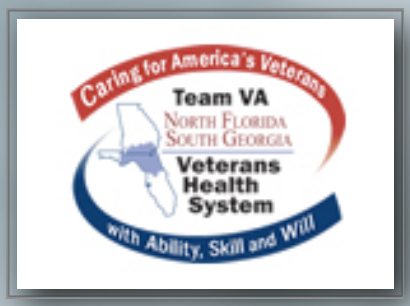
OUT OF THE OR AIRWAY MANAGEMENT

NFSGVHS
Department of Anesthesiology



NFSGVHS OORAM INITIATIVE

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AIRWAY SKILLS

A major responsibility of many physicians and non-physicians is the management of critically ill patients with life-threatening conditions that often require dealing with the airway.

DIFFICULT AIRWAY

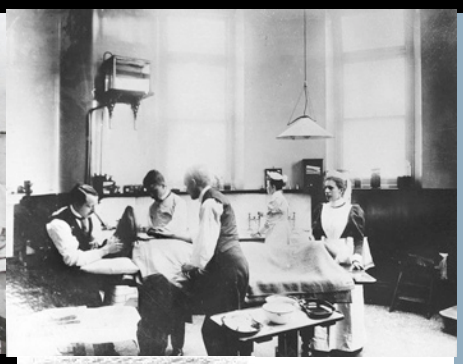
A difficult or failed intubation is without a doubt one of the most terrifying, frustrating and humiliating events any practitioner dealing with critical patients will ever face. "The scene of a difficult airway is best described as one where absolute chaos and disarray reign; everyone involved goes into a state of panic; some people become catatonic; there is confusion, uncontrolled trembling, and a strong desire for a spare change of clothes."

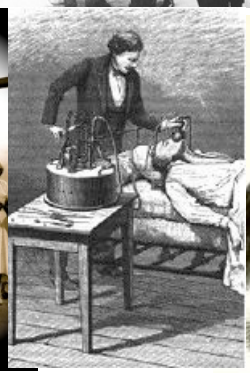
It is important to disclose that I do not have any commercial ties and I do not represent the industry and have not received directly or indirectly any financial contribution for any particular device mentioned in this handout , in the workshop or shown in the O.R.

Airway Management Skills

Airway management is considered a core responsibility of many medical practitioners. Recently other groups (physicians and in some circumstances non-physicians) have often assumed the role of primary "Airway Responders" not only in the hospital setting, but also outside the hospital as well. Handling the airway can sometimes be a routine task, but in certain circumstances,specifically during emergencies, it can be extremely difficult and sometimes can lead to disastrous consequences. Mismanagement of the airway can lead to catastrophic and devastating consequences for both patients and the providers caring for them. The responsibility to achieve proficiency in airway management can be associated with much pressure and anxiety. The handout, simulation workshop and O.R experience to check off skills is designed for physicians and non-physicians, who according to this new initiative may be required to handle an adult patient's airway especially in the context of an emergency situation, although the principles and techniques described also apply to non emergent airway management as well. Several devices and techniques will be discussed; some of them might be considered "new" and innovative. The devices and techniques chosen satisfy three essential principles for emergency airway management: S for simplicity, E for efficacious, and R for reliability (S.E.R). I have much respect for a difficult airway and admit to have struggled with this particular challenge, and therefore, decided to learn new skills and principles of airway management with the hope of decreasing the chances of getting into trouble, and to teach others what I have learned. This manual is not intended to review the clinical indications for intubation and mechanical ventilation; rather it is designed to make you more successful if you choose to instrument the

airway. The handout is a complement to a series of hands-on workshops. It is not designed to replace many wonderful textbooks on the subject. It follows a simple approach, with easy to remember ideas, and it is designed to follow the logical steps in airway management, from the evaluation phase to the actual execution of the technique chosen to deal with the airway. References for key publications are included. Participants are encouraged to do further reading on topics of their interest. Be aware of several icons as they point to either potential key points or mention several minefields that if not dealt with, there is a higher chance of approaching a rapid pathway to irreversible failure.





HISTORICAL REMARKS

CONTRARY TO POPULAR BELIEF THE SKILLS OF LARYNGOSCOPY AND INTUBATION ARE NOT JUST INHERENTLY DIFFICULT TO ACQUIRE BUT ALSO DETERIORATE OVER TIME IF NOT PRACTICED ROUTINELY. THE SKILL OF NON-SURGICAL ACCESS TO THE TRACHEA IS A RELATIVE RECENT PROCEDURE THAT ORIGINATED IN THE LATTER HALF OF THE 19TH CENTURY AND FLOURISHED IN THE SECOND HALF OF THE 20TH CENTURY AND CONTINUES TO EVOLVE TODAY.

The Evolution:

Although a review of the history of airway management and intubation is beyond the scope of this manual, a brief outline of some of the most important milestones in the history and evolution of the technique follows: Whom to credit for being the father of "intubation" is a complicated matter: Evidence of surgical approaches to the trachea date back as far as 2000 years B.C, when the Greeks and Egyptians report performing the procedure to relieving choking victims. Hippocrates and Galen used surgical approaches to the trachea; but it was not until Avicenna (1024 A.D) when a non-surgical oral approach for intubation was described. Think about it over 2'000 years before humans used the oral approach to intubation. This "artificial respiration" was used first to assist ventilation in neonates after complicated deliveries and then equipment for assisted respiration was described by the Royal Humane Society of Great Britain in 1774, to help victims of drowning. Because aspiration and communication between the respiratory and gastric systems have always been an issue, there is always been an effort to deal with this and prevent this adverse event from happening. The first cuffed tracheostomy tube ("Trendelenburg's tampon") was used in 1868. But it still required surgery and that lead to many complications. In 1888 Joseph O'Dwyer described a method of oral intubation via the mouth to relieve the obstruction caused by complications of Diphtheria. The laryngoscope was first described in 1895 Alfred Kirstein introduced the first direct laryngoscope, and this instrument started making its appearance in operating rooms. In 1899 Franz Kuhn from Germany described a technique of securing the airway in awake patients using "flexo-metallic bougies" under the aid of the effects of cocaine to the pharynx, he also published the first paper on nasotracheal intubation and was the first to write a textbook on the subject in 1910. In 1922 Ivan Magill and Stanley Rowbotham at the Queen Hospital for Facial and Jaw Injuries in the U.K were working on development of techniques to administer anesthesia to patients with facial injuries; in one of their cases, they were using pharyngeal insufflation technique and as described, the tube accidentally entered the trachea. This incident may have sparked the whole concept of modern endotracheal anesthesia. In the 1940's a couple of Roberts (Miller in the U.S and Macintosh in the U.K) introduced their iconic blades still being used today. Neuromuscular agents were used to help with intubation first in 1943 with Curare and then in 1952 with the introduction of Succinylcholine. In 1967 P. Murphy introduced the technique of fiberoptic-guided tracheal intubation. In 1988 the LMA introduced into clinical practice in the U.K., four years later in the U.S. In 1993 the ASA Practice Guidelines for the Difficult Airway were originally published the most recent update was done in 2013. More recently a new group of devices termed "Videolaryngoscopes" have really had a positive impact on the airway management and also on education, since the instructor and the student can now watch the procedure as it is taking place.

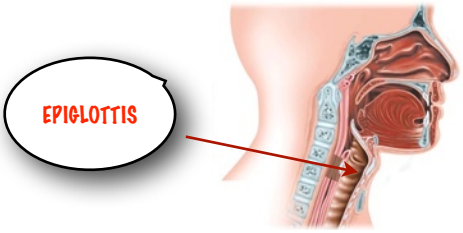
Basic Anatomy of the Airway

The Airway is divided into two equally important sections the *upper airway* which extends from the nose to the glottic opening and the *lower airway* which includes all structures located below the glottic opening: trachea, bronchi, bronchioles and alveoli.

