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Managing the airway
in acute care patients

Abstract: Understanding how to assess, secure, and manage an airway can save a patient's life in an emergent situation. This article briefly describes the basics of airway management in the acute care setting.

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On a Saturday morning at 2:00 a.m., the critical care nurse reports that Ms. S, an 83-year-old woman, has had an acute change in status. Upon arrival, the acute care NP observes that the patient is unresponsive with rapid, shallow breathing and is in significant distress. The critical care nurse has activated a code, but no one responds.

Being the sole provider covering the unit, other than an in-house hospitalist who is currently with another critical patient, what should be done next? Scope and standards of practice for an NP in the acute care setting include the management of a patient in respiratory distress.[1] Those who understand how to quickly assess, secure, and manage an airway can save a patient's life in an emergency.

Airway assessment

The NP must assess patients in respiratory distress quickly and in an organized manner to implement life-saving treatment and stabilize the patient before further decline occurs. When a patient experiences acute respiratory failure, the key objective is to facilitate adequate gas exchange by maintaining a patent airway.[2] The provider must simultaneously obtain a focused history, formulate differentials, and perform a focused physical exam that will allow him or her to diagnose

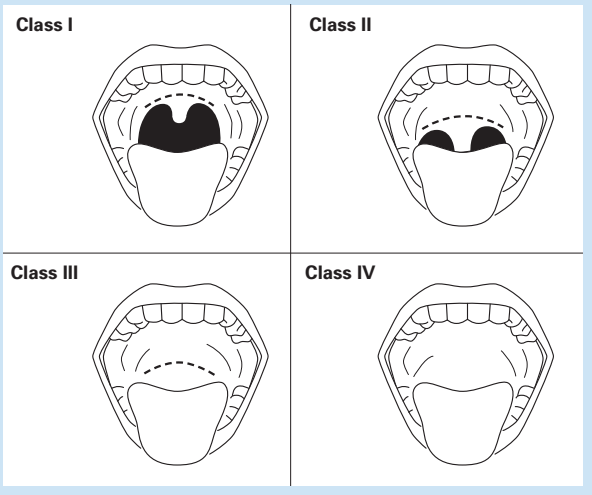
Keywords: airway basics, bag mask ventilation, direct laryngoscopy, nurse practitioner in acute care, video laryngoscopy

the problem and create a treatment plan. Of these, the formulation of differentials is crucial to guide the next steps in patient care.

Mallampati classification and Cormack-Lehane classification[4-6]

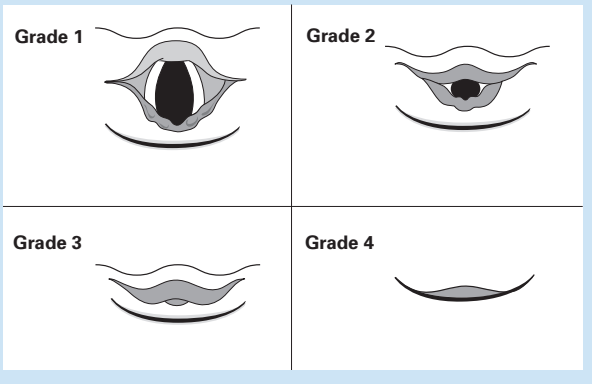
Mallampati classification:

Class I – Visualization of the soft palate, fauces, tonsillar pillars, and uvula
Class II – Visualization of the soft palate, fauces, and a portion of the uvula
Class III – Visualization of the soft palate and only the base of the uvula
Class IV – Only the hard palate is visible



Cormack-Lehane classification:

Grade 1 – Full visualization of the glottic aperture
Grade 2 – Partial visualization of the posterior glottic aperture
Grade 3 – Only the epiglottis visible (the glottis is not visible)
Grade 4 – Only the soft palate is visible



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Wolfson AB. *Harwood-Nuss Clinical Practice of Emergency Medicine*. 5th ed. Philadelphia, PA: Wolters Kluwer Health, 2010.

During initial assessment, airway patency, mental status, and vital signs should be evaluated. The provider should have an in-depth understanding about how to predict and prepare for a difficult airway.[2] The NP should look for anatomical deformities, stridor, snoring, copious secretions, food particulates, or other airway obstructions.[3] Nasal flaring, chest retractions, and tracheal deviation may also indicate more rapid respiratory decline.[2]

To assess the patient's mental status, any history of opioid use or sedatives administration should be considered. If history of such use exists, administering reversal agents could allow for avoidance of intubation. However, if the history is unclear, the airway needs to be secured and protected until a further workup is completed.

