anterior to the esophagus. Therefore, we can look at the quality of the light shining through the neck to determine if the tip of the device is located in the trachea or esophagus. When the lighted stylet is in the trachea, the light has to travel through less tissue, so you'll observe a well-defined circumscribed glow below the thyroid prominence. When the lighted stylet is in the esophagus, the light has to travel through more tissue, so you'll observe a more diffuse transillumination of the neck without the circumscribed glow.

The lighted stylet is best used in the patient with an anterior airway, small mouth opening, or limited cervical spine mobility. It should be avoided in the patient with a short, thick neck or in the presence of an airway tumor, foreign body, epiglottitis, traumatic laryngeal injury, or in the “can’t ventilate can’t intubate” scenario.

**LMA**

The LMA is the most common supraglottic airway used in anesthetic practice. It consists of a shaft that connects to a cuff that seals the airway in the hypopharynx. The tip of the cuff rests against the cricopharyngeus muscle at the upper esophageal sphincter, the sides reside in the pyriform sinuses, and the proximal region sits just below the base of the tongue.

It offers an attractive array of benefits including ease of insertion, less coughing and bucking, greater hemodynamic stability during placement and removal, and maintenance of mucociliary function. The LMA can be used as a primary airway or as a rescue during difficult airway management. It’s value in difficult airway management stems from the fact that the conditions that make tracheal intubation difficult do not correlate with those that make LMA placement difficult. Additionally, the LMA can be used as a conduit for tracheal intubation, where the endotracheal tube can be passed blindly or with the aid of a fiberoptic scope. Finally, the LMA should not be used when the patient is at risk for aspiration, high airway resistance, poor lung compliance, or when there’s an obstruction at or below the level of the glottis. Indeed, laryngospasm will prevent ventilation when a LMA is used.

What are some complications that might arise when a LMA is used? The presence of an air leak can be a vexing problem. The most likely causes of an air leak include light anesthesia, laryngospasm, increased peak airway pressure, inadequate muscle relaxation, reduced lung compliance, or repositioning of the head and neck. Treatment is directed at the underlying cause. As an aside, some practitioners routinely administer a muscle relaxant to facilitate LMA insertion or to improve ventilation when an air leak is present (assuming that the LMA position is good and the LMA is properly inflated). At this time, there does not appear to be any evidence to refute these practices.

The integrity of the seal is primarily dependent on LMA size and position and less dependent on cuff volume or pressure. With this in mind, the optimal cuff pressure is 40 – 60 cm H₂O, and a common error is to continue to add air to the cuff when the LMA does not seat properly. A cuff pressure that exceeds 60 cm H₂O increases the risk of sore throat, pharyngeal necrosis, and injury to the lingual, hypoglossal, and recurrent laryngeal nerves. Other risk factors for nerve injury include using a LMA that is too small, lidocaine lubrication, and traumatic insertion (1). When using nitrous oxide, one must be aware that this gas diffuses into the cuff, which can increase cuff volume and pressure. Frequent monitoring of cuff pressure with a monometer can help mitigate this risk (2).

Although the cuff shields the larynx from pharyngeal secretions, it does not reliably protect against gastric regurgitation. Therefore, the LMA should not be used when the patient is at risk of gastric regurgitation and aspiration, such as a full stomach, hiatal hernia, small bowel obstruction, symptomatic GERD, or delayed gastric emptying.
In the event of a “can’t ventilate and can’t intubate” scenario, the LMA can be lifesaving and should be used even if the patient is at risk for aspiration. In this situation, hypoxemia (not aspiration) is the greatest risk to the patient!

What if the patient vomits with a LMA in place? If you observe gastric contents inside the airway tube of the LMA, then you should perform the following interventions. Leave the LMA in place. There may be gastric contents behind the LMA cuff and removing it can worsen the situation. Place the patient in the Trendelenburg position and deepen the anesthetic if necessary. Give 100% oxygen via a self-inflating resuscitation bag. If gastric contents are present inside the breathing circuit you don’t want to push them into the lungs. Use a low tidal volume. Use a flexible suction catheter to remove gastric contents from the airway. Use a fiberoptic bronchoscope to evaluate the presence of gastric contents inside the trachea. If present (or if the patient becomes symptomatic), then consider intubation and aspiration protocols.

**LMA Variants**

There are a multitude of LMA variants available, and each may offer a distinct advantage in a particular situation. We’ve linked to several that are commonly utilized in clinical practice.

- LMA Unique
- LMA ProSeal
- LMA FastTrach
- LMA Flexible
- iGel

**Flexible Fiberoptic Scope**

The flexible fiberoptic bronchoscope is used for indirect laryngoscopy in awake or asleep patients. Light from an external source travels along a fiberoptic bundle and out from the distal tip. This allows the operator to view the patient’s anatomy through the eye piece or a camera attached to the eye piece. The scope has a second channel that may be used to insufflate oxygen, suction the airway, or inject local anesthetic on to the airway anatomy.

What are the indications for the fiberoptic scope? Flexible fiberoptic bronchoscopy in the awake, spontaneously ventilating patient is the gold standard for managing the difficult airway. Also, it may be used in the anesthetized patient when intubation has failed but ventilation is possible. Other indications include cervical spine limitations such as severe cervical stenosis, cervical fracture, Chiari malformation, or vertebral artery insufficiency. Additionally, the fiberoptic scope is useful in the patient with limited mouth opening that may occur with disease of the temporomandibular joint, facial burns, mandibular-maxillary fixation or in the patient with distorted upper airway anatomy.