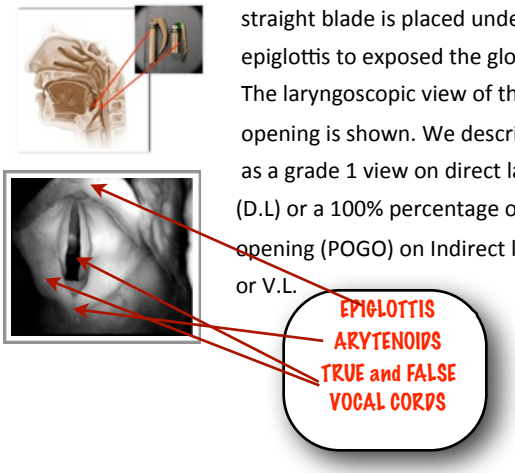
In adults the nasal passages are usually 10-14 cm in length and extend from the nostrils to the nasopharynx. It is composed of cartilage and bone and separated from the cranial vault by the cribriform plate. This is the reason why positive pressure mask ventilation and placement of nasopharyngeal tubes should be made with extreme caution if at all since oral bacteria and tip of the cannula can inadvertently enter into the cranium. The mucosa of the nose and its turbinates have a rich vascular supply and are prone to bleed if instruments are not well lubricated and sized. The Pharynx is divided into three main areas the naso-pharynx, the oropharynx and the laryngopharynx, which correspond to C1, C2-C3, C4-C6 vertebrae. In adult patients the usual distances for the anatomical structures in relationship with Tracheal tubes are as follows: From the lips there is usually 27 cm to the carina, therefore ETT's should be secured at at the 23-24 cm mark in the ETT.

Supraglottic Pharynx

Includes the aryepiglottic folds , the false vocal cords, and other structures superior to an imaginary line drawn through the laryngeal ventricles. The epiglottis forms the superior margin of this supraglottic larynx, and has the critical function of preventing aspiration, by folding into a horizontal position during swallowing to direct food or drink into the hypopharynx.



The vallecula located at the root of the tongue is a depression that is an important landmark for direct laryngoscopy with a curved blade that must be lifted in order to expose the laryngeal inlet. On the other hand the straight blade is placed underneath the epiglottis to exposed the glottic opening. The laryngoscopic view of the Glottic opening is shown. We describe this view as a grade 1 view on direct laryngoscopy (D.L) or a 100% percentage of glottic opening (POGO) on Indirect laryngoscopy or V.L.



Incidence of Difficult Intubation

Degree of Difficulty	Range of Incidence Per 10'000	%
ETT placed successfully but multiple attempts and/or blades required. Grade II/III	100-1800	1-18
ETT placed successfully but multiple attempts and/or blades and/or laryngoscopists required Grade III	100-400	1-4
ETT not placed successfully . Grade III or IV	5-35	0.05-0.35
CNV/CNI; Transtracheal Jet Ventilation,Tracheostomy, Brain damage, death	0.01-2	0.0001-0.02

From Benumof: Airway management: Principles and Practice. Mosby,1996

DIFFICULT AIRWAY

The exact definition of difficult airway is not precise, and a uniform definition is not widely accepted in the literature. One of the main reasons for the lack of such uniform definition is that often the term, difficult airway, is related to difficulty with endotracheal intubation.

Difficult Airway

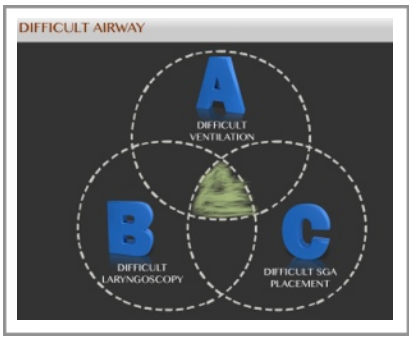
The exact incidence of difficult airway (DA) is unknown. In fact, the exact definition of a difficult airway is not precise, and a uniform definition is not widely accepted in the literature.[1] One of the main reasons for the lack of such a definition is that often the term, difficult airway, is related to difficulty with endotracheal intubation. The reported incidence of difficulty endotracheal intubation can be seen in Table #1. These data are taken from the operating room (OR) in the anesthetic surgical context. It is correct to consider that, even in "ideal" conditions with highly experienced practitioners, the incidence of DA is not zero. In the emergency setting, the heterogeneous nature of patients potentially needing airway management, including trauma, pediatric and obstetric patients, renders handling the airway potentially more difficult and demands a high degree of skill and familiarity with airway related topics by practitioners involved in airway care.

Paradigm Change

A difficult airway is not just synonymous with difficulty with laryngoscopy and endotracheal intubation, but rather is a continuum of degrees of difficulty with:

a) Bag Mask Ventilation (BMV)
b) Conventional Direct Laryngoscopy/intubation (DL)
c) Videolaryngoscopy Intubation
d. Supraglottic Airway placement
e) Surgical (Invasive) Airway access.

The difficulty may be provider dependent, situation dependent, equipment and/or device dependent,



patient dependent or a combination of these factors. The provider may be the source of difficulty because of lack of knowledge or skill, or because of unfamiliarity with current airway management topics. Situation difficulty refers to conditions in which airway management is necessary but there is lack of tools or equipment necessary to deal with the case (as occurs, for example, in the field). Equipment difficulty refers to inadequate or limited availability of proper equipment and, last but not least, due to inherent patient difficulties. If after the initial evaluation of the patient, the provider determines that there will be potential difficulty with any of these variables, or if there is unfamiliarity with any of the basic airway options, then it is safe to consider that there is a high likelihood that there will be a DA.[2]

The point is that you have to consider all aspects of airway management as you are evaluating and executing your plan. All variables and criteria that determine ease or difficulty to instrument the airway are interrelated. If one option fails you must have alternative options readily available that can bail you out if your first-and typical best option-fails.

A common error that happens is that providers fail to try different alternatives when difficulty arises. Remember if one device or technique fails, try something else. Why expect that all of the sudden things are going to get better? I can assure you more than likely things will get worse.

"Fail to plan, plan to fail"

Before you instrument the airway

Just as you would not drive your car without knowing if you have enough gas or if your engine is functioning properly, you should not be taking care of the airway without knowing what equipment you have at your disposal, and if the equipment you have is functioning properly. It is essential and imperative that someone in each facility or location where airway management is going to take place be in charge of this task. Someone should be responsible for organizing supplies, doing inventory, and restocking airway equipment after each use. It is also essential that the members of the rapid airway response team are knowledgeable about what equipment they have at their disposal. In the O.R we are currently using the team approach with a special code (911) appended to the room number where the emergency is taking place so that team members know where to bring the Airway cart. Outside the OR, we have a special beeper assigned by the hospital to inform us of the location of the emergency, and we travel with a tackle box stocked with emergency drugs and emergency airway equipment and each location has a crash cart with essential resuscitation equipment. See pictures of a "Tackle" box and of the elements and supplies we have in our crash carts.

Basic Airway Equipment and Techniques

This workshop does not cover basic pharmacologic principles of drugs used to instrument the airway and presumes that every person in charge of airway management is trained in BCLS and ACLS, and is familiar with drugs (indications and contraindications) used for rapid sequence intubation (RSI). See Table #2.

