New Airway Models *in the* Fast Lane

By S. CHRISTOPHER SUPRUN

OK, so your EMS service can intubate. Is your airway arsenal still a nasal cannula, non-rebreather face mask, and bag-valve mask? Can your service do RSI? Does it use any other skills, such as the bougie tube, retrograde intubation, or fiber optic intubation? It's time to up the ante and consider new science that shows that we need new products.

Before we talk about specific products and systems, several important technical issues related to the airway need to be discussed.

First, EMS providers should proactively estimate the difficulty of intubating a patient using the Malanpotti Scale, shown in Figure 1. The Malanpotti Scale estimates the difficulty of intubating a given patient's airway after visualizing, or not visualizing, structures in the patient's upper airway. These structures include the tongue, soft palate, uvula, and fauces, among others. The fewer structures visible, the more difficult the airway is likely to be for any provider to intubate.

This increased difficulty should serve as an indicator that backup devices or procedures such as the Combitube®, laryngeal mask airway, or cricothyrotomy should be ready. Depending on the relative skill of the person who will be intubating, an appropriate ventilation technique may be an oropharyngeal airway with dual nasopharyngeal airways placed and a bag-valve mask device.

Of additional concern to both ALS and BLS providers is new science suggesting that they do not understand the nature of hyperventilation. Hyperventilation is not breathing fast, which if we remember back to our first EMS class we should have learned as tachypnea. Instead, hyperventilation is over-ventilating a patient's minute volume (MV). A patient's respiratory status should be evaluated not only on respiratory rate, but also tidal volume (VT) and effort. The ratio of respiratory rate and tidal volume leads us to our minute volume. This seesaw should be in balance; when either rate gets too fast or too slow, or volume gets too big or too shallow, the patient's ventilation status will suffer.

Too often, we raise a patient's respiratory rate and tidal volume, causing a much higher than normal MV. This increased level of air volume causes an increase in intra-thoracic pressure, which impedes blood flow and thereby reduces coronary perfusion. Patients who are infarcting or in cardiac arrest already have a weakened myocardium, which with a high MV will now have its oxygen working against it in the return of blood to the heart.

Finally, for years we have known that gastric insufflation occurs from inappropriately overventilating patients. This happens when we exceed approximately 20 mm H_2O pressure—the pressure required to open the esophageal sphincter. Too often, this causes the patient to vomit, further complicating the airway. Rapid and overzealous bagging of the patient can cause this to occur.

All this indicates we have been off base in providing appropriate ventilation to our patients and leads us to products that may improve our resuscitative measures.

S. CHRISTOPHER SUPRUN JR., NREMT-P, CCEMT-P, is a paramedic/firefighter and an instructor living in the Dallas Metroplex. He has taught and written about EMS, terrorism response, and incident management for fire departments, federal and local law enforcement, and private industry. In Summer 2003, he was appointed an adjunct instructor in emergency medicine at The George Washington University Emergency Health Sciences program in Washington, D.C.

Typical Airways Better

A new device from O-Two, a British company, is designed to overcome some of the overventilation issues. The O-Two bag-valve mask has a piston designed to fire when inflation pressures are too high in the air outlet. The piston keeps providers from overinflating the lungs and increases resistance so that the provider cannot force air into a patient. This serves several purposes, but certainly makes it more difficult to inflate the stomach and keeps providers from overventilating in a manner that is dangerous to the patient.

In one study, participants at an EMS conference were recorded bagging a simulated patient with O-Two's Smartbag and a standard BVM device. In all categories—respiratory rate per minute, mean tidal volume, mean minute volume, gastric inflation, mean peak pressures, and inspiratory-expiratory ratios—measurements were all better with the Smartbag.

If you're not convinced that "more oxygen can't be bad," remember the recent study conducted by doctors Guggenberger, Lenz, and Federle, which studied wave form capnography's ability to predict esophageal intubation. It showed us that patients who are esophageally intubated still retain large amounts of oxygen that remain attached to hemoglobin until it is used at the cellular level. Patients who were esophageally intubated by medical school residents did not desaturate until several minutes into the airway maneuver. They had the oxygen their body needed; the issue was getting it to the brain.

Another device is called the ResQPod®, an impedance threshold device, designed to help EMS providers cause the negative thoracic pressures that return blood flow to the coronary vasculature. Providers can use the ResQPod with either an endotracheal tube or a face mask with an appropriate face seal. The device keeps the influx of respiratory gases during relaxation—which helps maintain negative or low pressures and by this mechanism returns blood flow to double that of not using an impedance threshold device .

