CHAPTER 1

The Decision to Intubate

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INTRODUCTION

Airway management is constantly evolving. The emergence of new technology, principally the various methods of video laryngoscopy, our understanding of contributors to intubation difficulty, and a renewed focus on effective preoxygenation and cardiovascular stability during airway management are changing our fundamental decision-making to maximize patient safety and outcome. What has not changed, however, is the critical importance of the determination of whether a patient requires intubation and, if so, how urgently. The decision to intubate is the first step in emergency airway management and sets in motion a complex series of actions required of the clinician, before performing the actual intubation:

- Rapidly assess the patient's need and indication for intubation and the urgency of the situation.
- Determine the best method of airway management based on assessment of the patient's predicted anatomic and physiologic difficulty.
- Decide which pharmacologic agents are indicated, in what order, and in what doses.
- Prepare reoxygenation and rescue intubation plans in the event that the primary method is unsuccessful. Know in advance how to recognize when the primary airway intervention has failed or will inevitably fail, and clearly lay out the sequence of alternative (rescue) technique(s).

Clinicians responsible for emergency airway management must be proficient with the techniques and medications used for rapid sequence intubation (RSI), the preferred method for most emergency intubations, as well as alternative intubation strategies when induction and neuromuscular blockade are contraindicated. The entire repertoire of airway skills must be mastered, including bag-mask ventilation, video laryngoscopy, conventional (direct) laryngoscopy, flexible endoscopy, the use of extraglottic devices, adjunctive techniques such as use of an tracheal tube introducer (also known as the gum elastic bougie), and surgical airway techniques.

This chapter focuses on the decision to intubate. Subsequent chapters describe airway management decision-making, methods of ensuring oxygenation, techniques and devices for airway management, the pharmacology of RSI, and considerations for special clinical circumstances, including the prehospital environment and care of pediatric patients.

INDICATIONS FOR INTUBATION

The decision to intubate is based on three fundamental clinical assessments:

1. Is there a failure or impending failure of airway patency or protection?
2. Is there a failure or impending failure of ventilation or oxygenation?
3. Is the anticipated clinical course likely to require intubation?

The results of these three evaluations will lead to a correct decision to intubate or not to intubate in virtually all conceivable cases.

Is there a failure of airway patency or protection?

Without a patent airway and intact protective reflexes, adequate oxygenation and ventilation may be difficult or impossible and aspiration of gastric contents can occur. Both expose the patient to significant morbidity and mortality. The conscious, alert patient uses the musculature of the upper airway and various protective reflexes to maintain patency and to protect against aspiration of foreign substances, blood, gastric contents, or secretions. The patient's ability to phonate with a clear, unobstructed voice is strong evidence of airway patency, protection, and cerebral perfusion. In the severely ill or injured patient, such airway maintenance and protection mechanisms are often attenuated or lost. If the spontaneously breathing patient is not able to maintain a patent airway, an artificial airway may be established by the insertion of an oropharyngeal or nasopharyngeal airway. Although such devices may restore patency, they do not provide any protection against aspiration. Patients who are unable to maintain their own airway are also unable to protect it. Therefore, generally, any patient who requires the establishment of a patent airway or tolerates the presence of an artificial airway, also requires protection of that airway. The exception is when a patient has an immediately reversible cause of airway compromise (eg, opioid overdose) and reversal of the insult promptly restores the patient's ability to maintain an open, functioning airway. The need to protect the airway requires placement of a definitive airway (ie, a cuffed endotracheal tube), and devices that simply maintain, but do not protect, the airway, such as oropharyngeal or nasopharyngeal airways, are temporizing measures only. It was previously thought that the gag reflex was a reliable method of evaluating airway protective reflexes. In fact, this concept has never been subjected to adequate scientific scrutiny, and the absence of a gag reflex is neither sensitive nor specific as an indicator of loss of airway protective reflexes. The presence of a gag reflex has similarly not been demonstrated to ensure the presence of airway protection. In addition, testing the gag reflex in a supine, obtunded patient may result in vomiting and aspiration. Therefore, gag reflex testing has no clinical value, may be dangerous, and should not be used to assess the need for intubation.