The Glasgow Coma Scale (GCS) provides a quick bedside tool for assessment of the level of consciousness.[2] The GCS evaluates the best eye-opening response, best verbal response, and best motor response. The highest score attainable is 15 and the lowest score is 3 (indicating no response). Should a patient have a GCS score of less than 8 paired with an unclear history of cause, the patient should be intubated for airway protection.[3]

Next, the provider should obtain a complete panel of vital signs, including respiratory rate, oxygen saturation, heart rate, and BP. Consider increased use of respiratory accessory muscles, tachypnea, or shock as a decline in status. It is important to remediate life-threatening disorders and to also treat the underlying cause.

Grading the airway

No single tool by itself effectively identifies a difficult airway; however, the use of multiple tools increases the predictive value.[4] It is important to employ several methods to assess an airway. Although not obtainable when the patient experiences an altered mental state, the Mallampati classification is one of the most common tools (see *Mallampati classification* and *Cormack-Lehane classification*).

A score of Mallampati I indicates the provider can see the soft palate, fauces, tonsillar pillars, and uvula. A score of Mallampati II indicates visibility of the soft palate, fauces, and a portion of the uvula. A score of Mallampati III indicates visibility of only the base of the uvula and the soft palate, whereas a score of Mallampati IV indicates visibility of only the hard palate. Mallampati scores of III and IV indicate the likelihood of a difficult intubation by way of direct laryngoscopy (DL).[4]

Some providers prefer the quick "3-3-2" rule to assess a difficult airway by measuring interincisor distance, or mouth opening, and the distance from the hyoid bone to the chin. If each distance is less than three fingers, a difficult airway may be present. Additionally, a measurement of less than two fingers from the thyroid notch to the floor of the mandible could indicate a difficult airway.[5]

The Cormack-Lehane classification is another tool frequently applied during DL and video laryngoscopy (VL), which uses different "grades" to indicate anatomical difficulties that may block airway securement.[6] Grade 1 indicates complete visualization of the entire glottic aperture; grade 2 refers to partially seen posterior glottic aperture; grade 3 indicates visibility of the epiglottis only; and grade 4 indicates visibility of only the soft palate.[6]

During the initial assessment, the NP should check for anatomical variations and obstructions, consider ways to adapt for any cervical spine injuries, and examine dentition. The patient's oxygen saturations must be given close attention relative to baseline. For most individuals, hypoxemia occurs when oxygen saturations fall to less than 90% to 92%, which can indicate the need for supplemental oxygen.[3]

Basic airway

The NP should use personal protective equipment as appropriate for all airway procedures. The initial step in airway management is to establish a patent airway to deliver the oxygen and ventilation a patient needs to survive. The NP should check for cervical spine injury before trying to open the airway. If initial exam indicates the possibility of cervical spine injury, alternatives (jaw thrust maneuver) should be considered. If cervical spine injury is ruled out, a simple head tilt-chin lift can open the airway and relieve obstruction.

Slight neck extension into a sniffing position can lift the tongue from the back of the throat and relieve obstruction, but overextension can make any obstruction worse. Elevating the mandible, or jaw thrust, is a technique used to open the airway when a cervical spine injury is suspected or if the head tilt-chin lift does not work. To perform a jaw thrust, the NP should place the fingers of both hands on the posterior portion of the mandible under the angles of the jaw and simultaneously with both hands, displace the jaw forward; if the lips are closed, gently push on the lower lip with the thumbs to open the mouth.[7]

Other adjuncts that help to open the airway and relieve obstruction include an oropharyngeal airway (OPA) as well as nasopharyngeal airway (NPA). An OPA should not be inserted if the patient's gag reflex is intact. The distance from the corner of the mouth to the earlobe needs to be measured to determine the proper sizes of an OPA. For an NPA, the distance from the tip of the nose to the earlobe should be measured. Sizes vary and devices are available for both children and adults.

