

# The critique of the American Society Of Anesthesiologists. Difficult airway algorithm: a practical approach to the "critical" airway

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Conflict of interests: Dr Adrian Maticoc is the inventor of the ergonomic face mask and receives royalties from King Systems Inc.

## The airway management algorithms

Humans can not store oxygen for prolonged period. It is the health care provider's essential responsibility both inside and outside the operating room (OR) to provide the patient with oxygen to prevent irreversible organ injury (neurologic compromise) or death. Difficulty in managing the airway is the single most important cause of major anesthesia-related morbidity and mortality.

An airway algorithm may assist the practitioner to reach an optimal outcome. The challenge of applying an airway algorithm stems from having to complete two distinct steps. The theoretical (cognitive) step requires clinical knowledge and judgment and matures in "clinical experience". The practical step refers to the actual instrumentation of the upper airway and requires "skill" with different airway devices.

The first airway algorithm was published in 1993 and revised in 2003 by the American Society of Anesthesiologists (ASA) (1). The ASA Difficult Air-

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way Algorithm (DAA) offers guidance for the management of the anticipated and unanticipated difficult airway (Fig.1).

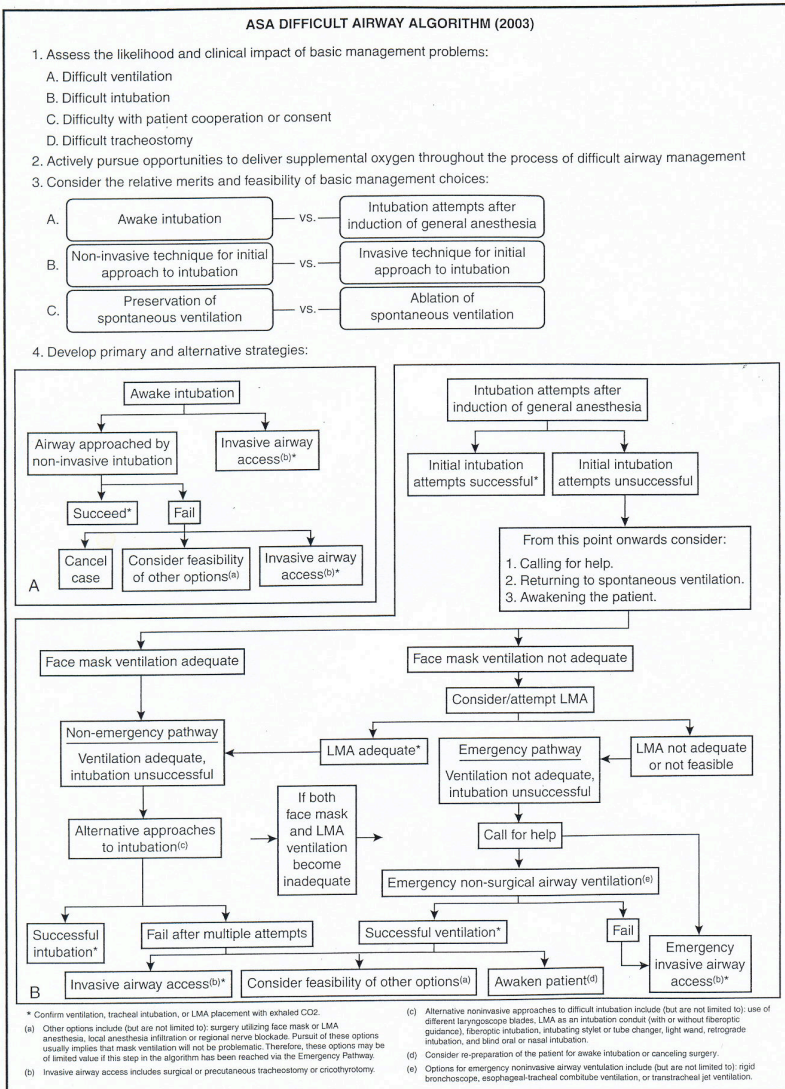


Figure 9-1B Revised American Society of Anesthesiologists' (ASA) difficult airway algorithm. (From Practice Guidelines for the Management of the Difficult Airway: An updated report by the American Society of Anesthesiologists Task Force on the Management of the Difficult Airway. Anesthesiology 98:1269-1277, 2003.)

Fig.1. The American Society of Anesthesiologists Difficult Airway Algorithm.