This device also helps providers during cardiac arrest by

Airway-Related Drugs

DRUGS USED FOR SEDATION

Etomidate (Amidate)
Class: Hypnotic
Sedation Dose: 0.1-0.3mg/kg IV over thirty seconds
Effect: Produces anesthesia without significant cardiovascular effects. It also does not produce any analgesia.
Contraindications: Pediatric patients
Side Effects: Nausea/Vomiting

Fentanyl (Sublimaze)
Class: Narcotic Analgesic
Sedation Dose: 25 – 100 µg slow IVP
Effect: Produces analgesia and sedation with quick onset and short duration after stopping administration of the drug.
Contraindications: MAOI, myasthenia gravis, ICP, kidney dysfunction.
Side Effects: Nausea/Vomiting, dizziness, delirium

Midazolam (Versed)
Class: Sedative
Sedation Dose: 2.5 – 5.0 mg slow IVP
Effect: Produces anesthesia with a retrograde amnestic effect. It has no effect on pain.
Contraindications: Hypotension, COPD, CHF
Side Effects: Nausea/Vomiting, dizziness, delirium

DRUGS USED FOR PARALYSIS

Succinylcholine (Anectine)
Class: Depolarizing neuromuscular blocking agent
Sedation Dose: 1.0-1.5 mg/kg IV
Effect: Produces paralysis to facilitate intubation. Its effects last between 5 and 15 minutes.
Contraindications: Patients with burn injuries, history of myasthenia gravis
Side Effects: Muscle fasciculations, hypertension, hyperthermia, hyperkalemia, increase ocular pressure.

Vecuronium (Norcuron)
Class: Nondepolarizing neuromuscular blocking agent
Sedation Dose: 0.10 mg/kg IVP
Effect: Produces paralysis to facilitate intubation. Its effects last approximately 30 to 45 minutes.
Contraindications: Severe liver disease
Side Effects: Hyperthermia

providing a timing light which tells the provider to ventilate the patient for one second every five seconds, encouraging the patient to receive at least 100 compressions per minute, in line with the American Heart Association's emergency cardiac care standards.

Harder Airways Less Difficult

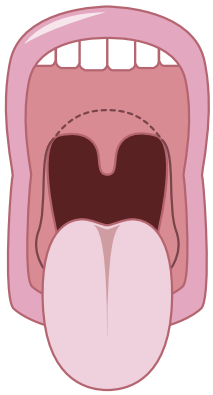
Little by little, many smaller jurisdictions are receiving the authority to use pharmaceutical adjuncts to intubation through either pharmacology-assisted intubation (PAI) or rapid-sequence intubation (RSI). This skill has great value to EMS providers as a tool for patients who need airway management but have an intact gag reflex. These patients may have suffered a traumatic brain injury or may be in respiratory failure, but both will be in need of emergent airway control.

Providers should certainly estimate the difficulty of intubation prior to introducing drugs that will sedate, cause amnesia, and paralyze patients' muscles so they can no longer control their own airway. Patients whose ability to maintain their airway is taken away from them pharmacologically using RSI most often do not make an informed consent to this treatment, even though it may be necessary. Once the drugs are introduced into the patient, failed airways are not an option. Deliberately taking away a patient's ability to breathe and then not successfully achieving an artificial airway is a recipe for disaster in the courtroom and in one's own conscience.

RSI starts by hyperoxygenating a patient, just like any intubation attempt. In some cases, EMS systems use drugs such as atropine or lidocaine as a preagent to combat potential bradycardia and lidocaine, which may have some use in preventing increases in intracranial pressure. It then continues with the introduction of sedation with any number of agents listed in the table. Most of these will cause the patient to have little to no memory of the event.

