Difficult airway management

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Airway management is unequivocally the most important responsibility of the emergency physician. No matter how prepared for the task, no matter what technologies are utilized, there will be cases that are difficult.

The most important part of success in the management of a difficult airway is preparation. When the patient is encountered, it is too late to check whether appropriate equipment is available, whether a rescue plan has been in place, and what alternative strategies are available for an immediate response.

The following article will review the principles of airway management with an emphasis upon preparation, strategies for preventing or avoiding difficulties, and recommended technical details that hopefully will encourage the reader to be more prepared and technically skillful in practice.

(Intern Emerg Med 2006; 1 (2): 139-147)

Key words: **active airway management, airway, airway rescue, cricothyrotomy, difficult airway, tracheal intubation**

There are an almost an infinite number of emergencies that can be encountered in a busy emergency department. But there are only a finite number of pathways to the demise of the patient, and of these, the airway is the most important.

Not only can it be technically demanding, it requires great experience to judge correctly when active airway management is in order, and it is one of the places in medicine where the hard and fast rules must be broken almost as often as they are observed.

We shall attempt in this paper to proffer some rules for active airway management, present difficult cases and discuss technical intubation options, present protocols for the technical responsibilities, and discuss some personal style preferences.

There are few more terrifying situations than the patient who is in severe respiratory distress. Hypoxia induces great fear in patients in most situations, the only exception being where it is accompanied by hypercarbia. Since this latter is often experienced in divers, it has led to many hypoxic arrests underwater and is described as CO_2 narcosis. It is less frequently encountered in clinical emergency medicine practice. Exceptions are patients with acute superimposed upon chronic respiratory failure, for example the patient with chronic emphysema. These patients are functioning from a chronic hypoxic drive, and often have higher than normal levels of carbon dioxide. They thus become insensitive to elevated pCO_2 levels, and if given high flow oxygen therapy, may look pinker, and breathe with less difficulty; only to suddenly be found in respiratory and cardiac arrest. Moreover, their somnolence often leads to obstructive combative behavior when one attempts to intubate them. But usually, the patient who is acutely hypoxic, has a lowered pCO_2 and is not only agitated, but is also combative, disoriented, and appears intoxicated rather than hypoxic. It is always prudent to make sure that hypoxia is not present before assuming that a patient is out of control, drunk or drugged. But the terror does not exclusively belong to the patient; the emergency physician is also frightened because of the realization that there are only minutes to intervene before the patient is permanently brain damaged or dead. It is for this reason that the ABCs of resuscitation must always start with adequate management of the airway[1].

The great difficulty of airway management is that there are few easily recognizable situations that mandate immediate active airway management. In fact, most of these are either not airway problems at all, or are situations where a patient has failed to respond to other medical therapies. The most common answer given when asked which patient always needs active airway management is respiratory arrest. But, unfortunately, even when one is standing at the patient's bedside, it is often impossible to notice that the patient has stopped breathing, and if one comes upon a patient who is not breathing, if one waits the necessary time to ascertain that there are no respirations, and not just slow breathing or a breathing pause, one may have waited too long to benefit the patient. In fact, what usually triggers awareness of respiratory arrest is cardiac arrest: the patient is pulseless and unconscious. Unless one comes

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across a patient with a syringe and needle still in a vein, who is comatose or not breathing secondary to a drug overdose, it is very hard to conclude that the patient is in respiratory arrest. Even in cardiac arrest, if one arrives early upon the arrested patient who is in ventricular fibrillation, the correct and best response is defibrillation. If successful, the patient may continue or resume spontaneous respirations, and not need to be intubated. Or in the case of the drug abuser referred to above, the patient may respond to an opiate antagonist, and not need immediate active airway management.

We therefore suggest the following mandatory indications for active airway management, realizing that even these may be controversial (Table 1). In accepting these indications, there may well be exceptions depending not only on patient variations, but also because of conditions driven by expertise, availability of equipment, personnel, or special circumstances such as a disaster scene.

The patient with severe multiple facial injuries may not need intubation at all should the injuries have been confined to the face, not accompanied by a loss of consciousness, and the patient is able to sit upright and handle or expectorate secretions.

Case 1

A 39-year-old man was thrown into a barbed wire fence post by his horse. He had no loss of consciousness, but did strike his face on a tree branch. Despite multiple facial, arm and truncal lacerations, he managed to ride his horse about five miles to his truck, and then drive himself to the emergency department. On his initial examination, he had the ability to expectorate the bleeding into his mouth, and while his face was clearly deformed with laxity of both sides of the maxilla, and with signs of dried nasal hemorrhage, he was in no respiratory distress. He had eaten just prior to leaving on his horseback ride.