Spontaneous or volitional swallowing is a better assessment of the patient's ability to protect the airway. Swallowing is a complex reflex that requires the patient to sense the presence of material in the posterior oropharynx and then execute a series of intricate and coordinated muscular actions to direct the secretions down past a covered airway into the esophagus. The finding of pooled secretions in the patient's posterior oropharynx indicates a potential failure of these protective mechanisms, and hence a failure of airway protection. A common clinical error is to assume that spontaneous breathing is proof that protective airway mechanisms are preserved. Although spontaneous ventilation may be adequate, the patient may be sufficiently obtunded to be at serious risk of aspiration.

Is there a failure of ventilation or oxygenation?

Stated simply, gas exchange is required for vital organ function. Even brief periods of hypoxia should be avoided, whenever possible. If the patient is unable to ventilate sufficiently, or if adequate oxygenation cannot be achieved despite the use of supplemental oxygen, then intubation is indicated. In such cases, intubation is performed to facilitate ventilation and oxygenation rather than to establish or protect the airway. An example is the patient with status asthmaticus, for whom bronchospasm and fatigue lead to ventilatory failure and hypoxemia, heralding respiratory arrest and death. Airway intervention is indicated when it is determined that the patient will not respond sufficiently to treatment to reverse these cascading events. Similarly, although the patient with severe acute respiratory distress syndrome may be maintaining and protecting the airway, he or she may have progressive oxygenation failure and supervening fatigue that can be managed only with tracheal intubation and positive-pressure ventilation. Unless ventilatory or oxygenation failure is resulting from a rapidly reversible cause, such as opioid overdose, or a condition known to be successfully managed with noninvasive ventilation (eg, bi-level positive airway pressure [Bi-PAP] for acute pulmonary edema), intubation is required. Even then, the clinician must be vigilant and constantly reassess the patient's condition, and if there is not an early and clear trajectory of improvement, intubation is indicated.

What is the anticipated clinical course?

Most patients who require emergency intubation have one or more of the previously discussed indications: failure of airway patency airway protection, oxygenation, or ventilation. However, there is

a large and important group for whom intubation is indicated, even though there are no immediate fundamental failures at the time of evaluation. These are the patients for whom intubation is likely or inevitable because their conditions are predicted to deteriorate from dynamic and progressive changes related to the presenting pathophysiology or because the work of breathing will become overwhelming in the face of catastrophic illness or injury. For example, consider the patient who presents with a stab wound to Zone II of the anterior neck and a visible hematoma. At presentation, the patient may have perfectly adequate airway maintenance and protection and be ventilating and oxygenating well. The hematoma, however, provides clear evidence of significant vascular injury. Ongoing bleeding may be clinically occult because the blood often tracks down the tissue planes of the neck rather than demonstrating visible external expansion of the hematoma. Furthermore, the anatomical distortion caused by the enlarging internal hematoma may well thwart a variety of airway management techniques that would have been successful if undertaken earlier. The patient inexorably progresses from awake and alert with a patent airway to a state in which the airway becomes obstructed, often quite suddenly, and the anatomy is so distorted that airway management is difficult or impossible.

Similarly, an agitated polytrauma patient who presents with an open femur fracture, unstable pelvis, and hypotension may require intubation even though there may be no immediate threat to his airway. Intubation is indicated as part of the safe management of the constellation of injuries. The reason becomes clear when one examines the patient's anticipated clinical course. The hypotension mandates resuscitation and evaluation for the source of the blood loss, including abdominopelvic computed tomography (CT) scan. Unstable pelvic fractures with hypotension require immobilization and likely embolization of bleeding vessels. Open long bone fractures require aggressive pain control and inevitable operative intervention. If chest injury is suspected, chest tubes may be needed to treat hemopneumothorax or in preparation for positive-pressure ventilation during surgery. Combative behavior confounds efforts to maintain spine precautions and requires pharmacologic restraint and evaluation by head CT scan. Throughout all of this, the patient's shock state causes inadequate tissue perfusion and increasing metabolic debt. This debt significantly affects the muscles of respiration, and progressive respiratory fatigue and failure often supervene. With the patient's ultimate destination certain to be the operating room or the intensive care unit (ICU), and the need for complex and potentially painful procedures and diagnostic evaluations, which may require extended periods of time outside the resuscitation suite, this patient is best served by early intubation. In addition, intubation improves tissue oxygenation during shock and helps reduce the rising metabolic debt burden.