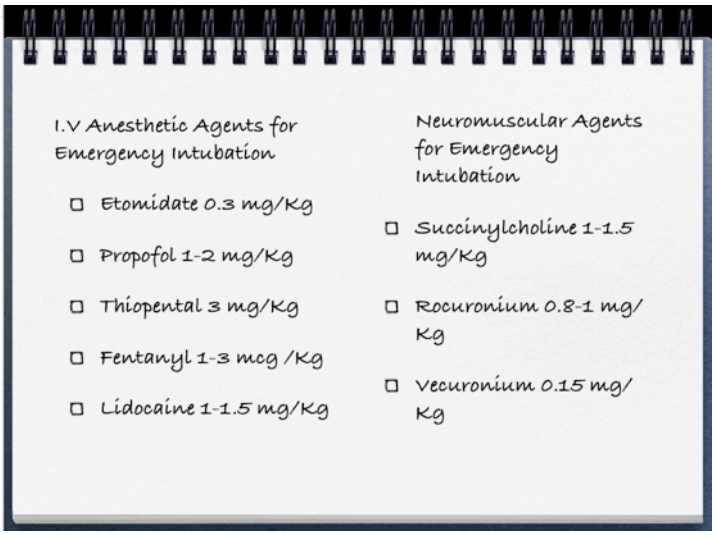


Table #2

Bag Mask Ventilation (BMV)

BMV is usually the first step in airway management and an essential rescue maneuver when the attempt at intubation or supraglottic airway (SGA) placement fails. Adequate BMV requires proper technique, tight mask fit, and patency of the airway. If any of these or all three requirements are not met, BMV may fail. BMV is a core technique that must be learned and mastered by anyone handling the airway. There are two methods of applying BMV: a) One-hand ventilation in which the mask is held with the left hand of the provider and placed against the face by downward pressure on the mask by the left thumb and index finger (pressure should be placed on the bony mandible (not on the soft tissues) while the right hand gives positive-pressure ventilation with the breathing bag. b) Two-hand-ventilation technique in which the provider uses two hands to provide jaw thrust and create a mask seal similarly to the one-hand technique, while an assistant provides positive-pressure ventilation with the breathing bag.

If the one-hand technique fails, the provider must attempt to ventilate with the use of the two-hand technique and

must consider using adjuncts such as oral and/or nasal airways (if applicable) to assist if difficulty is met, which usually comes from inadequate seal or from obstruction from redundant tissues, especially the tongue. Other common causes of failed mask-ventilation are found in obese patients with and without obstructive sleep apnea, and in elderly edentulous patients. The importance of a difficult BMV, which has been estimated to be as high as 5% in the general population lies in the fact that if there is difficulty with BMV there might be a higher incidence of subsequent difficult and failed intubation attempts. Moreover, if the next airway management maneuver fails or is ineffective, we find ourselves in the emergent pathway of the ASA DA algorithm. The next step might require establishing an airway by invasive surgical means to guarantee oxygenation.[3]

Patient Positioning

An important consideration to prevent difficulty with BMV or to enhance ventilation and the chances of successful intubation, is proper patient positioning. If the patient you are facing has any of the criteria of difficulty for mask ventilation or if you suspect intubation is going to be difficult, (obesity, OSA, age >55, heavy beard) consider placing the patient in an optimal position. Recently, one of the most popular methods to improve the chances of successful airway management is by using a position called the "ramp" position. Other terms used for this position are HELP (head elevated laryngoscopy position) or the 'troop', but they are all essentially the same. The goal of this position is to align the auditory canal with the sternum in a straight line. This position can either be obtained by placing folded blankets behind the occiput and shoulder blade or

by using commercially available products as the ones shown in the pictures below. This "ramp" position has been studied and validated as one of the most important steps in enhancing the chances of successful airway management. [4]

My advice is do not wait to get in trouble before you correctly position the patient, do it from the moment you decide you need to instrument the airway. This will save you many headaches.

Oral and Nasopharyngeal Airways

Although the term, "airway", is used interchangeably between devices placed in the oropharynx or nasopharynx, supraglottic or extraglottic devices and/or to describe the space between the oral and nasal cavities and the larynx, in this handout and workshop we will use the term to describe the anatomical structures or a group of devices used since the beginning of the 20th century and designed to maintain patent oral and nasopharyngeal structures, what we commonly refer to as the "upper airways".

Adult oral airways are usually either of the Guedel or Berman types and come in sizes 3 and 4. They are made of plastic or rubber; they have three parts one straight that is in contact with the teeth (or gums in the absence of teeth) and has a flange to prevent swallowing, a curved portion that seats on the tongue and ends in the pharynx and displaces

the tongue anteriorly and an air passage in between.

The recommended technique of placement is using a tongue blade placed on the posterior end of the tongue and separating it from the pharyngeal structures. Some people recommend placing it upside down and turning it 180 degrees as you advance. Others advocate the opposite technique, of inserting them straight. Just be careful not to damage any soft tissues or teeth or create bleeding which will make your next move much harder. Make sure the tongue is displaced anteriorly. Also remember that an awake patient will not tolerate placement of an oral airway, and trying to do so will result in either gagging, regurgitation, or laryngospasm and a potential bite to your fingers.

Nasopharyngeal airways

These are less stimulating and better tolerated by awake patients. They are cylindrical in shape, malleable, and soft and have a flange to prevent the end from passing beyond the nares. In adults they are usually between 28 and 32 Fr, and are designed with a slight curvature and made to rest on the nasopharynx. Great care and slight lubrication (usually with lidocaine gel) are required. Both types of airways should be available when handling the airway, and both can be used at the same time if the need arises. The use of these adjuncts can be

extremely helpful and, more often than not, they provide help that is invaluable; there is a wide array of sizes to fit the needs of your patients.

Laryngoscopy and Intubation

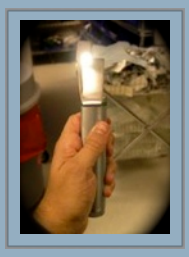
In the emergency setting, the most common approach to intubation is via the oral route, with the aid of a laryngoscopic view. There are currently two types of laryngoscopy systems the traditional Direct laryngoscopes (D.L) and the newer Indirect or Video-Laryngoscopes (V.L) . Both have many variants and practitioners should be familiar with their use. The purpose of the laryngoscope is to provide visualization of the glottic opening and allow placement of the endotracheal tube (ETT) with the greatest chance of success and the least amount of difficulty, complications and injury. Common laryngoscopes are lighted devices with a handle and a blade that has a flange on the left side to help retract the tongue laterally and a channel to help visualize the glottis. They are

designed to be held with the left hand, while the right hand holds and manipulates the ETT. A more recent and better type of laryngoscope is the fiberoptic scope (which can be recognized by a green line on the handle). These scopes have rechargeable batteries and have a bulb at the top of the handle rather than an electrical connection as in the old versions, and provide much better and whiter illumination, therefore improving the field of vision.

There is a proper technique for laryngoscopy that must be learned and practiced many times by each individual that will be handling the airway both with mannequins and in real patients:

Proper Preparation: All devices and pharmacologic agents used in intubation should be readily available before the sequence of intubation is started. This includes suction, face masks, laryngoscopes with an assortment of blades of different sizes, oral and nasopharyngeal airways, assortment of ETT's of different sizes, stylets, and rescue devices, such as LMA's.

If the laryngoscope is working properly when the user looks at the light of the scope, it should be bright enough to make the user squint. If not the scope needs to be charged, repaired or changed. I cannot overemphasize this principle: the time to discover there is something missing or not working properly is NOT when you are facing an emergency situation or after you started the intubation.



Certain patients are notoriously difficult to intubate with conventional laryngoscopy. One of the primary goals of the preparation phase is to determine if your patient has any of the many characteristics that have been associated with a difficult intubation. This will allow you to take extra precautions and search for alternative means of securing the airway. People with receding chins, rigid necks, small mouth opening, prominent incisors, or with stridor, or those who are obese or have a heavy beard, are frequently found to be difficult to intubate.