Table 1. Mandatory airway management.

Trauma
Massive facial injuries
Head injury with Glasgow Coma Score < 8
Penetrating injury to the cranial vault
Missile penetrating injury to the neck
Blunt injury to the neck with expanding hematoma or alteration of the voice
Bilateral missile penetrating injuries of the thorax
Multisystem trauma with persistent severe shock
Nontrauma
Cardiac arrest
Respiratory arrest
Epiglottitis
Status epilepticus
Severe shock
Severe hypoxia
Cerebral herniation syndromes

Discussion

It was deemed more prudent to repair his skin lacerations in the emergency department, and after obtaining adequate imaging studies, transfer him to the operating theatre after his stomach had emptied, for repair of his LeFort III injuries on the right, and LeFort II on the left. He was intubated awake in the operating room, and this via local anesthesia to the mouth and trachea, sedation with midazolam, and oral intubation.

For the patient whose facial injuries are accompanied by head injury, or who is in respiratory distress, or unable to handle secretions, or in those patients whose other injuries preclude the upright position (e.g. multiple trauma induced by an auto crash with blunt trauma to the neck, chest and abdomen) the mandatory indication for intubation becomes operative[2].

While some of these patients are capable of being managed by rapid sequence intubation (RSI) if there is adequate suction (often requires more than one suction unit) it is wise to prepare for surgical airway intervention, and we would not question a decision to proceed immediately to the performance of a surgical airway. If the mandible is broken, it often makes oral intubation much easier since the tongue can be lifted with a towel clip and it will enable direct visualization of the glottis.

The next mandatory indication is serious head injury with a Glasgow Coma Score (GCS) of ≤ 8. This too needs judgment since it is also dependent upon when the patient is seen, what the emergency medical service system permits in airway management, when the emergency physician or trauma surgeon see the patient, and what drugs or alcohol consumption has occurred. The GCS was not supposed to be applied originally until after consumed alcohol had been metabolized, but it has become routine to not wait for this to occur. Assuming there is *bona fide* head injury, and the GCS is ≤ 8, there has been evidence that these patients will benefit from early intubation. Even though the patient may be breathing spontaneously, it is worthwhile to avoid hyperventilation to the point of hypocarbia, as well as to try to treat any traumatic cerebral edema that is developing. We believe that RSI is indicated for these patients, and that it is safe so long as the intubator avoids hyperextension, hyperflexion and hyperdistraction of the patient's neck[3-5] (see below for more detailed discussion of RSI).

Early in the 70's in Belfast when the civil war was becoming violent, it was observed that if one waited for a patient, with a penetrating gunshot wound of the cranium, to lose consciousness; there was 100% mortality.

If, however, the patient was intubated before loss of consciousness, and if intracranial pressure could be maintained with minimal elevation, then there was approximately a 30% survival with good cerebral function[6]. We therefore believe that once it has been established that there is penetration of the cerebral vault (pneumocranium, or signs of brain exiting the cranial wounds) the patient should immediately have an RSI intubation. Any patient who is stabbed through the cranium should be considered for intubation depending on the stabbing implement, and how far it entered the skull, and we would not argue with anyone who also felt these patients should have a mandatory RSI.

Similarly, the patient with a missile penetration to the neck can be predicted to develop swelling over the next few hours. It is unlikely that any facility has the manpower in personnel to station someone at the patient's bedside, and watch for impending respiratory distress. We realize that not all such patients will develop enough edema to put them into respiratory distress or interfere with ventilation, but since we cannot predict the future, we feel it only prudent to intubate all these patients, while the anatomy is still not obscured by hematoma or edema especially since these patients will need a variety of imaging studies during which they cannot receive optimal monitoring, nor rapid care. Most will also be undergoing surgery that would require intubation in any event.

The patient with blunt injury to the neck will have a mandatory need for intubation if there is an expanding hematoma in the neck, or any alteration in voice. Some times it is possible to avoid intubation if the patient can be taken immediately to the appropriate imaging studies, and have immediate laryngoscopy, but in most patients, these studies will not be obtained rapidly, nor will there be rapid acquisition of otolaryngologic consultation. Therefore we again feel it only prudent to look upon these indications as mandatory, and attempt to intubate the patient before edema can distort the anatomy[7-9].

Bilateral missile penetration of the thorax is a difficult problem since its management is dependent upon not only the patient's condition, but also the number of personnel available to participate in the care. Every effort should be made to decompress the chest bilaterally prior to intubating the patient.