Basic noninvasive oxygen delivery devices

Oxygen administration is the next step in treating patients in respiratory distress. This typically happens before an initial responder notifies the provider of worsening decline, however, appropriate attention should be given to the delivery method and device used for each patient. Common types of supplemental oxygen delivery devices include nasal cannula, high-flow nasal cannula, simple face mask, air entrainment or Venturi face mask, and reservoir face masks.[2,8-11]

The nasal cannula can effectively treat minimally hypoxemic patients with an intact mental status who breathe spontaneously and show no indications of respiratory distress. A low-flow nasal cannula system is comprised of two short cannulas inserted into the patient's nares. Oxygen within the system is delivered at 100%, but variations in minute ventilation, as well as low flow rates, mean the patient will receive a maximum of 40% to 50% Fio_2. The flow rate of oxygen through the nasal cannula can range from 0.5 L/minute to 5 L/minute. Higher flow rates frequently dry the nares and increase patient discomfort.[2]

For patients already experiencing respiratory demise, the face mask may be more uncomfortable than nasal cannula.

Patients with mild-to-moderate hypoxemic respiratory failure may require high-flow nasal cannula (HFNC).[8] HFNC is an open system in which 100% oxygen is delivered at flow rates up to 60 L/minute.[2,8] This device warms and humidifies the oxygen, which makes it more comfortable as compared with low-flow

nasal cannula.[9] Benefits of HFNC include reduction of anatomical "dead space" and provision of positive end-expiratory pressure (PEEP).[8] Alternatives to HFNC should be considered for patients with severe hypoxic respiratory failure.

Air entrainment masks, or Venturi face masks, can be applied to patients who experience mild-to-moderate respiratory failure. Air entrainment masks consist of a jet mixing device to combine room air with oxygen and a face mask that covers the nares and mouth.[11] Air entrainment masks deliver a predetermined and precise amount of Fio_2, ranging from 0.24 to 0.50 (24% to 50%). For patients already experiencing respiratory demise, the face mask may be more uncomfortable than nasal cannula.[2,11]

Reservoir face masks should be used for patients who experience severe respiratory failure as the provider evaluates them for life-saving treatments. One such reservoir system is the non-rebreather (NRB) face mask.[10] Reservoir face masks cover a patient's nares and mouth, and an attached bag holds 100% oxygen. The provider can adjust the flow of oxygen into the bag, and in emergent situations, he or she can set the flow to an NRB as high as 15 L/minute. The NRB mask has a valve that prevents the patient from inhaling room air and exhaled gases. A patient with a reservoir face mask could receive between 0.60 and 0.90 (60% to 90%) Fio_2.[10]

As compared with DL, the clearer view of the glottis allowed by VL has resulted in higher success rates in first-attempt intubations.

A reservoir face mask can bridge a severely hypoxic patient to therapies that improve oxygenation, such as invasive mechanical ventilation (IMV).[2,10] A reservoir face mask prior to bag mask ventilation (BMV) and emergent endotracheal intubation should be used for patients who require higher levels of oxygen, experience increased accessory muscle use, have lost consciousness, or may need emergency intubation. The NP should use a support device that delivers high concentrations of oxygen at flow rates appropriate to the need.

Advanced noninvasive oxygen delivery devices

Noninvasive positive pressure ventilation. NPs should consider using noninvasive positive pressure ventilation (NIPPV) to improve gas exchange and reduce the work of breathing for patients in severe respiratory distress.[12] A frequently used mode of NIPPV is bilevel positive airway pressure, which provides inspiratory pressure and expiratory pressure. The difference in the two pressures determines tidal volume and can affect minute ventilation.

Bilevel positive airway pressure can help patients in respiratory failure caused by exacerbations of chronic obstructive pulmonary disease or those who have cardiogenic pulmonary edema.[12] NIPPV provides mechanical ventilation without endotracheal intubation and can reduce intubation rates and in-hospital mortality in select patient populations.[12] However, NIPPV has been associated with complications such as gastric distension and facial and nasal lesions from mask seal and can also delay intubation.[2]

A proper mask seal is vital to providing the appropriate pressures needed to successfully ventilate the patient. If the patient cannot protect his or her airway due to loss of consciousness, emesis, gastric hemorrhage, or sedation, the patient should have an advanced airway inserted and be placed on IMV.[12] Both NIPPV and IMV are complex modes of oxygen delivery, and the provider must understand the mechanics and potential complications of each.