Remember: assume that behind every beard there is a receding chin and an anterior larynx.

Criteria of Difficulty

Several clinical criteria have been developed to try to estimate the degree of difficulty with D.L and intubation. None of these criteria alone or in combination is 100% sensitive or specific. However the more criteria of difficulty your patient fits into, the greater the chance of difficulty and therefore the more precautions ought to be taken before manipulation of the airway. Some of the more commonly used criteria to determine difficult intubation are:

a-Thyromental distance: If the distance between the thyroid cartilage and the bony point of the chin is less than 6 cm there is an increase chance DL and Intubation will be difficult.[5, 6]

b-Oral opening or Inter-incisor gap: If the patient has < than 4 cm mouth opening or roughly less than 3 finger-breadth distance between his teeth, there is a greater chance of difficulty on DL and ETT placement.[9]

c-Mallampati Score: In 1985 a classification system was created in an attempt to predict the ease of larynx exposure on DL based on the degree of visibility of oropharyngeal structures and the ratio of the size of the tongue to oropharyngeal size. It was modified to the current four Classes M1-M4 in 1987. [7,8]. The higher the score the greater chance of difficulty and/or failure. One important point to make is that this system was originally described with the patient in a sitting position, with the head in a neutral position, and the observer located in front of the patient that should not phonate. Unfortunately in emergent

circumstances the ideal conditions or a cooperating patient are not the norm.

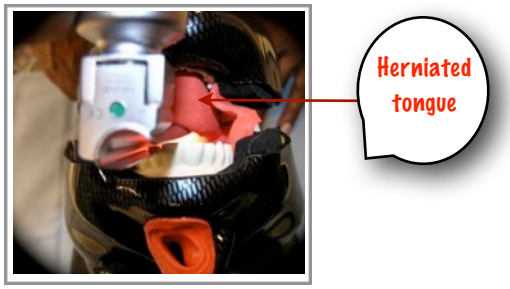
d-Neck circumference: Neck circumference > than 45 cm has been found to be predictive of difficult DL and intubation[10]

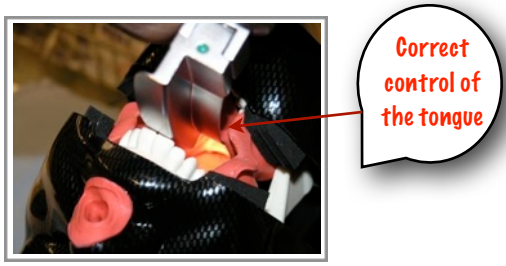
Technique for Laryngoscopy and Intubation

1-Proper Patient Positioning: The person in charge of the airway should have unobstructed access to the head of the patient, and the head should be placed at the level of the operator's sternum. This obviously implies that sometimes the best position for the operator will be kneeling down if the patient is found on the ground. Considerable controversy exists surrounding the recommended head position for laryngoscopy. Some recommend the "sniffing" position, with slight flexion of the neck and extension of the head; others recommend no flexion of the head and strictly extending the neck. Sometimes patient condition or circumstances such as having a cervical collar for recent trauma dictates the proper head and neck position and in obese patients the HELP position (described above) might be the best option.

2-Mouth Opening: The operator's right hand may either grab the occiput and extend it which may open the mouth, or use the "scissor maneuver" in which the operator's right thumb grasps the lower lip, while the index finger grabs the upper one.

3-Blade Insertion: The blade of the laryngoscope is introduced into the right side of the mouth (avoiding grasping and entrapping the lower lip in the process); the blade is advanced toward the base of the tongue, keeping it to the left side of the blade. Once the oropharynx is passed and the tongue is being held in place, the operator should lift the laryngoscope blade forward to show the glottic opening. The human tendency will be to tilt the blade forward; AVOID this maneuver as it will not just increase the chances of damaging the incisors, but also will decrease the chances of having an unobstructed view of the larynx. One of the more common mistakes made during laryngoscopy is not having control of the tongue. The tongue occupies a great deal of the surface area of the mouth and if not displaced properly (laterally and to the left) it will "herniate" to the right side of the blade and obstruct your field of vision and not allow the ETT to be introduced into the larynx. See pictures.



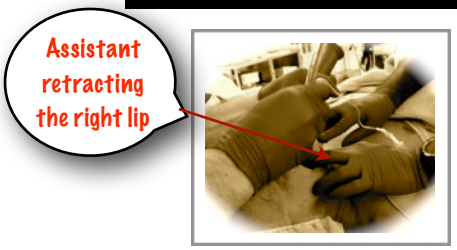


At this point where the tip of the blade ends up depends on the type of blade you are using:

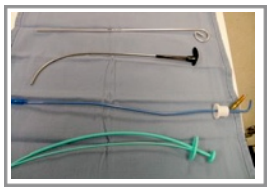
i. Straight blades: The tip should extend underneath the epiglottis and lift it.

ii.Curved blades: The tip should extend into the vallecula with the action of upward movement on the hyoepiglottic ligament exposing the glottic opening.

4-ETT Placement: Once the cords are exposed, the ETT is handed by an assistant and introduced with the right hand. A useful maneuver on behalf of the assistant is to gently retract the right cheek to make this maneuver easier. It is very important for the person doing the laryngoscopy to not take their eyes off the glottic opening while extending the right hand so the ETT canto be handed by the assistant without disturbing the view.



In the emergency setting, where speed of insertion and the possibility of gastric aspiration are always of concern, it is preferable to always use a malleable stylet inside the ETT to control the shape and direction of the tip of the tube. It is important to ensure that the tip of the stylet does not protrude beyond the tip of the ETT.



In general, adults should get tubes that range in size from 7.0 -9.0 Fr. Modern ETTs have external markings. A normal size adult male will have the ETT in the mid-trachea (above the carina) when the marking on the tube is between 22-24 cm at the level of the teeth. Once the ETT is placed, the laryngoscope is taken out, the ETT cuff is inflated, the operator or assistant holds the tube in place, and correct placement is confirmed.

"In the airway world the tongue is your enemy, the glottis your friend".

Newer Laryngoscopy Devices

Although from the inception, there have been known limitations to the use of conventional direct laryngoscopes), only until very recently have new generations of devices have made their appearance and have revolutionized the field of airway management. These new systems are collectively known as Video laryngoscopes (VL), however in the future perhaps they will be better known by the term "glottic-scopes" as used by Dhonneur (since not all of them require the use of video). [31, 32] These devices as a group make laryngoscopy easier, better, and safer; in fact they satisfy my S.E.R classification (Simple, Effective and Reliable). However, a word of caution as with any new device there are also drawbacks:

a) Cost: all these devices are definitely more expensive than conventional laryngoscopes. However, the issue of cost versus value has to be considered. They are a wise investment and valuable tools.

b) Given their recent release, information and validation is just beginning to trickle into the medical literature (not surprisingly the majority is positive), so a bit of patience is needed before we see video-laryngoscopy recommended in the mainstream airway literature, such as in the ASA Airway algorithm.

The use of these devices requires training, and like with any new device, there are tricks inherent to each of them, and there is a learning curve.

d) Since they are optical devices their use is affected by the presence of secretions and/or blood in the pharynx.

You will wonder why you would favor old laryngoscopy over this new technology. Initially you will want to use these devices in special occasions or in patients that are considered "difficult" but then you will want to use them even for patients that are considered "easy".

Currently there are a few choices in the market. There are channeled and Non-channeled devices. Among the channeled devices there is the Pentax video system, the Res-Q-scope and the Airtraq. These devices have a track a guiding channel for ease of ETT placement -a great feature especially in emergency situations-. The non-channeled devices (the ETT is introduced freehand without a guide) include the McGrath scope, the Storz C-Mac system and the current industry leader the Glidescope which comes in two versions the regular Glidescope and the portable Ranger scope.