Case 2

A young man, who appeared to be in his late twenties, was dropped in front of the emergency department by unknown persons. He was responsive only to painful stimuli and could give no history. He appeared to have multiple stab wounds and gunshot wounds of chest and abdomen. He had gasping respiration, and was coughing bright red blood. He was immediately brought into the trauma room and disrobed. There were stab wounds to both sides of the thorax and abdomen, and a bullet hole laterally in both sides of the chest.

The breath sounds were diminished but present bilaterally, and the pulse was weak and thready at 130 b/min. No blood pressure was obtained.

Discussion

This patient needs not only intubation for a number of reasons, but also chest decompression. It is not clear upon which side the first thoracostomy should be performed, nor should one waste any time in trying to obtain imaging studies to help in the decision[10]. If there is only a single physician to manage this patient along with nurses and perhaps paramedics, the first procedure by the physician should be a thoracostomy. This is one situation in which intubation of the trachea prior to decompression of the thorax could convert an otherwise simple pneumothorax into a tension pneumothorax and quickly cause the patient to arrest. While the rest of the team start intravenous lines, and set up to intubate the patient, a thoracostomy should be performed. Unless there are some helpful physical findings, such as absent breath sounds on one side, or bullet penetration only on one side, it does not matter which side to do first. We suggest starting on whichever side you happen to be standing, and can even reach across the chest to insert a needle thoracostomy on the opposite side. After immediate needle decompression to relieve a possible tension pneumothorax, a more formal tube thoracostomy should be performed.

As you can see from Table 1, the majority of the mandatory indications are traumatic. It is curious that there are not more nontraumatic indications, but these all include a variety of situations in which the patient should immediately be intubated should there fail to be an immediate response to therapy.

The generic reasons are: first to take control of an airway that if not presently compromised, will be as soon as traumatic edema forms, and second, to relieve the patient of the massive work of respiration. Thus any condition that bodes a promise of anatomical distortion should be an indication for immediate intubation. If one awaits airway compromise, one will not have the luxury of many different techniques, but will be flailing in the struggle to save the compromised patient[11].

Even though most physicians would accept the list of nontraumatic conditions as given, they too represent conditions that might respond to therapy and not always need mandatory management. For example, everyone has certainly seen patients with sudden ventricular fibrillation who respond immediately to defibrillation and who will not need to be intubated. Likewise, patients in respiratory arrest can sometimes be immediately reversed with an agent such as naloxone or flumazenil,

and will not require intubation. Most patients in persistent *status epilepticus* will require paralysis and intubation, but many can have their seizure activity stopped without such control. The one place where we always need to intubate is the patient whose hypoxia can not easily be reversed, and who needs help in the work of breathing. Moreover, any patient with increased intracranial pressure will benefit from intubation and controlled ventilation[12].

Adult epiglottitis also falls into this category of problem. Because the diameter of the adult trachea is large, not every adult with epiglottitis will require intubation, and early in the course of the disease, the patient may well have a noncompromised airway. It is curiously psychologically difficult for the emergency physician to actively intubate those patients who are early in their deterioration, since it almost always means sedation or anesthesia. But to wait for the patient's clinical status to deteriorate is unwise. It will be more difficult to manage the airway, and the availability of a tracheostomy tray, or an intubation set at the bedside does not mean that one will be able to use them appropriately when called upon to do so. This is one place in emergency medicine where the conservative approach is to actively manage the airway before the patient is in trouble. We intubate any patient whose respiratory rate is rising, who is unable to handle secretions, who is becoming confused, who cannot talk, or whose color is bad. We would also intubate on a mandatory basis, any child with epiglottitis. Fortunately with the *Haemophilus influenzae* vaccine, this has now become a very rare disease[13].

It is not readily appreciated by most practitioners how much work is expended in breathing by patients when there is abdominal distention or traumatic reasons for pulmonary shunting, e.g. pulmonary contusion, ruptured diaphragm, pneumothorax, or hemothorax[14]. Moreover, in the presence of painful injuries, patients may not be able to ventilate normally due to efforts to splint the painful respiration.

One must be aware of the conditions that cause great metabolic demands upon the patient, and multiple system trauma is a very common case. Even if the patient does not have, or appear to have pulmonary injury, if there is significant intra-abdominal pathology, the patient will benefit from having the airway actively managed.

