Ailyn, a paramedic, and Jacob, her EMT partner, are dispatched to a “difficulty breathing” at a residential address. They arrive with the first-responding engine company and find a 62-year-old male in respiratory failure secondary to exacerbation of congestive heart failure. While they prepare to start continuous positive airway pressure (CPAP), the patient suddenly goes into respiratory arrest.

“Time for you guys to ventilate, and I’ll prepare to intubate,” Ailyn tells Jacob and an EMT from the engine company as she palpates a rapid and weak carotid pulse. “He still has a pulse.”

Maintaining a patent BLS airway and securing an ALS airway via endotracheal intubation can be a dynamic and challenging endeavor, requiring coordinated efforts from multiple rescuers. As such, it’s advantageous to use methods and techniques that help you achieve your goal of effective airway maintenance and ventilation.

This month’s CE article offers 10 tips in a step-wise progression that spans the spectrum through BLS to ALS airway management and ventilation. It is our intent to move away from the more “traditional” airway and ventilation tips and offer suggestions drawn from current airway literature.

1 Place the patient in an optimal position to open the airway.

A patent upper airway is a critical component of effective ventilation. The more open an airway is, the lower the ventilation pressure and volume required for effective ventilation. Richard Levitan, one of the first emergency medicine physicians to use an airway camera and the author of more than 20 airway management research articles, asserts that the creation of a patent open airway is a three-step process:

- Place the patient in a proper position;
- Insert an oral or nasal airway;
- Lift the mandible and submandibular structures.  

Airway occlusion is worsened by flexion of the head and opening of the mouth. Thus, any maneuver used to open the airway should correct these issues. The head-tilt chin-lift works toward accomplishing this goal, and anecdotally most EMS providers say it does indeed work, most of the time.

That being said, we should know if there’s a position we can use to better open the airway. In fact, there...
are possibly two positions that will allow us to maximize the airway dimensions and ventilate with minimal pressures and volumes in patients without suspected cervical spine injury: the sniffing position and the head-elevated position.

The sniffing position is a two-part maneuver achieved by first placing padding under and raising the head in a supine patient so the external auditory meatus (ear canal) is on the same horizontal plane as the sternal notch, then extending the head at the atlanto-occipital joint (see Figure 1). This maneuver brings the oral, pharyngeal and laryngeal axes of the upper airway into better alignment, allowing for more laminar air flow and less resistance to ventilation.

There is an argument against the sniffing position that claims that atlanto-occipital extension pivots the base of the tongue and epiglottis against the posterior pharynx and promotes obstruction. The head-elevated position prevents this movement of the epiglottis. The head-elevated position closely mimics the sniffing position in that the obtunded patient is laid supine and positioned so their external auditory meatus lines up with the sternal notch (see Figure 2).

Unlike the sniffing position, the head is not extended, but left in such a position that the face is parallel to the surface on which the patient lies.

Achieving the head-elevated position often involves using padding under the head, as well as the upper shoulders. Thin patients may require padding under the head only, but obese patients will require a substantial “ramp” created under the shoulders. Do this by placing padding, commonly blankets, under the shoulders to elevate the head and ear canal to the sternal notch. It takes time, but
it is worth it.

There is debate over which position is better, and it’s advantageous to consider the use of both techniques if the need arises. Variations in head, neck and airway anatomy may predispose individual patients to one or the other position as optimal, and it’s better to have multiple airway maneuvers in your toolbox to vary your approach to individual airways.

Both the head-elevated and sniffing positions presume, of course, that there is no potential of cervical spine injury and need to keep the patient in a neutral inline position. If injury to the cervical spine is suspected, keep the neck in a neutral inline position and perform a jaw-thrust maneuver to open the airway.

**2 Use a BLS airway adjunct.**

BLS airway adjuncts should be utilized in every patient receiving positive-pressure ventilation unless absolute contraindications for their use are present. It is a rare patient on whom you cannot use an oropharyngeal or nasopharyngeal airway. Support of the tissues comprising and surrounding the airway depends on intact muscular tone and control. In an unconscious patient, decreased muscle tone allows the jaw and hyoid bone to displace posteriorly, resulting in posterior displacement of the tongue, which then occludes the oropharynx. A properly sized and placed OPA and/or NPA will displace the tongue and prevent it from becoming an airway obstruction; this allows for more effective ventilation at lower pressures and volumes. A properly sized OPA rests with the distal end in the hypopharynx while the phalange rests on the teeth.

The use of an NPA does not exclude the use of an OPA, or vice versa. In fact, using both devices at the same time may increase the likelihood of better opening the airway. If necessary, an OPA can be utilized with two NPAs (one in each nostril). Using two NPAs has actually been shown to be the most effective strategy to maintain a patent airway with simple adjuncts.

Before ever seeing a patient, plan your use of airway devices carefully. Ensure both your OPAs and NPAs are in locations that allow easy access and use both on scene and in the ambulance. Use of airway adjuncts during BVM ventilations should be as standard as the use of oxygen.