Sometimes, the anticipated clinical course may necessitate intubation because the patient will be exposed to a period of increased risk on account of patient transport, a medical procedure, or diagnostic imaging. For example, the patient with multiple injuries who appears relatively stable might be appropriately managed without intubation while geographically located in the emergency department (ED). However, if that same patient requires CT scans, angiography, or any other prolonged diagnostic procedure, it may be more appropriate to intubate the patient before allowing him or her to leave the ED so that an airway crisis will not ensue in the radiology suite, where recognition may be delayed, and response may not be optimal. Similarly, if such a patient is to be transferred from one hospital to another, airway management may be indicated based on the increased risk to the patient during that transfer.

Not every trauma patient or every patient with a serious medical disorder requires intubation. However, in general, it is better to err on the side of performing an intubation that might not, in retrospect, have been required, than to delay intubation, thus exposing the patient to the risk of serious deterioration from aspiration or hypoxia.

APPROACH TO THE PATIENT

When evaluating a patient for emergency airway management, the first assessment should be of the patency and adequacy of the airway. In many cases, the adequacy of the airway is confirmed by having the patient speak. Ask questions such as "What is your name?" or "Do you know where you are?" The responses provide information about both the airway and the patient's neurologic status. A normal voice (as opposed to a muffled or distorted voice), the ability to inhale and exhale in the

modulated manner required for speech, and the ability to comprehend the question and follow instructions are strong evidence of adequate upper airway function. Although such an evaluation should not be taken as proof that the upper airway is definitively secure, it is strongly suggestive that the airway is adequate *at that moment*. More importantly, the inability of the patient to phonate properly; inability to sense and swallow secretions; or the presence of stridor, dyspnea, or altered mental status precluding responses to questioning should prompt a detailed assessment of the adequacy of airway protection and patency (see **Box 1.1**). After assessing verbal response to questions, conduct a more detailed examination of the mouth and oropharynx. Examine the mouth for bleeding, swelling of the tongue or uvula, abnormalities of the oropharynx (eg, peritonsillar abscess), or any other abnormalities that might interfere with the unimpeded passage of air through the mouth and oropharynx. Examine the mandible and central face for structural integrity. Examination of the anterior neck requires both visual inspection for deformity, asymmetry, or abnormality and palpation of the anterior neck, including the larynx and trachea. During palpation, assess carefully for the presence of subcutaneous air. This is identified by a crackling feeling on compression of the subcutaneous tissues of the neck, much as if a sheet of wrinkled tissue paper were lying immediately beneath the skin. The presence of subcutaneous air indicates disruption of an air-filled passage, often the airway itself, especially in the setting of blunt or penetrating chest or neck trauma. Subcutaneous air in the neck also can be caused by pulmonary injury, esophageal rupture, or, rarely, gas-forming infection. Although these latter two conditions are not immediately threatening to the airway, patients may nevertheless rapidly deteriorate, requiring subsequent airway management. In the setting of blunt anterior neck trauma, assess the larynx for pain on motion. Move the larynx from side to side, assessing for "laryngeal crepitus," indicating normal contact of the airway with the air-filled upper esophagus. Absence of crepitus may be caused by edema between the larynx and the upper esophagus.

After inspecting and palpating the upper airway, note the patient's respiratory pattern. The presence of inspiratory stridor, however slight, indicates significant upper airway obstruction. Lower airway obstruction, occurring beyond the level of the glottis, more often produces expiratory stridor. The volume and pitch of stridor are related to the velocity and turbulence of ventilatory airflow. Most often, stridor is audible without a stethoscope. Auscultation of the neck with a stethoscope can reveal subclinical stridor that may also indicate potential airway compromise. Stridor is a late sign, especially in adult patients, who have large-diameter airways, and significant airway compromise may be present before stridor is evident. When evaluating the respiratory pattern, observe the chest through several respiratory cycles, looking for normal symmetrical, concordant chest movement. In cases where there is significant injury, paradoxical movement of a flail segment of the chest may be observed. If spinal cord injury has impaired intercostal muscle functioning, diaphragmatic breathing may be present. In this form of breathing, there is little movement of the chest wall, and inspiration is evidenced by an increase in abdominal volume caused by descent of the diaphragm. Auscultate the chest to assess the adequacy of air exchange. Decreased breath sounds may indicate pneumothorax, hemothorax, pleural effusion, emphysema, or other pulmonary pathology.