Bag mask ventilation. Proper BMV helps maintain essential gas exchange until an advanced airway can be obtained. In cases of severe respiratory distress, BMV can supply the appropriate oxygenation and ventilation to maintain vital organ function.[13] BMV can also increase mean airway pressures, particularly when a PEEP valve is attached.

For effective BMV to occur, the airway should be opened to ensure patency, and a tight seal with the mask should be established. Causes of an improper seal include anatomical deformities, facial trauma, or facial hair, and these may make BMV more difficult.[2] Additionally, patients with an intact mental status may become agitated during BMV.

BMV can be a difficult technique to master, and as such, should be practiced regularly with an expert mentor. A head tilt-chin lift or jaw thrust maneuver during BMV will improve gas exchange. As noted previously, only the jaw thrust maneuver should be performed, and forgo head tilt-chin lift if initial assessment indicates cervical spine injury.

The mask must cover the nose and the mouth and should not protrude past the chin.[7] If the NP is working

alone, the mask needs to be held in place with the "E-C clamp technique," in which the middle finger, ring finger, and pinky finger create an "E" under the patient's mandible, allowing the provider to lift the mandible to the mask. The index finger and thumb create a "C" shape to hold the mask in place.[7]

If working with another provider, the preferred "E-O technique," which is a variation of the "E-C clamp technique," should be used to create a better seal and to deliver more effective ventilation. The E-O technique resembles the E-C technique, but both the right and left hand of the first provider create an E-C shape. The two "Cs" are created by the right and left index finger and thumb joining together to hold the mask in place creating an "O" shape. The "E" is created by the right and left middle finger, ring finger, and pinky finger under the patient's mandible. The second provider delivers the ventilation while the first provider maintains the mask seal.[7]

The adequacy of BMV can be assessed by watching the chest rise. Adequate BMV can maintain a patient's vital organs until a definitive advanced airway is placed.[13] If the chest does not rise, the patient's head and the mask should be repositioned and the seal rechecked. If the chest still does not rise after mask repositioning and seal check, this may indicate an airway obstruction, and the provider should immediately begin emergency airway securement.[13]

Advanced airway: DL

DL is a technique for securing an airway using an instrument composed of a handle and blade to directly view the laryngeal inlet. This technique facilitates the placement of an endotracheal tube (ETT) beyond the vocal cords.[14] A rigid laryngoscope has either a Miller (straight) or Macintosh (curved) blade attachment. Typically, blade selection is based on operator preference.

Once the blade is inserted, the tongue should be swept from the providers' right to left to get a view of the airway. When using a Macintosh blade, the tip needs to be placed in the vallecula, which is the space between the base of the tongue and pharyngeal surface of the epiglottis. Next, the mandible is raised anteriorly to elevate the epiglottis, thus exposing the vocal cords. When using the Miller blade, the tip is placed directly under the epiglottis followed by raising the epiglottis to see the vocal cords.[3] Once the provider can see the vocal cords, the ETT is placed and connected to oxygen and bag ventilation.

Assess breath sounds and end-tidal capnography to validate proper placement. Many institutions use a color-changing device to check for carbon dioxide release; however, the gold standard is quantitative waveform capnography.[3] Many situations call for advanced airway techniques such as DL, and it is critical that the NP properly identify which clinical situations require DL with placement of ETT.

For patients with a predicted easy airway who require IMV, including those unable to maintain a patent airway or those experiencing difficulties in oxygenation and/or ventilation, DL is an appropriate technique to secure the airway. Patients who lack the inherent respiratory capacity to prevent or compensate for hypoxemia and/or hypercarbia (due to neuromuscular depression, trauma, or respiratory failure) will require DL with ETT placement and initiation of IMV.[15]

Additionally, patients who experience persistent seizures, evolving hepatic encephalopathy, evolving septic encephalopathy, or a GCS of less than 8 require ETT placement for airway protection and IMV initiation. Those who experience persistent hypoxemia and/or hypercarbia refractory to more basic modes of oxygen delivery or methods of NIPPV also require DL with ETT placement and IMV initiation.[14]

Difficult airway: VL

ETT placement using DL is a sophisticated process comprised of both psychomotor and cognitive abilities, so the NP must be highly skilled with validated competency of the procedure.[16] It is vital that the provider have the ability to identify characteristics of difficult airways, which can result in difficult intubations.