There are a number of relative indications (Table 2) for active airway management, and most of these involve patients who deteriorate, or who fail to respond to treatment. Some of these decisions will be helped by laboratory determinations, such as abnormal arterial blood gases, but one must always rely on clinical judgment, rather than laboratory results when deciding when to intubate a patient.

The quickest method to assess the patient's airway is a rapid inspection. Color is a quick clue to ventilatory inadequacy, and even the patient who has a blue hue on the basis of methemoglobinemia will benefit from this inspection. In this case of artificial cyanosis, the patient will usually not look as ill as one would expect if the blueness were due to ventilatory failure. Fortunately this condition is rare, and when one sees cyanosis, one should be alerted that definitive airway management might be necessary. When the color is good, but the patient has labored respirations, one must avoid the temptation to conclude that the patient is hyperventilating from hysteria. More than one patient has been given a paper bag to breathe into when actually suffering from severe metabolic acidosis, or hypoxia from a massive pulmonary embolism. It is safest, wisest, and most prudent to overestimate the hysterical patient as someone who is sick. If the patient has any retractions, be they intercostal, supraclavicular, or if the patient appears to be fighting and using all thoracic musculature to obtain air, the patient is in deep trouble.

Auscultation may be misleading, but even in a noisy emergency department can be very informative. If breath sounds are absent, and the patient does not have the physical appearance of severe emphysema then one must conclude the patient has a pneumothorax, and probably a tension pneumothorax. It is rare for this to be a bilateral problem so if breath sounds are absent bilaterally, consider severe asthma with maximum air trapping and bronchospasm. If the patient has absent breath sounds on only one side, and exhibits the severe air hunger described above, one will not have time for the luxury of

Table 2. Relative indications for active airway management.

Trauma
Upper airway obstruction
Injuries impairing ventilation
Flail chest with increasing respiratory rate or deteriorating blood gases
One or more rib fractures in patients requiring a ventilator or a general anesthetic
Patients with a bilateral pneumothorax
Patients with an expanding hemothorax not responding to thoracostomy
Severe hypovolemic shock
Cardiogenic pulmonary edema not responding to therapy
Nontrauma
Noncardiogenic pulmonary edema
Asthma with a quiet chest and slowing respirations
COPD not responding to low flow oxygen
Pneumonia with failing ventilation
Massive pulmonary embolus
Poisoned patient requiring gastric lavage but without gag reflex
Altered level of consciousness and inability to protect the airway
Severe shock of any origin
Severe anaphylaxis
Ruptured aneurysm

COPD, chronic obstructive pulmonary disease.

a diagnostic chest X-ray study, but should immediately perform a thoracostomy on the affected side. Do not waste time trying to feel for a deviated trachea, since this is a very difficult physical finding to confirm.

Other findings from auscultation can be very helpful in distinguishing between upper and lower airway obstruction, but wheezing can be very misleading since not all wheezing is asthma, i.e. small airway obstruction. It may represent foreign body, or cardiac failure. One must quickly obtain some history, and place the patient in the proper context; e.g. 65-year-old patient who is wheezing for the first time probably has pulmonary edema, rather than bronchial asthma.

For most nontraumatic conditions that require active airway management, one must decide whether the patient merely needs oxygen supplementation while commencing appropriate therapy to relieve the acute respiratory failure, or whether more active invasive procedures are necessary. In the adult, this is usually quickly apparent except for the patient with chronic respiratory failure, with superimposition of an acute failure. This particular crisis should be tested with low flow oxygen, while one is assessing the patient's ability to mentate and to cough. If the patient cannot be aroused easily, and if the patient cannot cough, one must assume that the patient has achieved a dangerous level of hypoxia and CO_2 narcosis that requires immediate intubation. In this instance, it is certainly a waste of time to acquire blood gases.

For the patient who needs rapid airway management, one must decide which position is best tolerated, and try to pick a form of airway management that fits this need. For example, the failing asthmatic, the patient in pulmonary edema, and the adult with epiglottitis often cannot tolerate a supine position. These patients are more easily intubated in a sitting position, using a nasotracheal tube in the case of an epiglottitis, our preference is to anesthetize the neck with lidocaine prior to attempting the intubation, so that if laryngospasm occurs, the patient can immediately be placed supine and a cricothyrotomy be performed[15].

In general we prefer to intubate the patient orally because one can use a larger tube, which makes suctioning easier, and because it is easier to see the larynx and be sure the tube is in the right place. Moreover, there are many complications of nasotracheal intubation that are not easy to avoid. Epistaxis is very common in dry climates, and especially in cities that sit at high altitudes. Even with experienced personnel, there is a higher incidence of failure with nasotracheal intubation although there are technical aids that can be useful[16]. In a crisis situation, one should choose the method with which one is most familiar, and the equipment that one prefers.