The assessment of ventilation and oxygenation is a clinical one. Arterial blood gas determination provides little additional information as to whether intubation is necessary and may be misleading. The patient's mentation, degree of fatigue, and severity of concomitant injuries

BOX 1.1 Four Key Signs of Upper Airway Obstruction

- Muffled, hoarseness or "hot potato" voice (as though the patient is speaking with a mouthful of hot food)
- Inability to swallow secretions, because of either pain or obstruction
- Stridor
- Dyspnea

The first two signs do not necessarily herald imminent total upper airway obstruction; stridor, if new or progressive, usually does, and dyspnea is a compelling symptom.

or comorbid medical conditions is more important than isolated or even serial determinations of arterial oxygen or carbon dioxide (CO_2) tension. Oxygen saturation is monitored continuously by pulse oximetry, so arterial blood gases rarely are indicated for the purpose of determining arterial oxygen tension. In certain circumstances, oxygen saturation monitoring is unreliable because of poor peripheral perfusion, and arterial blood gases may then be required to assess oxygenation or to provide a correlation with pulse oximetry measurements. Waveform capnography may be used to assess changes in the patient's ability to ventilate adequately, and the measurement of arterial CO_2 tension contributes little additional useful information, although often a single arterial blood gas measurement is used to provide a correlation baseline with end-tidal CO_2 readings. A venous or arterial blood gas can provide a good general snapshot of the patient's acid-base status and baseline ventilation, but assessment of overall ventilation remains a clinical task, requiring evaluation of the patient's overall status and perceived trajectory. In patients with obstructive lung disease, such as asthma or chronic obstructive pulmonary disease (COPD), intubation may be required in the face of relatively low CO_2 tensions if the patient is becoming fatigued. Other times, high CO_2 tensions may be managed successfully with noninvasive positive-pressure ventilation instead of intubation if the patient is showing clinical signs of improvement.

Finally, after assessment of the upper airway and the patient's ventilatory status, including pulse oximetry, capnography (if used), and mentation, consider the patient's anticipated clinical course. If the patient's condition is such that intubation is inevitable and a series of interventions are required, early intubation is preferable. Similarly, if the patient has a condition that is at risk of worsening over time, especially if it is likely to compromise the airway itself, early airway management is indicated. The same consideration applies to patients who require interfacility transfer by air or ground or a prolonged procedure in an area with diminished resuscitation capability. Intubation before transfer is preferable to a difficult, uncontrolled intubation in an austere environment after the condition has worsened. In all circumstances, the decision to intubate should be given precedence. If doubt exists as to whether the patient requires intubation, err on the side of intubating the patient. It is preferable to intubate the patient and ensure the integrity of the airway than to leave the patient without a secure airway and have a preventable crisis occur.

EVIDENCE

Are there reliable indicators of the need to intubate?

The clinician's determination regarding the need for intubation is based on the clinical scenario, pathophysiology, bedside airway assessment, and likelihood of deterioration. Some measurable data and patient characteristics can be helpful, whereas others are largely folklore. First, the gag reflex continues to be taught, in some settings, as a key determinant in assessing the adequacy of airway protection or the need for intubation, yet the literature does not support this claim. The patient's Glasgow Coma Scale is a better predictor of airway protection and his or her aspiration risk in overdose.[1] Inspiratory stridor, when seen in adults, is particularly ominous and often mandates intubation. Although there is no absolute cutoff for oxygen saturation or CO_2 that dictates intubation, a saturation that cannot be sustained above 80%, a RR >30 or a CO_2 >100 has strong associations with intubation. Moreover, many conditions can often be managed without definitive airway management even when the patient seems, initially, to be in severe respiratory distress. COPD and acute pulmonary edema are uncommon causes of ED intubation and can typically be managed with medical therapy and noninvasive positive-pressure ventilation.[2]

Are there reliable predictors of the need for intubation in patients with known or suspected COVID-19?

Patients with COVID-19 can be managed with a variety of supportive strategies ranging from ambient pressure supplemental oxygen to high-flow nasal oxygen (HFNO) to tracheal intubation depending on the severity of hypoxemic respiratory failure. For patients treated with HFNO, a ROX index reliably predicts the likelihood of intubation. The ROX index is the ratio of Spo_2/Fio_2 to respiratory rate. A ROX index >4.88 indicates a low risk of intubation whereas an index <3.85 indicates a high rate of failure and eventual need for intubation.[3,4]

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