With both types of devices, the glottic view is generally easily obtained, and the view is superior to the view by DL. However, ETT placement may be tricky, even with the channeled devices. [33-39].

A-**Airtraq**: It was released into the clinical arena in 2006. It is a disposable optical laryngoscopy device with a guiding channel to be used for routine and complex airway cases.

It can be used either alone or in combination with a reusable separate camera that is mounted at its base and attached to a video source. The image is transmitted optically by a system of mirrors and a magnifying lens expands the view. It comes in different sizes for pediatrics and adults and recently the company released the double-lumen and the nasal Intubation Airtraqs.

There are numerous features that make it a very attractive device. Among them are:

1) Ease of use, even for inexperienced personnel and a great alternative for use in the pre-hospital setting, in the ED and during resuscitation.

2) Lightweight and portable, which makes it ideal for using it as part of the transport airway box or even in your pocket while you are establishing an airway during emergency situations.

3) It can be used even for emergency awake intubations with relative ease. [40]

4)Channel/Guiding port which makes ETT placement a lot easier and it does not require a stylet.

There are a few drawbacks:

1) Cost. The feature of being disposable, might be its "Achilles heel" and, in spite of being an exceptional product, this issue of cost makes other alternatives like the Glidescope financially a wiser investment. (the company is aware of the need to design a non-disposable/reusable Airtraq, which will be great news if indeed this happens)

2) High profile. This issue makes the use of the device a bit difficult in people with small mouth openings.

3) The guiding channel limits manipulation and possibility of rotation of the ETT.

A word of advice: if the ETT is not going into the larynx and continues to bump the arytenoid cartilages, your tendency will be to place it even deeper and the problem will perpetuate. What you have to do is exactly the opposite maneuver and actually pull the device back 0.5 cm at a time to increase your chances at successful intubation

.

B-The **Glidescope**: Was introduced into clinical practice in 2003 and currently is the industry's leading video-laryngoscopy system. It has a blade system connected by way of a cable to either a stand-alone camera screen or a newer device (Ranger) that is easy and convenient to transport. There are currently 4 versions:

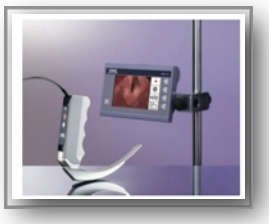
1) Regular available in sizes 2-5, with sizes 4 and 5 for a typical adult.

2) Ranger/portable unit, that comes with its own pouch for ease of transportation and comes in sizes 3 and 4.

3) Ranger single-use (Cobalt System) which comes in sizes 1 to 4.

4) Cobalt neonate which comes in size #1 and #2. The advantage of the Glidescope and why it has gained so much attention and popularity is because it provides a great view of the glottic opening in the great majority of patients, especially those considered difficult with conventional DL (CL III and IV). The drawback of the Glidescope is cost (but that is the norm with all of the video-systems) and the fact that the difficulty of its use is not in viewing the larynx but rather getting the ETT into the larynx [41]; this is where the difficulty arises and why there is a need to use a stylet (the company sells their own stylet; however, there are reports of pharyngeal tissue damage with its use) [42]. Perhaps a better choice is to use conventional malleable stylets with a slightly exaggerated angle of bend at the tip. There are also some commercially promising devices such as the Gliderite stylet with a retractable tip that might be very useful. It is important to practice the use of the Glidescope on a mannequin before it is used in the clinical setting, and once the technique is mastered, you will want to use it repeatedly. We have witnessed some of our residents getting to the hospital earlier just to make sure they get their hands on it first before others, and our current single-unit cannot keep up with the demand.

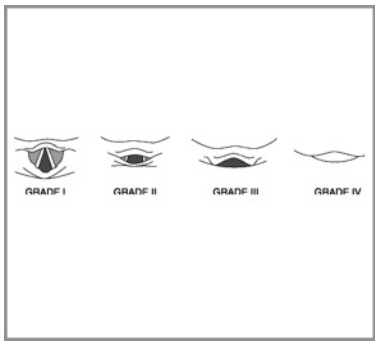
C-The C-Mac: The C-MAC videolaryngoscope has an original Macintosh type steel blade shape with no edges and gaps for hygienic traps and is now available in 3 sizes (2, 3, and 4). At the tip it has an optical lens with an aperture angle of 80° and a small digital camera and a high-power light-emitting diode that displays a crisp color image to a lightweight, portable high-resolution liquid crystal display monitor. The advantage of this system is the fact that since it uses the same blade design as regular D.L it requires the least amount of technique modification between direct and indirect laryngoscopy views compared to other systems. There is also another blade design the D-Blade that is specifically designed for difficult intubations.



Aids to Facilitate Laryngoscopy and Intubation

1. **Malleable Stylets**: The use of these aids for laryngoscopy and intubation dates back to the 1920s and represented a major breakthrough as aids for intubation. In the 1940s the design changed to include atraumatic ends and later copper was used to make them malleable. As discussed before in the urgent or emergent setting, ETTs should include a malleable stylet to facilitate the intubation. The recommended approach is to place the stylet in advance, making a bent or curve at the distal end of the ETT right above the cuff, making the ETT-stylet take what is known as the "hockey stick" appearance. It is important for the tip of the stylet not to protrude beyond the tube tip in order prevent trauma to soft tissues, larynx, and trachea.

2.Gum-elastic Bougie: One of the most popular methods used is the gum-elastic bougie. This device was developed in the 1970s and it is also known by its commercial name the Eshman bougie. There are two versions reusable and disposable. This device is best suited for patients in whom the laryngeal view is limited, as described originally by Cormack and Lehane in 1984 when they classified the degree of difficulty predicted on laryngoscopy [11]



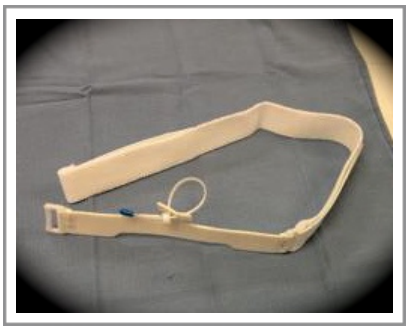
according to the glottic view obtained. The recommended approach is to place the device (which has an angled bent tip) underneath the epiglottis and advanced it into the glottic opening and trachea in a blind fashion, with the correct placement judged by the irregular sensation felt while the bougie is advanced and it touches the cartilaginous trachea, and by the fact that if indeed the bougie is inside the trachea, it is not possible to advance it beyond 30 cm of length. Once the bougie is placed, the ETT can be "railroaded" over the bougie usually with the help of an assistant that stabilizes the bougie in place while the operator performs a laryngoscopy to facilitate advancement of the tube. Confirmatory maneuvers must be made to rule out the possibility of esophageal intubation. Every difficult airway cart or tackle box should have one of these devices available, and every practitioner should practice the technique first with mannequins and then in normal patients, so that if confronted with a difficult patient they have the mechanics of using this device already developed. There are other introducers available in the market whose function and principle are similar to the original Eshman bougie.

3-OELM (Optimal External Laryngeal Manipulation):

This maneuver also known as BURP (backward, upward, rightward pressure), was described in 1993 by R.L. Knill[12]. The object is to bring the larynx into view if for some reason the glottic opening is located too anteriorly or to the left and therefore placement of the ETT is difficult. Remember normally the laryngoscope is placed to the right side of the mouth and moved to the left displacing the tongue; the laryngeal view is located to the right side of the laryngoscope opening. The BURP maneuver is designed to exaggerate this principle. There are two methods of performing it: one by an assistant who knows the principle and places pressure in the thyroid cartilage (upwards and to the right) or a guided one in which the person performing the laryngoscopy guides the assistant into the optimal direction and degree of pressure that affords the best glottic view.