There are many situations in which patients are too awake to intubate without intense struggle on their parts, and too sick or too somnolent to make it safe not to intubate them. This is especially true of the overdosed or poisoned patient. One must not conclude that they therefore have adequate ventilation and a safe airway because they fight whenever you insert an oral airway or a laryngoscope.

We believe the safest approach to such patients is the controlled "crash" induction (Table 3). For the adult, this means some form of sedation (depending upon the condition for which we are intubating) will be necessary. We prefer etomidate (0.3 mg/kg), fentanyl (3 μg/kg) or diazepam (10-20 mg) intravenously, or midazolam 1-2 mg/kg intravenously although there are many different ways to sedate the patient. It is always wisest to assume the emergent patient has a full stomach. Therefore, we will preoxygenate the patient by allowing spontaneous breathing through the bag-valve-mask. If the patient's breathing is inadequate, we will assist ventilation with a bag-valve-mask with 100% oxygen. Prior to commencement of the sedation, this spontaneous breathing can assist oxygenation. During this period, the suction is turned on, a tonsil suction tip is inserted, an oral airway is made ready, an appropriately sized endotracheal tube is chosen and the balloon on the tube is tested. A stylet is inserted, and the tip of the tube is lubricated. If nasotracheal intubation is to be attempted, and time permits, the nares are inspected to see which one will more easily accept the tube, and the chosen side is anesthetized with 4% lidocaine, and phenylephrine to minimize discomfort and the risk of epistaxis. The laryngoscope blade is chosen, and the laryngoscope light is tested. We then administer lidocaine 1.5 mg/kg intravenously. This will diminish the burst of intracranial and systemic hypertension that can accompany

Table 3. Crash intubation summary.

Preoxygenate the patient
Select appropriate endotracheal tube
Test the balloon
Insert stylette
Make sure suction is working
Apply tonsil tip to suction
Pretreat with lidocaine 1.5 mg/kg
In children give atropine 0.01 mg/kg
Sedate the patient with etomidate 3 mg/kg
Give succinlycholine 1.5 mg/kg
Perform Sellick's maneuver
Await paralyzing agent-induced fasciculations
Intubate quickly
Have a preset rescue plan
Clinically assess tube position
Tie and tape the tube in place
Obtain follow-up chest X-ray
Assist ventilations
Provide long-term sedation and paralyzing agents

intubation, as well as diminish some of the vagotonic, or hypertensive responses stimulated in the larynx and trachea[17]. In the child, we also administer atropine 0.01 mg/kg to avoid the normal physiologic bradycardia induced during blade insertion into the oropharynx.

When all is ready, we administer the sedative, and follow this with a dose of succinylcholine 1.5 mg/kg. A common error is to use a paralyzing agent, but not to wait for its effects, and then to not understand how the patient can still be in spasm. We recommend administration of the paralyzing agent, awaiting muscular fasciculations and intubating in an expedient fashion. Once the procedure is commenced, and paralyzing agents given, someone should hold pressure on the cricoid cartilage (the Sellick maneuver) until intubation has been successfully accomplished. This probably does not protect the airway from secretions, but often helps the intubating physician to better visualize the vocal cords that may have an anterior lie. Once the tube is seen passing through the vocal cords one should confirm its placement by auscultating with a stethoscope over the gastric area to make sure there is not a rush of air into the patient's stomach with each ventilation, and then confirm bilateral breath sounds. The left chest should be examined before the right as the absence of left sided breath sounds may indicate a right main stem intubation, requiring the endotracheal tube to be pulled back approximately 2 cm proximal to the carina.

Prior to intubating a patient, the prudent physician should have a pre-set rescue plan in mind should it not possible to intubate the patient on the first attempt. The rescue plan must be based upon the problem preventing intubation. If the patient has a large tongue and epiglottis with redundant tissue in the oropharynx, it may be necessary to approach the patient's airway with a straight blade technique instead of a curved blade and to switch to a smaller tube. If the patient is inadequately medicated and the vocal cords are in spasm, it may be necessary to give the paralyzing agent more time to work or even increase the dose of the medication in larger patients.

