INTRODUCTION

This lecture describes the best techniques for predicting and overcoming the difficult airway. It also covers the most up to date devices to assist in airway control.

Objectives

By the end of this lecture, the participant should be able to...

1. Explain the characteristics of a difficult airway.
2. Explain the anatomy of the normal and difficult airway.
3. Describe and anticipate specific problems before they arise.
4. Demonstrate knowledge to correct airway problems before encountered.
5. Explain the most common backup airway devices.
6. Describe the advantages and limitations, as well as indications for use of the most common backup airway devices.
7. Explain the anatomy and procedure of surgical airways.
8. List and explain the most common emergency surgical airway techniques and devices.
9. Describe airway confirmation devices

Introduction

• In the acutely ill, airway is the most important consideration. It is the first part of every assessment and the "A" in ABC's. It can also be the most difficult part of the patient to treat. Nothing is more stressful than attempting intubation and failing. In the entire scope of pre-hospital practice, nothing is as critical as airway management. Of all the interventions, it is the one most likely to make the difference between life and death.

• Many factors can complicate your efforts to control an airway. Recognizing these factors and adjusting beforehand, will increase your success rate and decrease your complication rate. These same factors may influence your choice of backup plan as well. All airway protocols should have a backup airway, and you should already have your options thought out before first attempting intubation.

• In this lecture we will go over airway classifications and discuss ways of predicting and handling difficult airways. We will also go over the more common backup airway devices and techniques.
Considerations

- What makes an airway difficult? Anything that makes visualization of the cords, or passing of the ET tube harder than normal. This sounds simple, but is the easiest approach to breaking down the potential difficulties before they are encountered.
- The first consideration is anatomy. All airways are different. The size of the mouth, tongue, jaw, teeth, and placement of the trachea all have impact on the ability to visualize the airway.
- Other considerations are injury, swelling, and foreign bodies. Burns, swelling, hematoma, secretions, aspirated material can all get in the way. They may also be hidden until you are performing laryngoscopy, so you need to be able to deal with these complications as they arise.

Evaluation

- There are many different methods of airway evaluation. Most are designed to quickly evaluate the most common obstacles to intubation. None will accurately predict either the easy or difficult airway 100% of the time. There is still no substitute for clinical judgment and the ability to adjust as needed. Caution is still the best policy.

Mallampati

- The Mallampati classification is designed to predict the difficult airway by a quick look in the oropharynx of the conscious patient. Ask the patient to open their mouth as wide as they can and stick out their tongue.
- If you can see all of the uvula and tonsillar pillars, it is a class I, the most likely to be easy.
- If all you see is tongue, it is a class IV and most likely to be difficult.
- This is a quick evaluation tool but it fails to take into account many other variables likely to be encountered in the emergency environment. The best approach is a systematic evaluation that will take into account all the likely difficulties, but is quick and easy to remember.

MEDICTUBES

The mnemonic MEDICTUBES has been suggested as a practi

- **Mouth, Mandible.** Measure the size of the mouth opening. It should be three finger-breadths. Anything less may limit your view. The mandible should be midline without deformity or trauma.
- **Excessive Weight.** Obese patients are notoriously hard to intubate.
• **Deformity.** Look for any face or neck deformities or masses. These may be traumatic or baseline deformities such as a goiter.

• **Incisors.** Buck teeth are bad. Also look for dentures or other dental appliances. Loose and decayed teeth are especially fragile.

• **C-Spine.** The longer the neck, the better. This makes lining up the airway with the oral cavity easier. The head and neck should ideally be in the sniffing position (not in traumas with suspected c-spine injuries). Expect c-spine immobilized patients to be more difficult than normal.

• **Thyro-mental distance.** This is the distance from the chin to the thyroid cartilage. It should also be three finger-breadths in distance. Shorter is harder.

• **Uvula.** This is the same as the Mallampati classification. The more uvula you see, the better.

• **Burns.** Look for burns or other injuries that may lead to airway edema. You may be able to line up the airway well, but not be able to visualize the cords or pass the tube if excessive swelling is present. These conditions also make it particularly hard to bag the patient and should be taken into account if you are planning on Rapid Sequence Intubation.

• **Emesis.** Barf, Blood, and secretions are always bad.

• **Stridor.** This is another clue to possible edema or foreign body.