What are the contraindications for the fiberoptic scope? Although there are no absolute contraindications to fiberoptic bronchoscopy, you must be familiar with the relative contraindications including impaired visualization (due to hemorrhage or excessive secretions), an uncooperative patient when an awake intubation is planned, or in the setting of hypoxemia. Indeed, the fiberoptic scope should not be used in the “can’t ventilate can’t intubate” scenario.

**Rigid Fiberoptic Scope**

The Bullard laryngoscope is an example of a rigid fiberoptic laryngoscope. It is best used in the patient with a small mouth opening, impaired cervical spine mobility, short and thick neck, and in patients with Treacher Collins syndrome or the Pierre-Robin sequence. There are no absolute contraindications to the Bullard, however the learning curve is high. A disposable tip extender is commonly used with this device, and it must be verified that this piece is recovered following intubation.
Retrograde intubation is a blind procedure, where tracheal intubation is accomplished by passing the endotracheal tube over a wire. Here’s a quick refresher on how to perform the procedure.

- Puncture the cricothyroid membrane with a 14 - 18g needle.
- Aspirate for air to confirm proper placement inside the tracheal lumen.
- Pass a wire through the needle and advance it in a cephalad direction.
- The wire should travel in-between the vocal cords and exit through the mouth.
- Load the endotracheal tube over the wire and advance it into the trachea.
- Once the ETT is in the trachea and cannot be advanced any further, withdraw the wire and then advance the ETT into its final position.

What are the indications for retrograde intubation? Indications include an unstable cervical spine, upper airway bleeding, and failed awake intubation.

Contraindications include inability to identify or access the cricothyroid membrane, pretracheal mass (such as a goiter), laryngotraheal disease (such as tracheal stenosis under the puncture site), a tumor that would obstruct the path of the wire, coagulopathy, or infection at the puncture site. Due to the time it takes even experienced providers, this procedure should not be performed in the “can't ventilate and can't intubate” scenario.

Complications include bleeding, pneumomediastinum, pneumothorax, trigeminal nerve trauma, breath holding, and a wire that travels in the wrong direction.

Percutaneous Cricothyrotomy With Jet Ventilation

Cricothyroidotomy is a lifesaving technique that can be employed in the "can't ventilate can't intubate" scenario. A percutaneous approach involves puncturing the cricothyroid membrane with a large bore cannula (commonly available in a premade kit) and then ventilating the patient with a high-pressure oxygen source, such as a jet ventilator. Because the cannula has a narrow diameter, a high inspiratory pressure of about 50 psi is required to ventilate the patient. Keep in mind that expiration is passive and that, for exhalation to occur, the upper airway must be patent. A jaw thrust or oral airway may be helpful in this regard. It's important to understand that upper airway obstruction can limit or prevent exhalation introducing the risk of barotrauma, pneumothorax, subcutaneous emphysema, and mediastinal emphysema. Because ventilation can’t be controlled, the patient is at risk for hypercapnia. Other potential complications include hemorrhage, aspiration, tracheal injury, and esophageal injury.

Surgical Cricothyrotomy

A surgical cricothyrotomy involves a small horizontal incision through the cricothyroid membrane through which an endotracheal tube may be placed. Children have more pliable and mobile laryngeal cartilages, and this makes surgical cricothyroidotomy incredibly challenging in this patient population. For this reason, a percutaneous approach is recommended for children under 10 years of age. Additionally, this procedure should not be performed in the patient with a laryngeal fracture or neoplasm. Potential complications of surgical cricothyrotomy include tracheal stenosis, tracheal or esophageal trauma, hemorrhage, disordered swallowing, or subcutaneous or mediastinal emphysema.

Airway Exchange Catheter

Although our discussion focused on how to obtain an airway, we’d be remiss if we didn't consider an important device to help
during the extubation of a difficult airway. The airway exchange catheter (also called a tube exchanger) is a long, thin, flexible, hollow tube that maintains direct access to the airway following tracheal extubation.

Here's how it works. The AEC is inserted into the in situ endotracheal tube. The distal end of the AEC remains in the trachea (at about 25 – 26 cm at the lip). Next, the endotracheal tube is removed, and the patient maintains his own airway with the AEC in place. By itself, the AEC doesn't provide a patent airway. Instead, think of it as a placeholder that can be used as a stylet for re-intubation via the Seldinger technique. Keep in mind that laryngoscopy will be required to displace the supraglottic tissue.

The lumen of the AEC can be used for end-tidal CO₂ measurement, jet ventilation (via a Luer-lock adapter) or oxygen insufflation (via a 15 mm adapter).

**Key Points**

Each airway device has its own strengths and weaknesses, so it’s critical to understand when a particular device is best suited for a particular patient.

Some airway devices can be used in combination to achieve a result that each would be unable to attain on its own. Examples include using a fiberoptic scope through a LMA or using an intubating stylet with a video laryngoscope.

It’s best to improve your airway skills with a particular device in patients with normal airways, so you’re well-rehearsed when you’re confronted with a difficult airway.

The well-rounded practitioner is comfortable with a range of airway devices, so he or she can select the best one for each particular situation.

**References**

**Textbooks:** These books are included on the CPC Exam Bibliography published by the NBCRNA


**Articles:**