Many difficult intubations arise from very anterior located vocal cords. In this situation the physician must maximize patient placement on the gurney and move to a rescue device such as the gum elastic bougie. The bougie offers the physician an opportunity to place a rigid plastic guide into the patient's trachea instead of trying to place the endotracheal tube when the cords are not visualized or only the most posterior aspect of the airway is identified. One can confirm placement of the bougie in the correct location when feeling the "click" of the tracheal rings and may assume it is in the esophagus if no clicks are felt. We recommend passing the endotracheal tube over the bougie while keeping the laryngoscope in the oropharynx to create space while using a modified Seldinger technique to advance the tube. The gum elastic bougie is cheap, easy to learn and has a low complication rate making it a reasonable second choice for the emergency physician in trouble.

Warning: do not use a paralyzing agent if you are not prepared to surgically manage the patient's airway!

It is hard to understand why there is such reluctance to use paralyzing agents in the emergency department. It is far preferable to use paralyzing agents rather than to fight with uncooperative and combative patients, especially when they are drunk or drugged and cannot protect their airways. It is true that all procedures have complications, and muscle paralyzing agents are no exception, but the complications of not using them and fighting a tube into a patient's airway are much greater. It is also the case that because of a reluctance to use these agents, many patients who require intubation, go without it to their short- and long-term detriment[18,19].

The most common complication of intubation is failure to place the tube in the right location. This is often a problem of a right main stem intubation, but more disastrous is the esophageal intubation. Breath sounds are often not helpful to distinguish this, and sometimes one must reinsert the laryngoscope, and make sure the tube is in fact passing through the vocal cords. To avoid the right main stem intubation, the tube should be measured, and if the patient is very small, cut down before insertion. A helpful rule is that the tube for the balloon exit from the main body of the endotracheal tube should be at the level of the patient's teeth[20]. It is also useful to use a carbon dioxide detector to confirm appropriate tube placement.

Intubation for the traumatized patient is often harder than for nontrauma since one must worry about the integrity of the spinal cord. While there is no good data to teach us what is the safest method of intubation, there has been a gradual change in our thinking. For years, we had been operating under the hypothesis that oral intubation in the multiple trauma patient is unsafe in the presence of cervical spine fracture, or when the status of the cervical spine is unknown. There is now data to support a new hypothesis: specifically that oral intubation is safe so long as hyperflexion, hyperextension, and hyperdistraction at any potential fracture site are avoided[21]. In the past, we have recommended that in the face of cervical spinal column fracture, or if the status is unknown, the active form of intubation chosen should be nasotracheal. If this route is unsuccessful, or not possible because of facial injuries, then one must perform a cricothyrotomy. As just indicated, it is also felt that the presence of facial fractures, or traumatic epistaxis

is a contraindication to nasal intubation for fear of passing the nasotracheal tube into the brain through a cribriform plate fracture. This may not be a real possibility because of the large diameter of the nasotracheal tube in relation to the size of the pores in the cribriform plate, but there is significant experience that this does occur with nasogastric tubes, and therefore it is wise to avoid this potential complication[22]. We must appropriately be concerned about the increase in intracranial pressure that accompanies nasal intubation, and therefore would prefer RSI for the head injured patient.

Whatever the final protocol chosen for the management of the trauma patient's airway, cricothyrotomy is a technical skill that needs to be possessed to practice modern and effective emergency medicine[23]. There will still be patients who will have massive facial injuries who will not afford the time for a cervical-spine clearance; there will still be upper airway obstructions; and there will always be patients who cannot be intubated orally because of laryngospasm, anatomical distortions, or peculiar airway anatomies as might be seen with ankylosing spondylitis, or congenital anomalies such as the Pierre-Robin syndrome[24].

Cricothyrotomy is not possible in small children because of the small area of the cricothyroid space. These children will either have to be intubated orally, bagged with bag-valve-mask assisted ventilations, or have a tracheostomy performed. Needle cricothyrostomy may be a temporary option if one has the appropriate equipment, and if there is not total upper airway obstruction, which is a contraindication to this procedure[25,26]. In general, we do not perform cricothyrotomy on a child under the age of 8 unless the child is unusually large for age. This is an instance in which even if the cervical spine has not been cleared, it would be safer to perform a careful oral intubation, than to attempt a surgical airway. Tracheotomy on small children is not a simple task as it requires much skill, experience, and is fraught with major complications. Nasotracheal intubation is also very difficult to utilize in most children since one must use such a small tube that suctioning is impossible, and it is hard to ventilate adequately.