References:


<table>
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<tr>
<th>DIFFICULT TUBE (predicted)</th>
<th>EASY TUBE (predicted)</th>
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<tr>
<td>Buck Teeth</td>
<td>No Teeth</td>
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<tr>
<td>Small Chin</td>
<td>Long Chin</td>
</tr>
<tr>
<td>Obese</td>
<td>Thin</td>
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<tr>
<td>Short neck</td>
<td>Long Neck</td>
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<tr>
<td>Big Tongue</td>
<td>Small tongue</td>
</tr>
<tr>
<td>C-spine immobilized</td>
<td>No Trauma</td>
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<tr>
<td>Airway trauma</td>
<td>No airway edema</td>
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<tr>
<td>Emesis</td>
<td>No airway obstruction</td>
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<tr>
<td>Foreign Body</td>
<td></td>
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<td>Airway edema</td>
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Basic Techniques

- Endotracheal intubation is a common procedure. In the emergency environment it is usually a life-saving one. There are many variations in-patient and provider. This is why there are many different tools and techniques available to ensure success. It is imperative that you are familiar with and ready to use a variety of techniques and equipment if the 1st attempt fails.
- Always remember to go back to the basics of ventilatory management when a difficulty arises. There is no substitute for good bag valve mask ventilation, with chin lift and oral or nasopharyngeal airways. This could easily get you and the patient to the hospital during even a prolonged transport if done well.
- This is a reasonable backup plan, and is an integral part of BLS transport across the country. It does not protect against aspiration, and in many instances can cause gastric distention and other undesirable consequences.

Endotracheal tube

- If possible, the airway should be secured with an endotracheal tube.
- The most common technique is by direct laryngoscopy, and visualization of the tube passing through the cords.
- The Macintosh (curved blade) is the most widely used blade, although most experts agree that the type of blade is less important than the provider's comfort with the one they have.
- The other common blade is the Miller (straight blade). It is most often used as a second-line blade, but some use it first.
- The choice of blade is a matter of preference but the technique is different depending on the blade. You should be skilled in both to accommodate the patient's anatomic differences.
- The one exception is the infant, where a straight blade works better to stabilize the more floppy epiglottis and displace the relatively larger tongue. (1)

References:

Sellick's Maneuver

- Applying pressure to the anterior cricoid cartilage is known as Sellick's Maneuver. This is usually performed by your partner while you attempt laryngoscopy.
- It helps push the cords into view and places pressure on the esophagus, preventing regurgitation and aspiration.
- It should be done with light pressure.
- Too much may either obscure the airway, or make passing the tube more difficult.
Back ups

- If the attempt to intubate fails, you need a quick and effective method to secure the airway.
- The worst-case scenario is the patient who is crashing and you can't intubate or ventilate the patient.
- The backup plan for this scenario must be in your mind at all times.
- There are many potential tools and techniques available.
- Be familiar with the ones available to you.
- The most common are blind nasal, digital, retrograde, laryngeal mask airway (LMA), Combitube, and esophageal obturator airway (EOA).
- Less common are fiberoptic and Bullard blade.

Nasal intubation

- Blind nasal intubation is a technique where the tube is passed through the nose into the pharynx and trachea. It has the advantage of not manipulating the neck as much as orotracheal intubation. It is also useful in patients with jaw injuries or who are clamped down. It may also be beneficial in patients whose necks will not flex secondary to arthritis. Nasotracheal intubation tends to be tolerated better in the awake patient, and cannot be bitten by the patient. It is also a little easier to secure than an orotracheal tube.
- It is not recommended in patients who have nasal or midface injuries. In patients with severe ethmoid fractures, the tube may theoretically be passed into the brain, although studies show this is unlikely (1).
- As it requires the rescuer to listen for the patient's breathing to place properly, it can only be done in the breathing patient. It is more time consuming than orotracheal intubation, and may clog easily.

To perform nasotracheal intubation, inspect the nose and select the larger nostril. Pre-treat the nostril and throat with topical lidocaine. Advance the tube with the bevel either facing the septum or floor of the nostril. Keep guiding the tube gently until you feel it drop into the posterior pharynx, then try to guide it towards the glottis. Listen for the patient's breath sounds at the end of the tube. They should be loudest just proximal to the glottic opening. When the patient takes the next deep breath, gently advance the tube into the trachea, past the cords. If you feel resistance, pull back and try again. If the trachea has been intubated, you will see condensation with each breath on the inside of the ET tube. An intubated patient should not be able to vocalize. Confirm placement with auscultation and at least one secondary device, such as an ET CO2 detector.