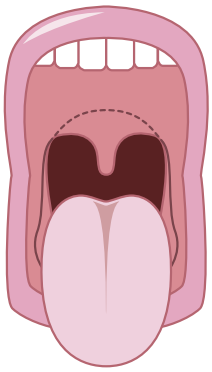
Sedatives are followed by paralytics, causing the muscles to relax and allowing the EMS provider to intubate the patient

Mallampati signs as indicators of difficulty of intubation



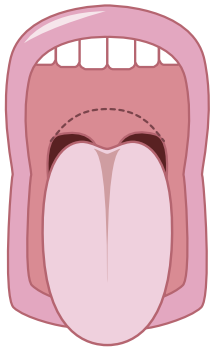
Class I: soft palate, uvula, fuaces, pillars visible

No difficulty



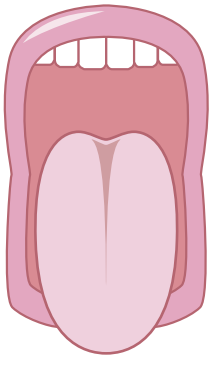
Class II: soft palate, uvula, fuaces visible

No difficulty



Class III: soft palate, base of uvula visible

Moderate difficulty



Class IV: hard palate only visible

Severe difficulty

Adapted from Mallampati and Samsoon and Young

In some cases, patients will not have a gag reflex present but will still have significant damage to the head and neck.

without the previously present gag reflex. After the paralytic is given, the patient is intubated and the tube placement is confirmed in multiple ways, including breath sounds, tube condensation, pulse oximetry and cardiac monitoring, esophageal detector devices, and preferably, wave form capnography.

Although RSI is often considered the be-all and end-all of definitive airway management, providers should be prepared to think outside the box to achieve an airway. Two devices that have great value here are Rusch's ViewMAX laryngoscope blades and the bougie or tube changer available from many providers.

The ViewMax blade is a latex-free laryngoscope blade that provides a refracted image of approximately 20 percent for those patients who have exceptionally anterior airways. The blade is used similarly as a Macintosh blade, but has an offset monocular view that requires only a slightly different intubation viewpoint that many providers find easier after limited practice. The blade helps improve intubation attempts by at least one grade.

For those patients where cord visualization is still not complete or not possible at all, the bougie or tube changer is another option. The bougie is a soft plastic device with a hard crooked end. The differences in anatomy between the esophagus and the trachea make the bougie useful. The esophagus is soft muscular tissue, whereas the trachea is a hard, cartilaginous tissue with rings. As you attempt to visualize a patient's vocal cords, the bougie is introduced like an endotracheal tube. The hook on the end allows it to catch rings of the trachea, making a "clicking" noise that can be heard without stethoscope auscultation. The bougie is then held in place while a standard ET tube appropriately sized for the patient is introduced over the bougie, to provide another mechanism for quick, safe intubation. Once the ET tube is in position at a height generally three times the tube size at the lip, the bougie is removed and normal tube confirmation follows. The bougie is very inexpensive (about $8) and offers EMS providers another option for endotracheal intubation.

Really Hard and Impossible Airways Quick

In some cases, patients will not have a gag reflex present but still will have significant damage to the head and neck. Another alternative intubation method is retrograde intubation. This technique is a combination of orotracheal intubation and cricothyrotomy.

Using the cricothyroid membrane as a landmark, an EMS provider will insert a needle at about a 45-degree angle toward the head. Using the catheter left in place,

a J-style guide wire 18 to 24 inches long should be inserted until it can be seen in the oropharynx. It can then be pulled out of the mouth with forceps or the hand. A standard endotracheal tube is then inserted over the guidewire and pushed until resistance is met. At this point, the guide wire can be removed; because the needle broke the skin at the cricoid membrane, the ET tube must be in the trachea. A slight push will then place the tube at its appropriate position, which should be three times the tube's diameter.

The knock on retrograde intubation is typically that it is time-consuming. This argument could be made for orotracheal intubation as well, except that we practice it so often that it has become commonplace. Similarly, retrograde intubation like any other skill, must be practiced frequently if it is to be added to the skill set of providers in your local system.

Finally, because of attacks of anaphylaxis, major trauma to the mandibular structures, and other situations where the upper airway is obstructed and cannot be corrected, there is a need for more invasive airway management. The QuickTrach®, also by Rusch, offers a cricothyroidotomy alternative to needle cric—which is often noted to not provide necessary minute volumes—or surgical crics, which require extensive training. This device is inserted into a patient's neck after locating the cricoid rings and appropriate aseptic technique using a needle over catheter method. The device provides an immediate airway opportunity for critically ill patients unable to maintain their own airway.

Although this article cannot provide a complete list of all new airway options, you will see that there are many new tools available to add to your airway arsenal. Spend some time test driving some of the new products available to EMS providers and see if they don't help you get up to speed on airway management issues in your area. ●