The pediatric airway has special problems because of unique aspects of the anatomy in childhood, and because of the need for special equipment. In most instances, children can have ventilation successfully assisted with an appropriate bag-valve-mask apparatus. Nevertheless, adult bag-valve-masks are not only too large to fit the child's face well, but can also generate pressures that will cause pneumomediastinum, or pneumothorax and often under tension in either location[27]. Especially if one is unfamiliar with the active management of pediatric airways, one must exercise great caution in embarking upon invasive procedures. It is particularly easy to place the tube in the right main stem bronchus. As soon as it is possible after the intubation procedure, not only should the location of the tube be checked by listening for breath sounds bilaterally not only on the chest, but in both axillae, assessing the color and heart rate of the child, and watching for movement of the chest wall. Moreover, a portable chest X-ray study must be performed to accurately assess the location of the tube. This is particularly true if any surgical airway procedure has been carried out upon the child since the incidence of accompanying pneumothorax is very high. If this is missed, it will often deteriorate into a tension pneumothorax with disastrous consequences for the child.

Finally, it is necessary to consider when not to intubate (Table 4). There are always going to be situations in which intubation is indicated, but a less desirable form of airway management has to be chosen because of a lack of experience with the equipment or special skills needed in that situation. For example, a patient with an obstructing tumor of the larynx may safely be intubated with a fiberoptic scope, but one might not be available, or the physician might not have experience with its use. A surgical airway is contraindicated because it might interfere with surgical extirpation of the tumor. In this case, we would recommend transfer of the patient to the locus or facility where the fiberoptic scope can be used, such as in the operating theatre. The airway should be managed with bag-valve-mask, and by positioning the patient on his side, or in an upright position to minimize the risk of aspiration. RSI is not a good choice for managing the patient's airway as anatomical distortion will make this approach difficult if not impossible.

There are some patients who are marginal in their ventilation, such as the patient with chronic obstructive pulmonary disease. While an RSI might enable the emergency physician to accomplish the intubation, it will doom the patient to a prolonged stay in the intensive care unit on a ventilator. It is sometimes preferable to stimulate the patient to cough and breathe, but not to induce the combative behavior that intubation might cause. Many patients may respond to temporizing methods such as noninvasive positive pressure

Table 4. When not to intubate.

If uncomfortable with intubation techniques
If the patient becomes combative during intubation attempts
If the respiratory arrest is reversible with a drug
Naloxone
Flumazenil
If the patient can be managed with stimulation and low flow oxygen
If the patient has deformity of the airway or neck
If the patient cannot be ventilated manually
If the patient has or should have a do-not-resuscitate order

ventilation allowing the patient time for medical therapy to work.

It is hard for many physicians in the emergency department to avoid intubating the terminally ill patient. There is often lack of information about what the patient desires, and at times a relative demanding intubation who is either not familiar with the patient's wishes, or wants to override them. Sometimes this is because of lack of preparation for the patient's death; but often it represents a different attitude or ethical needs than the patient's own. It may be impossible to sort this out, and some patients who deserve comfort care only, will end up with highly aggressive resuscitative care including inappropriate (for the patient's state of disease) intubation. Nevertheless, there are many situations in which the emergency physician must have the courage not to initiate futile treatments, and be willing to work with the relatives to avoid increasing the patient's suffering.

The principle proviso is that once embarked upon, active airway management must not be abandoned because it is difficult to achieve. All too often, the physician attempts intubation; is unsuccessful, and then revises the indications for the procedure because of an unwillingness to proceed to some other form of airway management such as a surgical airway. For example, the unfortunate patient who develops anatomic airway obstruction due to an expanding hematoma from having bitten his tongue after receiving enzyme reperfusion for a myocardial infarction. Even though this would normally preclude a surgical airway, if there is no other way to achieve airway management, the physician will have to accept the bleeding the surgical procedure will cause. The only instance in which it is acceptable to stop efforts or change plan, is if information becomes available that the patient has reached the stage of irreversibility in the disease process that would mandate comfort care only or if the intubation was initially performed electively by the emergency department physician to facilitate a procedure or imaging study. If problems are encountered with these patients, the most prudent decision might be to allow the medications to wear off and the patient to resume spontaneous respiration while the team provides ventilation with a bag-valve-mask.

In summary, the airway is often an overlooked, neglected, or delayed task in emergency management of the critical patient. It is too often allowed to be passive trusting to anesthesiology to perform active airway management when the patient is taken to the operative room. It is nevertheless the most important component of an effective resuscitation and must be pursued aggressively. With some forethought and practice, the situations that mandate active airway management will become familiar rather than frightening, and with good technique, the fear of undertaking an active airway management will disappear.