References:
**Digital intubation**

- Digital intubation is the technique of inserting the fingers into the airway to guide the tube into the trachea. It is the oldest method of intubating and requires no tools other than the ET tube. It is useful in the patient who is c-spine immobilized as it does not require extension of the neck. It is also useful in cramped spaces such as extrication situations. Digital intubation is also useful when the airway cannot be cleared of blood or secretions, which impair vision, but not palpation.
- It has one major drawback. Teeth! It should not be performed on any patients with a gag reflex as they may bite you. It is therefore reserved for deeply comatose patients only.
- To perform digital intubation, place your left middle and index finger in the patient's mouth. Use a bite block between the patient's molars to protect your fingers. Advance your fingers until you reach the posterior pharynx and can palpate the arytenoids and epiglottis. Press the epiglottis forward and then use your right hand to guide the tube into place between the fingers of your left hand. Keep advancing until the tube passes through the cords.
- Confirm placement and secure.

**Retrograde intubation**

- This is a technique that uses a combination needle cric, with a Seldinger-over-the-wire method to place the ET tube blindly. To perform, you need a syringe and needle, a long guide wire thin enough to pass through your needle, 2 clamps, and the ET tube.
- First puncture the cricothyroid membrane with your needle while aspirating with the syringe. You are in the trachea when air freely withdraws. Remove the syringe and pass the guidewire through the needle aiming towards the head. Simultaneously look into the oropharynx and grab the wire with the clamp. Clamp off the tracheal end at the level of the skin and pull taut. Load the ETT over the wire through the Murphy's eye. Advance the tube over the wire into the cricoid area, then relax the cricothyroid end of the wire and advance the tube into the trachea. It may be difficult to pass the tube through the cords. If so, reposition and try again. When the ETT is in place, release the wire and withdraw.

**Laryngeal Mask Airway (LMA)**

- The LMA is a device, which is placed in the hypopharynx and inflated. It resembles a facemask that is designed to go in the throat. It is a blind technique that can be performed with little training. It does not protect against aspiration and is subject to movement during transport. It cannot be used in a patient with a gag reflex, or who is clamped down. Overall, it is probably a better backup device than the bag valve mask alone.
Combitube

- The Combitube is a dual-lumen airway device designed to be placed blindly. It has the advantage of being able to work regardless of placement in either the trachea or esophagus. It has 2 ports and 2 cuffs. One cuff is designed to inflate in the pharynx and one in either the trachea or esophagus. It has the advantage of being able to be used in the c-spine immobilized, and limits gastric distention. It has the disadvantage of needing good airway skills to ensure proper placement and ventilation. It cannot be used in patients with esophageal disease or injury. It cannot be used in pediatric patients. When in the esophagus it does not completely protect against aspiration.
- To insert the Combitube, place the head in neutral position. As always, maintain c-spine precautions if injury is suspected. Lifting the jaw, advance the Combitube until the black line is between the patient's teeth. Inflate the cuffs. (100 cc's in the pharyngeal cuff and 15 cc's in the distal cuff).
- Ventilate through the blue proximal port and auscultate over the lungs and stomach. If you hear bilateral breath sounds and no gastric sounds, secure the tube. If you hear gastric sounds and no breath sounds, switch ports and listen again. You should now hear good breath sounds without gastric sounds. Secure the tube.
- With any airway device, confirm the tube with as many techniques as possible.

Needle Cricothyrotomy

- Of the surgical airways, needle cricothyrotomy is the least invasive. It can be done quickly and reliably. It can provide both oxygenation and ventilation. Complications include barotrauma from overinflation, bleeding, and inadequate ventilation. It is difficult to maintain catheter placement during transport and requires constant vigilance.
- To perform a needle cric, place the patient supine and extend the neck. Palpate the neck and find the cricothyroid membrane. (Between the thyroid cartilage and the cricoid cartilage) I recommend becoming very familiar with the landmarks before attempting the procedure for the first time. Using a large bore IV needle attached to a syringe, puncture the cricothyroid membrane while aspirating. When you easily withdraw air, you are in the trachea. Advance the catheter, remove the needle, and secure.
- Use 14 Ga. Angiocath
- It is important to note that needle cricothyrotomy does not prevent aspiration.

High Pressure

- The alternative is to attach the patient to a high-pressure transtracheal jet ventilation system. This provides oxygen at 50 psi and has enough pressure to make the chest rise and fall. This achieves ventilation and can maintain the patient for longer periods of time. It has the disadvantage of causing barotrauma easily. Complications include pneumothorax and subcutaneous emphysema.
Low Pressure

- At this point you may attach the patient to either a high pressure or low pressure system. Be familiar with the equipment in your area. A low-pressure system (high flow O2 off a standard regulator) can achieve oxygenation but not ventilation. You can get oxygen into the lungs but not with enough pressure to make the chest rise and fall. This method gives you time to attain another form of airway. It will not sustain the patient indefinitely, however, as the patient will retain CO2 and become acidotic.