**3 Use a jaw-thrust maneuver when opening the airway.**

So you’ve positioned your patient and inserted a BLS airway adjunct. Is it really necessary to use an additional BLS airway maneuver such as the jaw-thrust to open the airway?

As stated previously, decreased muscle tone in the obtunded patient allows the jaw and hyoid bone to displace posteriorly, resulting in posterior displacement of the tongue, which then occludes the oropharynx. The jaw-thrust maneuver is an extremely effective way of lifting the jaw and hyoid, displacing them anteriorly, and lifting the tongue from the oropharynx, thereby preventing airway obstruction. It is probably more effective than the chin-lift maneuver employed in the “head-tilt chin-lift” mantra. Think of the jaw-thrust as creating an underbite, with the teeth of the mandible displaced anterior to the teeth of the maxilla. The jaw-thrust is highly effective when used with a BLS airway adjunct. In addition, it can be used in patients with suspected cervical spine injury whose cervical spines must be maintained in a neutral inline position.

**4 Use two-rescuer BVM and the thenar eminence technique to obtain a good mask seal.**

Obtaining an adequate mask seal on the patient’s face can be one of the more challenging components of airway maintenance and ventilation. One of the first things we can do to create a better mask seal is to get two large, experienced hands on the mask. Whenever possible, bag-mask ventilation should be performed by two rescuers, one to hold the mask seal with two hands and the other to squeeze the bag-mask device at the appropriate rate. The appropriate ventilation rate is the fewest ventilations per minute that maintain SpO2 and ETCO2 within normal ranges. Whenever possible, the less-experienced rescuer responsible for ventilation. In addition to using an OPA or NPA, a jaw-thrust maneuver should be used while holding the mask seal.

Regarding specific techniques for creating an effective mask seal, the thenar eminence (TE) technique has been shown to be more effective than the traditional “CE” technique recommended by the American Heart Association. It is also more comfortable and less tiring than the CE method. The thenar method is performed by the rescuer assuming the normal airway maintenance position at the top of the patient’s head. The mask is held by placing the thenar prominences on the body of the mask, parallel to each other, with the rescuer’s thumbs pointed caudally. The remaining four fingers are used to grasp the body and angle of the mandible to pull it forward into the mask (see Figure 3).

**5 Ventilate the patient using long inspiration times, with the smallest tidal volume required and as slow a rate as necessary to achieve optimal oxygenation.**

The goal during BVM ventilation is adequate oxygenation without gastric insufflation or the generation of unnecessarily high intrathoracic pressure. This is achieved by engaging in practices that avoid high airway pressures during BVM ventilation, such as optimal airway opening, longer inspiratory times, smaller
tidal volumes and ventilating at as low a rate as possible. The importance of keeping inspiratory pressures low cannot be overstated. Inspiratory pressures greater than 25 cm H₂O can force air into the esophagus and stomach. Air in the stomach (gastric insufflation) increases the risk of regurgitation and aspiration. It has been shown that rescuers who are inexperienced or under stress can easily and routinely exceed the 25 cm H₂O threshold and create potentially hazardous situations.⁵

It’s possible to limit the potential for high ventilation (inspiratory) pressures by placing a pressure manometer on your BVM each time one is used. High intrathoracic pressure is also a detriment to the critically ill patient, as it decreases venous return to the heart. Decreased venous return results in decreased preload. That in turn results in decreased stroke volume, decreased cardiac output and decreased blood pressure. So, overventilation in an already hemodynamically compromised patient can make them more hypotensive.

To avoid these complications, deliver ventilations slowly, over 1–2 seconds. Use as low of a tidal volume as needed to achieve normal chest rise and fall (typically about 5–7 mL/kg). Avoid unnecessarily high ventilation rates. If your patient has a pulse and pulse oximetry can be monitored, consider lowering your ventilation rate to one that achieves your goal of adequate oxygenation at as few breaths per minute as possible. In other words, if you can achieve acceptable oxygenation levels (94%–100% SpO₂) at 8 breaths a minute, there is no reason to ventilate at 12.³ Monitoring the pulse oximetry in patients in cardiac arrest or extreme low-flow states is not an option. In such patients, relying on a predetermined ventilation rate—for example, 12 times a minute for an adult—is prudent.

Another adjunct that can be used to gauge the effectiveness of ventilation is ETCO₂ monitoring. Use of a capnometer (a unit that gives a quantitative numerical readout) or capnograph (a unit that gives an ETCO₂ waveform) can be valuable in ventilated patients. Ventilation rate can be adjusted to maintain an ETCO₂ of acceptable levels, most often 35–45 mmHg.

6 Position the patient for direct laryngoscopy and endotracheal intubation.

You’ve been ventilating a patient with a BVM and decided that endotracheal intubation is necessary. Is there an optimal position for direct laryngoscopy, one that best lines up the airway anatomy and ensures the best likelihood of a good look at the glottic opening and a better likelihood of success on the first pass?