References

1. Walls RM. The airway. In: Marx JA, ed. Rosen's emergency medicine concepts. St Louis, MO: CV Mosby, 2002: 2-21.
2. Walls RM, Wolfe R, Rosen P. Fools rush in? Airway management in penetrating neck trauma. *J Emerg Med* 1993; 11: 479-80.
3. Vilke GM, Hoyt CB, Epperson M, Fortlage D, Hutton KC, Rosen P. Intubation techniques in the helicopter. *J Emerg Med* 1994; 12: 217-24.
4. Walls RM. Rapid-sequence intubation in head trauma. *Ann Emerg Med* 1993; 22: 1008-13.
5. Ampel L, Hott KA, Sielaff GW, Sloan TB. An approach to airway management in the acutely head-injured patient. *J Emerg Med* 1988; 6: 1-7.
6. Friedman L, Vilke GM, Chan TC, et al. Emergency department airway management before and after an emergency medicine residency. *J Emerg Med* 1999; 17: 427-31.
7. Camnitz PS, Shepherd SM, Henderson RA. Acute blunt laryngeal and tracheal trauma. *Am J Emerg Med* 1987; 5: 157-62.
8. Angood PB, Attia EL, Brown RP, Mulder DS. Extrinsic civilian trauma to the larynx and cervical trachea: important predictors of long-term morbidity. *J Trauma* 1986; 26: 869-73.
9. Fuhrman GM, Stieg FH 3rd, Buerk CA. Blunt laryngeal trauma: classification and management protocol. *J Trauma* 1990; 30: 87-92.
10. Kiev J, Kerstein MD. Role of the three hour roentgenogram of the chest in penetrating and nonpenetrating injuries of the chest. *Surg Gynecol Obstet* 1992; 175: 249-53.
11. Walls RM. Airway management. *Emerg Med Clin North Am* 1993; 11: 53-60.
12. Woster PS, LeBlanc KL. Management of elevated intracranial pressure. *Clin Pharm* 1990; 9: 762-72.
13. Recommendations for use of Haemophilus B conjugate vaccines and a combined diphtheria, tetanus, pertussis, and Haemophilus B vaccine. Recommendations of the advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep* 1993; 42 (RR-13): 1-15.
14. Hirshberg A, Wall MJ Jr, Allen MK, Mattox KL. Double jeopardy: thoracoabdominal injuries requiring surgical intervention in both chest and abdomen. *J Trauma* 1995; 39: 225-9.
15. Corssen G, Gutierrez J, Reeves JG, Huber FC Jr. Ketamine in the anesthetic management of asthmatic patients. *Anesth Analg* 1972; 51: 588-96.
16. Danzl DF, Thomas DM. Nasotracheal intubation in the emergency department. *Crit Care Med* 1980; 8: 677-82.
17. Lev R, Rosen P. Prophylactic lidocaine use preintubation: a review. *J Emerg Med* 1994; 12: 499-506.
18. Dufour DG, LaRose DL, Clement SC. Rapid sequence intubation in the emergency department. *J Emerg Med* 1995; 13: 705-10.
19. Clark WC, Muhlbauer MS, Watridge CB, Ray MW. Analysis of 76 civilian craniocerebral gunshot wounds. *J Neurosurg* 1986; 65: 9-14.
20. Birmingham PK, Cheney FW, Ward RJ. Esophageal intubation: a review of detection techniques. *Anesth Analg* 1986; 65: 886-91.
21. Rosen P, Wolfe RE. Therapeutic legends of emergency medicine. *J Emerg Med* 1989: 7: 387.
22. Wilkinson JA, Mathis RD, Dire DJ. Turbinate destruction - a

rare complication of nasotracheal intubation. *J Emerg Med* 1986; 4: 209-12.
23. Narrod JA, Moore EE, Rosen P. Emergency cricothyrotomy - technique and anatomical considerations. *J Emerg Med* 1985: 2: 443-6.
24. Erlandson MJ, Clinton JE, Ruiz E, Cohen J. Cricothyrotomy in the emergency department revisited. *J Emerg Med* 1989; 7: 115-8.
25. Jorden RC, Moore EE, Marx JA, Honigman B. A comparison of percutaneouos tracheal ventilation in an acute trauma model. *J Trauma* 1985; 25: 978-83.
26. Jorden RC. Percutaneous transtracheal ventilation. *Emerg Med Clin North Am* 1988; 6: 745-52.
27. Paterson SJ, Byren PJ, Molesky MG, Seal RF, Finucane BT. Neonatal resuscitation using the laryngeal mask airway. *Anesthesiology* 1994; 80: 1248-53.