When a difficult airway has been identified, the use of VL is preferred. A miniaturized (typically fiberoptic) camera is located near the tip of the blade of the video laryngoscope. The camera facilitates intubation by using video to directly view the glottis.[17] A skilled provider can reduce the risk of life-threatening complications through the proper use of VL. In addition to the Mallampati classification and Cormack-Lehane classification, a quick way to identify a difficult airway is one in which at least one attempt at endotracheal intubation via DL has already failed. Once an initial intubation attempt fails, the provider should follow an established methodology to secure a safe airway.[18]

As compared with DL, the clearer view of the glottis allowed by VL has resulted in higher success rates

in first-attempt intubations. As such, providers should consider using VL as a first-line method when confronted with potential life-threatening complications, such as failed endotracheal intubation via DL (severe hypoxemia, cardiovascular collapse, airway injury, and esophageal intubation), which requires IMV.[17]

Laryngeal mask airway

Rescue maneuvers may be required when the provider is unable to effectively ventilate the patient using BMV or intubate a patient using normal strategies. The laryngeal mask airway (LMA) consists of a tube and an elliptical mask with a cuff.[2] Once inserted, the LMA, a supraglottic airway, fits behind the tongue on top of the glottis. Before insertion of an LMA, providers should check all connections to make sure the device is intact followed by lubricating the posterior side of the cuff. The cuff should be deflated at this point. (See *Key points for LMA insertion*.)

If no cervical spine injury is suspected, gentle flexing of the neck into sniffing position is advised. Using gentle pressure, the NP should insert the LMA into the mouth along the hard palate toward the hypopharynx until resistance is met; the LMA will ultimately rest above the glottis. The cuff should then be inflated and secured in place.[18] Placement can be confirmed with auscultation and/or capnography.

When BMV and intubation attempts have failed, the LMA can be placed quickly to provide necessary gas exchange. It is important to note that the LMA is only a temporary measure until a stable airway can be established.[2]

Key points for LMA insertion[18,21,22]

- Preoxygenate the patient with 100% oxygen prior to insertion.
- Choose the appropriate-sized LMA.
- Check the cuff for leaks and ensure the cuff is deflated.
- Apply a water-soluble lubricant to the posterior surface of the mask.
- Administer sedation to the patient prior to the procedure if appropriate.
- Gently flex the patient's neck into the sniffing position.
- Insert LMA using gentle pressure into the mouth along the hard palate toward hypopharynx.
- Once resistance is met, inflate the cuff and secure the LMA into place.
- Confirm correct placement (above the glottis) via auscultation and/or capnography.
- Newer LMA products incorporate a gel material in place of balloon cuff.
- The NP should be aware of which products are available for use in their institution.

Surgical options: Cricothyroidotomy and tracheotomy

In the event that BMV, intubation, and/or adequate oxygenation has failed, surgical methods may be required to prevent hypoxic brain damage or death. It is important to note that surgical options for securing the airway are to be performed by qualified physicians unless it is specified in the scope of practice for the NP; this varies by state and practice location.

In emergency cricothyroidotomy, a scalpel is used to incise the cricothyroid membrane just below the larynx followed by introducing a tracheal tube directly into the trachea.[19] When clinical conditions (such as severe oral or maxillofacial trauma) preclude conventional endotracheal intubation and the patient experiences unexpectedly difficult endotracheal intubation, a provider may need to resort to emergency surgical management of the airway.

Surgical or percutaneous tracheotomy is performed by a qualified provider after cricothyroidotomy once the patient is stabilized. Nonemergent tracheotomy is also favored for patients requiring prolonged IMV time, typically greater than 2 weeks.[10,20]

Conclusion

An NP's scope of responsibilities and standards of practice include management of patients in respiratory distress. The NP must have the knowledge and practical experience to assess, secure, and manage an airway. Effective BMV can maintain vital gas exchange until a definitive advanced airway can be secured; difficult airways may require VL.

In cases of failed endotracheal intubation via DL or VL or a failed rescue attempt with an LMA, surgical cricothyroidotomy performed by a qualified provider should be considered quickly to provide the patient with adequate gas exchange to maintain vital organ function. NP

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The authors and planners have disclosed no potential conflicts of interests, financial or otherwise.

DOI-10.1097/01.NPR.0000534937.35090.f1

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