The answer is yes, the head-elevated position. As stated earlier, positioning the patient with their ear canal on the same horizontal plane as their sternal notch maximizes the dimensions of the upper airway and facilitates direct laryngoscopy by bringing the pharyngeal and laryngeal axes into alignment, increasing the exposure of the glottic opening.⁷ This position is especially useful in patients who are morbidly obese, though they will require considerable “ramping” via blankets beneath their shoulders and neck.⁶

The sniffing position takes the head-chest position one step further in that atlanto-occipital extension is provided to bring the oral axis into better alignment with the pharyngeal and laryngeal axes, in theory allowing for a better view of the glottic opening. Which technique is better for optimizing the view of the glottic opening during direct laryngoscopy remains to be proven, but both techniques offer a greater likelihood of a better glottic view than the simple head-tilt chin-lift often employed during direct laryngoscopy.

7 Consider the use of apneic oxygenation during endotracheal intubation.

You’ve positioned your patient in preparation for direct laryngoscopy and an attempt at endotracheal intubation. You know that during your intubation attempt you will not be ventilating your patient (they will be apneic), and as a result their SpO₂ could fall. We know that preoxygenation with 100% oxygen can provide us several minutes of adequate oxygenation. Is there a way we can extend the duration of apnea by preserving a patient’s SpO₂ effectively increasing the amount of time we have to perform laryngoscopy during an endotracheal intubation attempt?

Apneic oxygenation has been proven to extend the duration of apnea without hypoxia during rapid sequence intubation.² Consequently it is reasonable to assume, though certainly not certain, that the same situation exists in the obtunded patient in respiratory arrest.

Apneic oxygenation is achieved by placing a nasal cannula on a patient and delivering oxygen at 15 lpm during the intubation attempt. In an EMS scenario (e.g., in a patient’s home) with a single portable oxygen cylinder available, a nasal cannula can be placed on the patient but not attached to the oxygen cylinder. BVM ventilation, with the BVM attached to the oxygen cylinder, can be provided with oxygen flowing. When the rescuer performing laryngoscopy is ready, BVM ventilations are discontinued, the nasal cannula is quickly attached to the oxygen cylinder, and oxygen is administered at 15 lpm while direct laryngoscopy takes place. If multiple oxygen cylinders are available, the nasal cannula can be attached and oxygen flowing continuously during BVM ventilation and the intubation attempt.

8 Use external laryngeal manipulation to achieve the best view of the larynx possible.

We have learned in the past several years that routine cricoid pressure is not
Use an endotracheal tube introducer.

An endotracheal tube introducer, commonly called a bougie, is a simple and inexpensive way to increase the success rate of your endotracheal intubation attempts. It is most effective in situations where only the epiglottis is visible, not the vocal cords or arytenoids. In such cases the bougie is inserted past the epiglottis and into the trachea, where it comes into contact with the tracheal rings, producing a palpable vibration. If tracheal placement is achieved but for some reason the tracheal rings are not felt, the bougie will eventually come into contact with the carina, preventing further insertion and confirming tracheal placement.

How effective is the bougie at increasing endotracheal intubation success rates? In one study, the endotracheal intubation success rate improved from 66% with the use of stylet only to 96% with the use of a bougie. Many systems now consider it a best practice to have a bougie immediately available any time laryngoscopy is being performed. Any visualization of the arytenoids permits bougie placement and improves the likelihood of successful endotracheal intubation.

Confirm tube placement in the trachea using end-tidal carbon dioxide detection.

It has been shown that visualization of the endotracheal tube passing through the vocal cords is not a reliable method of confirming placement of an endotracheal tube into the trachea. In addition, auscultation of the chest for breath sounds, auscultation of the epigasstrom for the absence of air ventilation sounds in the stomach, and the observation of chest wall movement during ventilation are “notoriously inaccurate methods of confirming endotracheal tube placement.”

The standard for endotracheal tube placement confirmation, and the method recommended by the AHA, is continuous waveform capnography. Even in most cases of cardiac arrest (as long as effective chest compressions are provided), a waveform capnograph will prove both a quantitative and qualitative measure of end-tidal carbon dioxide (EtCO₂). Colorimetric EtCO₂ detectors are not as useful in cardiac arrest, as an EtCO₂ of at least 12 mmHg is required to produce color change, but they are nearly 100% accurate in confirming endotracheal tube placement in the trachea in patients not in cardiac arrest.

Case Conclusion

Jacob quickly works with one of the firefighters to place some blankets under the patient’s shoulders and back to achieve a head-elevated position. An OPA is inserted, and Jacob provides a jaw-thrust while using the thenar technique to create a good mask seal. Owen, an EMT from the engine company, provides ventilations with the BVM at 8 times per minute, taking 1.5 seconds to deliver each breath and administering just enough tidal volume to result in normal chest rise and fall. A pulse oximeter reveals an SpO₂ of 97% on 15 lpm of oxygen. A nasal cannula is placed on the patient’s face in preparation for endotracheal intubation. When Ailyn is ready, BVM ventilations are stopped, and the nasal cannula is hooked up to the oxygen cylinder, with oxygen flow continued at 15 lpm as Ailyn moves in for her intubation attempt. She uses a bimanual maneuver to optimize her view of the larynx, then places a bougie into the trachea. An endotracheal tube is inserted over the bougie, and tracheal placement confirmed with waveform capnography.

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