ETT Fixation

Once the correct ETT position has been confirmed, the next step is to secure the tube in place to prevent tube migration and even extubation. The most common method is with adhesive tape; however, in individuals who have excessive secretions or have full beards this might be challenging. The use of circumferential tape around the neck has been recommended to be the most reliable method for tube fixation. Keep in mind that if not done properly it can restrict venous return from cranial **structures.** Newer commercially available products are available that combine the features of adhesive and nonadhesive methods and increased safety while keeping comfort and therefore have shown to be great choices for tube fixation.



The Extraglottic devices including the LMA

The LMA was introduced in 1988 in the U.K and in 1992 in the U.S. It was developed as an alternative to either ETT or face mask ventilation. It is considered by some to be the most important development in airway management of the second half of the 20th century. The LMA is the only noninvasive device explicitly recommended by the ASA algorithm for the management of the difficult airway. It has received endorsements from the European Resuscitation Council, the AHA, and NASA. [13-27]

It is a wedge-shaped miniature inflatable mask (although some newer models have no inflatable component) that is placed blindly and seats in the lower pharynx, creating a seal and covering the glottic opening. The LMA can be used as a definitive airway device, as a conduit for intubation, and as rescue airway device when either BMV or ETT by DL (or both) fail. In the emergency setting it is this "rescue" feature along with the fact that the device is placed blindly (no need to see the glottis) that is most attractive. Currently, there are numerous kinds of LMA's and LMA-like products; these are derived from the original product and are part of the "supraglottic airways" family (SGA). Regardless of which SGA device its used, the principles and technique of insertion, the drawbacks and potential complications are similar among these devices. SGA's come in multiple sizes, from pediatric to adult (typical male adult patient uses a #5, typical female a #4).

The recommended technique for insertion (as described by the original inventor) is like "imitating the act of swallowing":

a) The device should be deflated and slightly lubricated.

b) Use your fingers as guides. The mask is introduced, pressed into the palate, and directed to the hypopharynx until the base of the mask passes behind the tongue.

> A major mistake in airway management is to attempt something for the first time in a difficult patient or case. Mastery of any new airway technique should be done in a non-stressful simulated environment, and then tried on a normal "easy" patient, before it is ever attempted in a real difficult case without supervision.

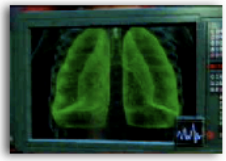
c) At this point, the mask is inflated via the pilot balloon, and it should seat nicely, covering the glottis. The recommended approach is to use a mask size that allows the lowest pressure possible (no more than 30 cc of air). If there is a leak the mask should be repositioned and/or the size changed; avoid overinflating the mask as it only increases the leak.

LMA-Supreme

There is a newer model of the LMA called the LMA-Supreme a latex-free, single-use device that has shown many advantages compared to the original classic LMA, allowing easier placement without the need to use the operator's fingers inside the patient's mouth; it has a different cuff design that provides a better seal and allows positive-pressure ventilation. It also has a gastric port to allow the suction of gastric contents. It is definitely a step further in the evolution of the design of the LMA. The insertion technique is similar as described for the LMA-Classic; however, as mentioned it is easier to use.

Igel

There is a newer kind of LMA-like device called the iGel. This device has a soft, gel-like, non-inflatable cuff, designed to provide an anatomical fit over the laryngeal inlet. The shape, softness and contours accurately mirror the supraglottic anatomy. No cuff inflation is required, It is simple to use, it provides a good seal, it has a gastric port and it is easy to insert and displacement trauma are significantly reduced.

	Method	Problem (s)
	1-Visualization of the ETT during placement.	1-Distraction/ Inatention. 2-Mistaken identity of the larynx. 3-Displacement of the ETT. 4-Inability to view larynx
	2-Outward expansion of the chest is a reliable sign.	1-Difficult in obese patients. 2-Difficult in case there is large breast tissue. 3-Difficult in case of chest wall rigidity.
	3- Auscultation	1-Quality of breath sounds vary. 2-Gastric noises can and have been mistaken as lung sounds and visceversa.

Confirmation of Ventilation,ETT and SGA Placement:

As important as the above mentioned steps are, confirming that the tube is in the desired location and not in the esophagus is of outmost importance. The ideal test or method to confirm ETT placement does not exist. Observing the ETT passing through the level of the vocal cords, and visualization of the tracheal rings with fiberoptic assistance and chest x-ray are the most sensitive markers of tube location. However, they are not practical. Observing the ETT while it is being introduced may not be easy since the ETT obstructs the vision as it approaches the glottic opening. There might be an incomplete view of the laryngeal opening in the first place, and also displacement of the ETT after it has been "correctly" placed. Fiberoptic availability in emergency situations is not practical and is virtually impossible. Radiographic confirmation, although reliable, is not practical in the acute/emergency setting due to the time it takes to shoot and develop an x-ray. Other methods have been used for this purpose:

a. Presence of bilateral breath sounds.

b. Absent gastric sounds and distention.

c. Chest rise.

d.ETT fogging or condensation.

e. Pressure change in the pilot balloon when the suprasternal notch is pressed.

f. Esophageal detector.

However, none of these options are very sensitive, they have limitations and, at one point or another, all have failed. See table above.

CO2 Detection

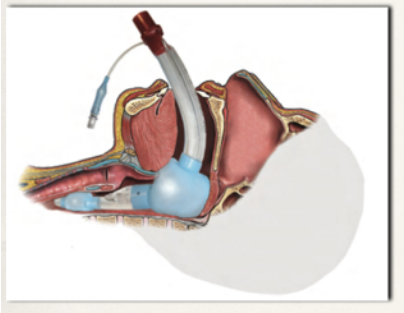
The presence of exhaled CO2 detected by way of colorimetric change or by capnography (in the emergency setting and in the field, is the "gold standard"). However, keep in mind that qualitative CO2 detection is not reliable in the presence of cardiac arrest (absent pulmonary blood flow), in cases of severe bronchospasm or if the ETT is kinked. Also, It can detect correct respiratory tract tube position, but not whether you have a mainstem bronchus intubation. Therefore, it is not a substitute for a healthy dose of paranoia and obsessive-compulsive instinct to detect if the tube is in the right or wrong position.

Emergency Tracheal intubation is a potential minefield for disaster. A common problem encountered is of accidental esophageal intubation; this problem happens even to very experienced and skilled operators.
However, esophageal intubation is not harmful…. Injury comes from undue delay in detection, and corrective actions.

Laryngeal Tube:

It is a non-latex tube that is designed as a single-lumen extraglottic airway; it has dual cuffs one (pharyngeal and esophageal) with a single pilot balloon that inflates them both. It is designed to be placed without the need of any external instruments and to seat in the hypopharynx and esophagus. The laryngeal tube lies along the length of the tongue and the distal tip is positioned in the hypopharynx. The proximal cuff provides a seal in the upper pharynx and the distal cuff seals the esophagus; The recommended cuff pressure is around 60 cm H2O.

The distal aperture should face the glottic aperture, however since this is not always possible, ventilation through the laryngeal tube may often be adequate even if the distal aperture is not facing the glottis directly.