Open Cricothyrotomy

- The open cricothyrotomy is a method of obtaining a definitive airway. It is the most invasive technique and has the most severe complications. It is indicated when no other method of ventilation will work, and the patient is at imminent risk of death. It can be performed rapidly and reliably. It has the same contraindications as needle cric. As you are cutting the neck with a scalpel it can cause severe bleeding and possible damage to surrounding structures such as the thyroid gland, vocal cords, and recurrent laryngeal nerve.
- To perform the open cric, find the cricothyroid membrane. Clean the area and stabilize the cartilage with one hand while making a 2 cm vertical incision down to the membrane. Find the membrane again and make a 1 cm horizontal incision through it. Insert a pair of curved hemostats and spread the membrane open. Keep the hemostats in place and insert a cuffed 6.0-7.0 ET tube (or tracheostomy tube) into the opening. Inflate the cuff, confirm placement, secure, and ventilate.

Other equipment and devices

- There are a number of new devices in the airway arena. They vary from End Tidal CO2 detectors and esophageal detection devices, to cricothyrotomy kits. Many or these devices have proven to be useful in the pre-hospital arena. Many areas require the use of airway confirmation devices.
- Airway confirmation devices fall into two categories. CO2 detectors and esophageal detectors. The CO2 detectors in turn fall into 2 categories. There are real time electronic detectors, which give a numeric number to the amount of exhaled CO2, and colorimetric detectors that turn color in the presence of CO2. Both are useful for continuous monitoring and confirmation of tube placement. The drawback to CO2 detectors is they require metabolism to function. Patients in cardiac arrest will not produce CO2 and will not register on the monitor, despite proper ET tube placement.
Esophageal detectors

- Esophageal detectors rely on the fact that the trachea is rigid and the esophagus is flexible. The esophagus collapses under negative pressure and the trachea does not. If you apply suction with either a bulb syringe or rigid syringe, it will draw back easily if the ET tube is in the trachea, and will not draw back if the tube is in the esophagus. False positives may occur if a large amount has been introduced into the stomach and esophagus.

Cricothyrotomy

- There are a variety of cricothyrotomy devices on the market as well. They are kits designed to make traditional needle or open cric procedures simpler, faster, and safer.
- Most are designed for compact use and will fit into the standard airway bag. The disadvantage is cost and training for a device that will be used only rarely. The advantage these devices make the procedure much more likely to succeed by taking away some of the more difficult steps. Since the procedure is done so rarely, anything that simplifies the process in a life-threatening emergency is beneficial.

ET tube securing devices

- ET tube securing devices are now widely used to secure the tube in place. These devices tend to be easier to work with than tape and secure the tube better. Most are made of plastic and Velcro and are adjustable to fit patient size.

Summary

Most intubations are uncomplicated. Some are much more difficult or even impossible. The key to success is to recognize the difficult airway before starting to intubate, and having a well thought out, often practiced, backup plan for all situations.
Be familiar with your equipment and check it before every shift. The time to find out you are missing something critical is not during the resuscitation!
Confirm ET tube placement frequently. The dynamic environment of the scene and back of the ambulance make tube movement a certainty. If the patient decompensates, always go back to the ABC's. Tube displacement is a common preventable cause of mortality.
Other References


Table

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<tr>
<th>Procedure</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>Bag Valve Mask</td>
<td>Quick and Easy</td>
<td>Does not prevent aspiration</td>
</tr>
<tr>
<td>MacIntosh Blade</td>
<td>Effective</td>
<td>Difficult with large tongues, small mouths</td>
</tr>
<tr>
<td>Miller Blade</td>
<td>Effective</td>
<td>May cause more airway trauma than Mac</td>
</tr>
<tr>
<td>Nasal intubation</td>
<td>More tolerable for awake patients</td>
<td>Bleeding, must be breathing, not for use in facial fractures</td>
</tr>
<tr>
<td>Digital intubation</td>
<td>Fast, easy, no tools required</td>
<td>Rescuer may get bitten</td>
</tr>
<tr>
<td>Retrograde intubation</td>
<td>Does not move neck</td>
<td>Invasive</td>
</tr>
<tr>
<td>Laryngeal Mask Airway</td>
<td>Easy, little cervical movement</td>
<td>Does not prevent aspiration, is not secure</td>
</tr>
<tr>
<td>Combitube</td>
<td>Blind, may prevent aspiration, little cervical movement</td>
<td>Need to choose correct port. May not form tight seal</td>
</tr>
<tr>
<td>Needle cricothyrotomy</td>
<td>Quick</td>
<td>Need high pressure to ventilate (barotrauma), invasive</td>
</tr>
<tr>
<td>Open cricothyrotomy</td>
<td>Definitive airway</td>
<td>Most invasive</td>
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