The incidence of complications associated with the use of the laryngeal tube is similar to that for the LMA, although the laryngeal tube may require more re-adjustments of its position to obtain a clear airway. It comes in sizes 0 for infants less than 5 Kg to size 5 for adults. There is a color code and, in most adult males, the one with either red or violet color should be used. Placement is blind, similar to that of the Esophageal Combitube, however it is definitely easier to use; it is softer and tends to cause less trauma to oropharyngeal structures. Because of its shape and length, tracheal placement usually does not occur. The depth of insertion can be monitored by external marks. The manufacturer claims it can deliver positive pressure up to 30 cm of H2O. A specific model the King LTS-D also has a gastric port that allows placement of up to an 18 Fr gastric tube, and it also has a port that allows placement of an exchange bougie or a fiberoptic scope to confirm placement [49-54] The LT has become quite popular by EMTs/ paramedics with acceptable success rates in adult out-of-hospital cardiac arrest patients compared to others devices. It is however not free from complications and difficulties and as every other device its use must be practiced on a simulation setting prior to trying it on real patients.

Airway Management Plan

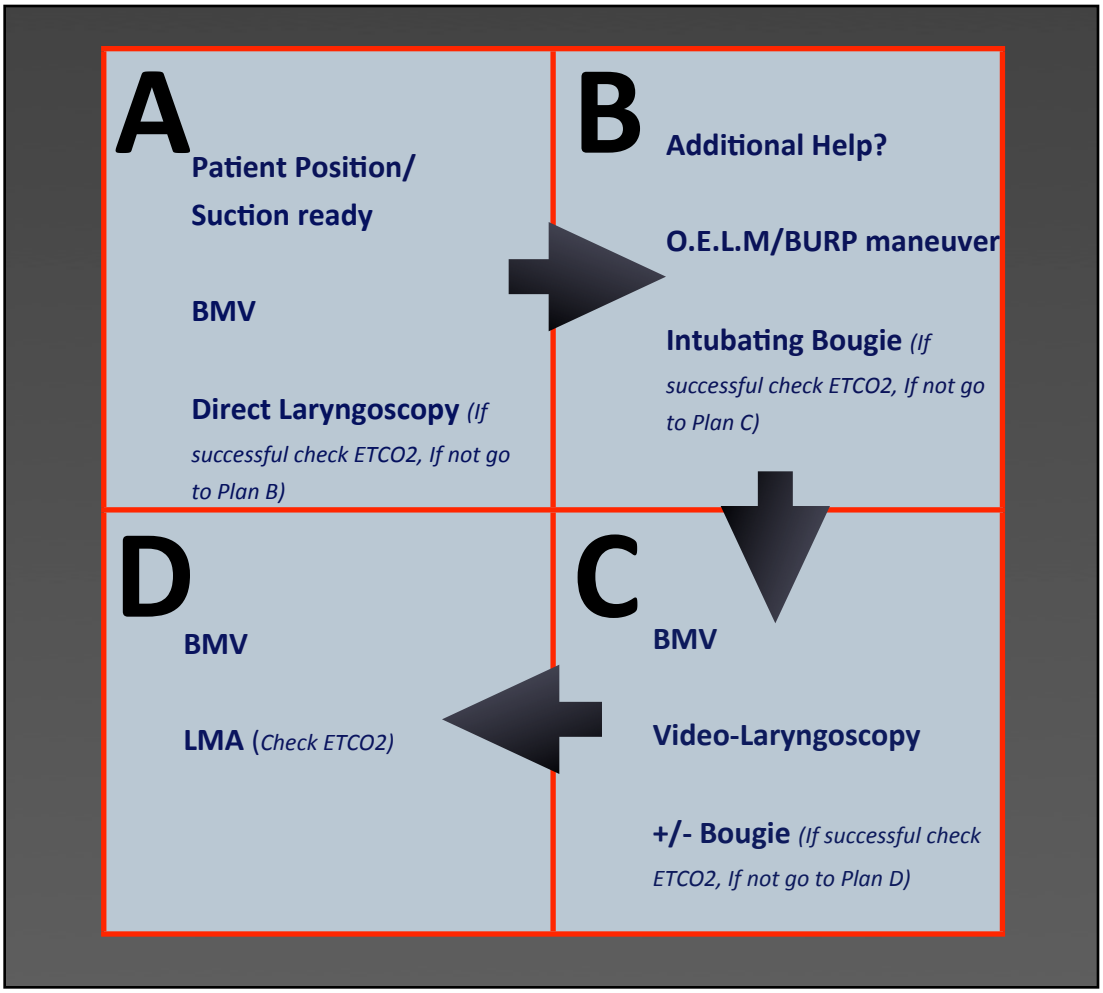
A plan is a list of steps used to achieve an objective. In this case our objective happens to be to either maintain or establish oxygenation and ventilation. Whether one is confronted with an Urgent airway with a patient whit a respiratory status that is deteriorating and needs support and eventual intervention for example airway assistance and/or eventual intubation, or an Emergent Airway with a patient who needs immediate support and intervention for example during a code blue situation, you will be part of the emergency response team and therefore you will be called during some uncontrolled setting with a patient that needs an intervention. My advice is for you to take the role of a leader, assemble a team to support and help you, establish clear roles and tasks; effective and clear communication between team members is a must. Resource allocation and equipment familiarity are very important to achieve adequate goals. Airway management is always a "Team sport". I cannot over emphasize enough the during an emergency you should call for help early and call for help often.

Analyze why you need to instrument and manipulate the airway; your options may vary depending on the patient conditions and circumstances. Does the patient have an oxygenation problem, a ventilation issue or both? this might determine what your plan of action will be. What is the best timing and location to carry out your intervention? Do you need to intervene immediately? There might be issues you absolutely have no control of, but use your best judgement. Do you have the necessary tools, pharmacologic support and help to handle the patient's airway? Always remember that although for decades emergency airway management has been synonymous with tracheal intubation, currently we have other options that although not definitive might be beneficial and less risky for the patient.

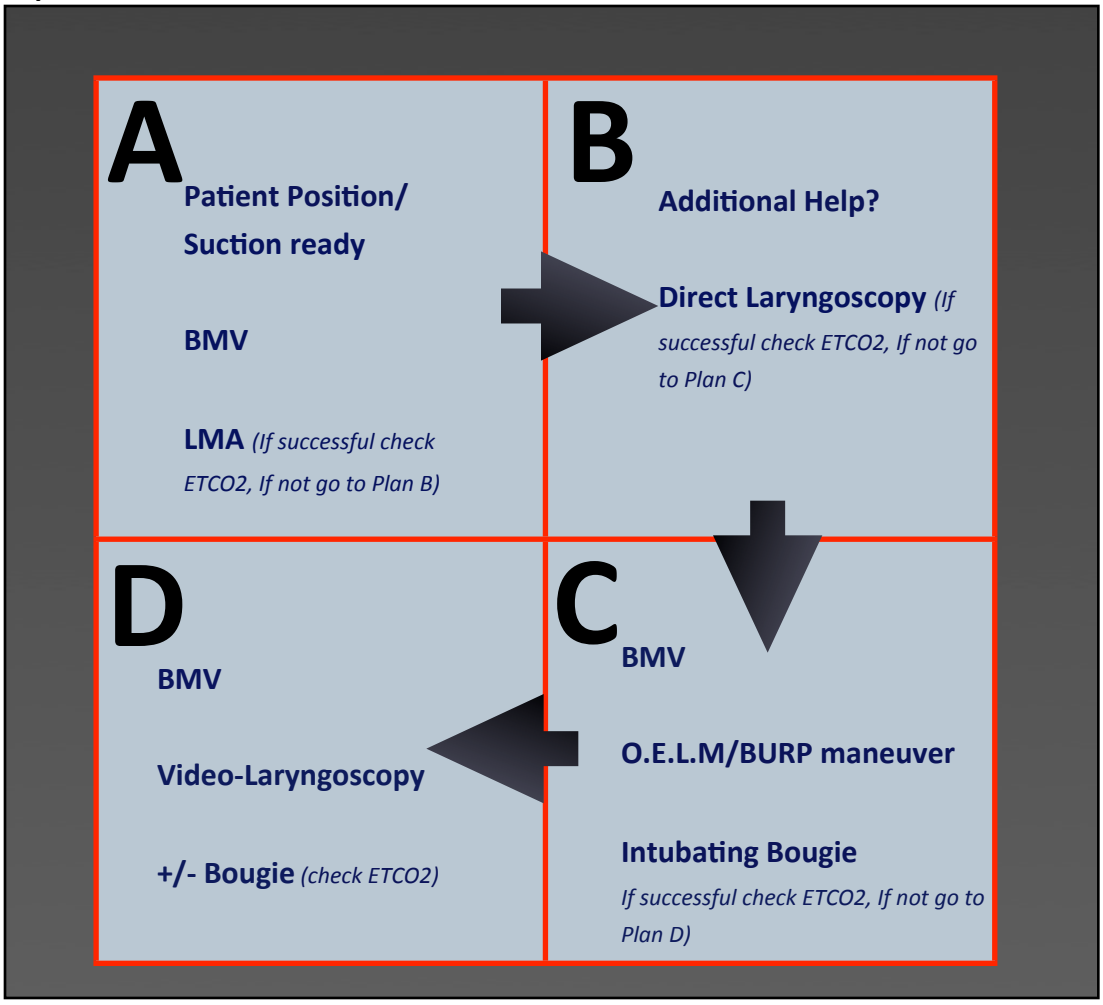
I approach an emergency case with a "DAMAGE CONTROL" philosophy; I tend to have a backup plan for my initial backup plan and a backup plan for that as well; to me being redundant and compulsive has been beneficial. Before I begin instrumenting the airway I already have made a decision about what I will be doing next in case for some reason or another my initial intervention failed or proves to be difficult. Experience has taught me that a common mistake even for seasoned practitioners is "blind persistence";

Why keep trying the same device or technique rather than trying something else? If your Plan A fails, move to Plan B and C. Which brings up another important issue: Do what you do best. Do not try something new you have never attempted or rehearsed or taught during an emergency case; the chances of you being successful are slim to none.

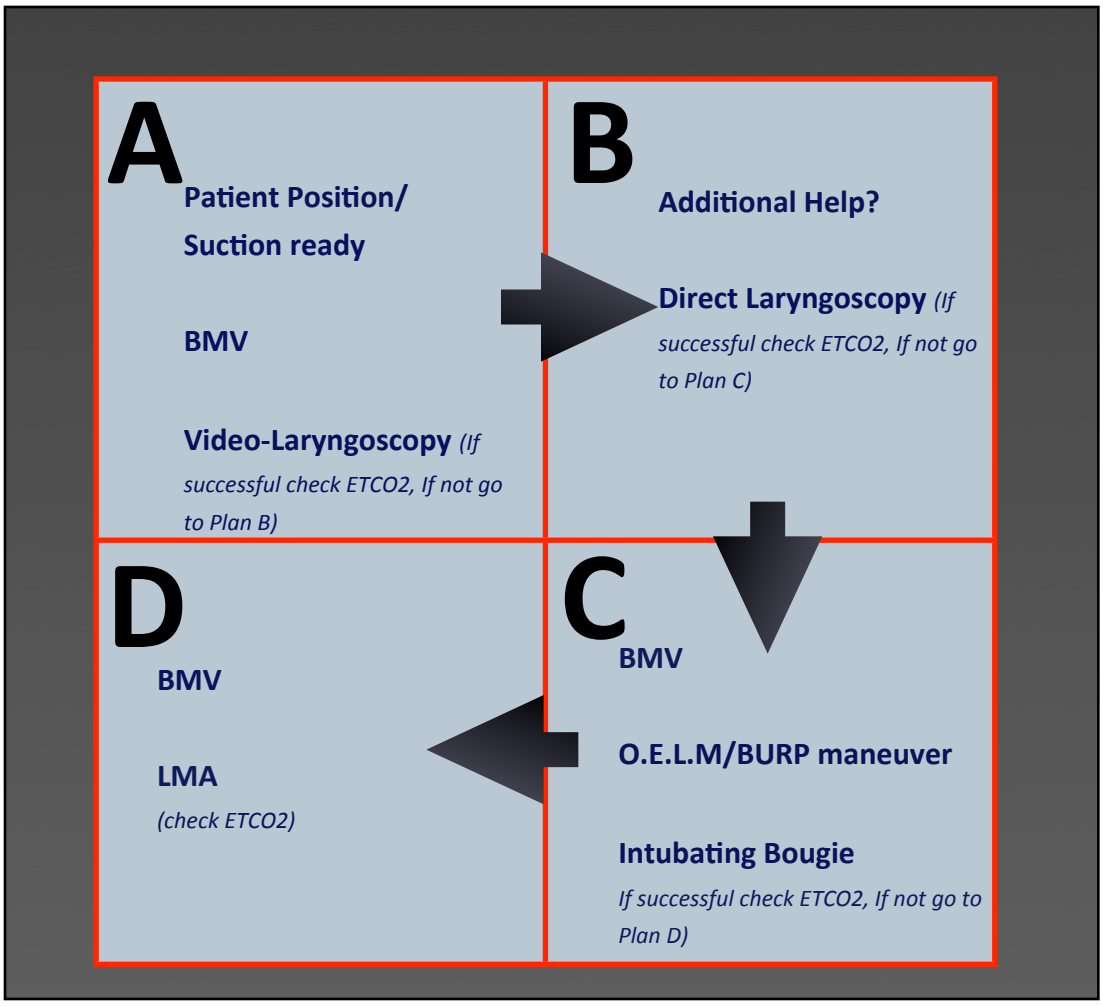
There are several published approaches at airway management and intubation that are beyond the scope of this handout or training. The most recognized is the one made by the American Society of Anesthesiologists (ASA) that periodically update their Practice Guidelines for the Management of the Difficult Airway. They were also the first to come out with an algorithmic approach for airway management that has been modified in many different countries and by different medical societies and organizations. An algorithmic approach to the management of the airway has several advantages and while the ASA might be the gold standard it is also complex and not easy to apply out of the context of surgical care. I think every practitioner that will be in charge of airway management, should follow a plan that is comprehensive but at the same time easy to follow. Below you will find a simple #4 step plan for initial airway management (Plan A) and #3 steps for back-up and rescue in case Plan A fails. Feel free to change the options, for example plan to place an LMA as your first option and have D.L as a back up; or make Video-laryngoscopy your first option and make either an LMA as your plan B and D.L your Plan C, or make D.L your plan B and the use of a bougie your Plan C....regardless what is important is to always have alternatives and backup techniques and devices, to assure that your intervention will have a greater chance of success. Each patient and situation more than likely will make you adjust your plans, but is is best to have to adjust and modify a plan rather than not having one in the first place. Afterwards, you must always use the intubation template in CPRS, to document your management plan.



Option #2


A
Patient Position/
Suction ready
BMV
LMA (If successful check ETCO2, If not go to Plan B)
B
Additional Help?
Direct Laryngoscopy (If successful check ETCO2, If not go to Plan C)
C
BMV
O.E.L.M/BURP maneuver
Intubating Bougie
If successful check ETCO2, If not go to Plan D)
D
BMV
Video-Laryngoscopy
+/- Bougie (check ETCO2)

Option #3


A
Patient Position/
Suction ready
BMV
Video-Laryngoscopy (If successful check ETCO2, If not go to Plan B)
B
Additional Help?
Direct Laryngoscopy (If successful check ETCO2, If not go to Plan C)
C
BMV
O.E.L.M/BURP maneuver
Intubating Bougie
If successful check ETCO2, If not go to Plan D)
D
BMV
LMA
(check ETCO2)

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