The British and the Canadian DAA give recommendations only for the unanticipated difficult airway while the French, German, and Italian have recommendations for both the anticipated and unanticipated airway (2). While all these complex algorithms cite several airway devices, none of them is actually endorsed by the respective national organization. As mentioned in the ASA DAA "the devices should be customized to meet the specific needs, preferences, and skills of the practitioner and healthcare facility".

Simple institutional algorithms using automatic conversion to one specific airway device once the direct laryngoscopy or face mask ventilation failed were criticized as they "may limit the anesthesia provider from applying individual problem bases solutions in the event of inadvertent difficult intubation"(3,4).

All these guidelines are structured on the same core concepts:

1. Build around the endotracheal direct intubation (DI).
2. Contrast the "easy" with the "difficult" airway.
3. Emphasize the primacy of oxygenation at all times.
4. Underline the need to avoid multiple ventilation or intubation attempts with the same technique, diagnose failure early, and apply quickly a (practiced) Plan B when Plan A fails.

#### **Limitations of the ASA DAA**

The ASA DAA has practical limitations relevant to the "nonelective/emergent" airway:

1. The clinical endpoint is successful direct intubation. However, when direct laryngoscopy or intubation is difficult and the patient is hypoxic, oxygenation should be the primary goal. In this situation DI can only be a secondary goal (5).
2. There are specific categories of patients that are not included in the ASA DAA: pediatric, obstetric, nonfasted, and patients with obstruction at or below the vocal cords.
3. Two essential strategies of the ASA DAA returning to spontaneous ventilation and awakening the patient can not be applied in the nonelective/emergent circumstances.
4. The algorithm is too complex to be remembered but not complex enough to cover all the clinical situations inside and outside the OR.
5. The algorithm does not detail the use of muscle relaxants, cricoid pressure, and manual in line stabilization.
6. The algorithm does not include the assessment for a difficult supra-glottic airway (SGA, e.g. laryngeal mask airway) or a difficult indirect laryngoscopy or intubation (e.g. Glidescope, Airtraq).

7. The algorithm does not provide a definitive flowchart for extubation.
8. The application of the ASA DAA improved the claims for injuries (death/ brain damage) due to inadequate ventilation during induction of anesthesia but other phases of anesthesia (maintenance, tracheal extubation, and recovery period) did not significantly change. The use of ASA DAA improved airway management in the OR for the elective induction but the odds of death/ brain damage were increased by the development of an airway emergency (6).

What do these limitations mean for our daily practice?

### The elective vs. the nonelective airway

The traditional airway management teaching contrasts the "easy" with the "difficult" airway. The limitations of the ASA DAA can be analyzed by contrasting the "elective" with the "nonelective" airway.

The four variables of the airway management are: personnel (experience and skill of the practitioner and the help available), equipment, patient (comorbidities and airway difficulty), and time (to cerebral damage or death) (Fig. 2).

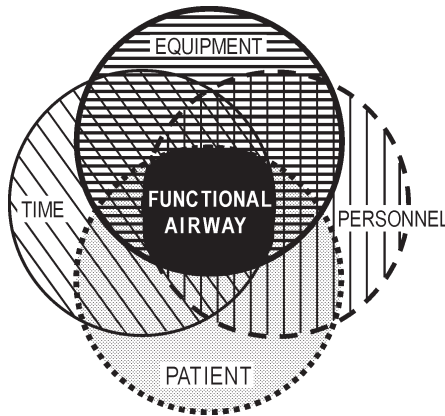


Fig. 2. The variables of the airway management: the personnel, equipment, time, and patient

The indication for the "elective" airway management in the OR is the induction and maintenance of a general anesthetic:

1. The personnel are a homogenous group of highly skilled anesthesia providers.
2. The OR is a controlled environment with all the equipment available (patient positioning and airway management).
3. Time is not limited as the surgical procedure is elective and can be de-

layed or even canceled.

4. The patient is usually cooperative and "stable". A cooperative patient and sufficient time allow a standard evaluation of the upper airway and adequate preparation for an anticipated "difficult airway" (face mask ventilation - FMV, supraglottic airway - SGA, direct and indirect intubation, cricothyroid membrane technique).

According to the ASA DAA the marker of the elective airway management is the ability to anticipate a difficult airway and the decision to secure the airway before induction of general anesthetic. The elective airway management is customized to avoid a crisis that does not exist at the beginning of the airway instrumentation. Airway management in the elective airway is focused on the "airway difficulty".

The management of the "nonelective/emergent" airway is usually a lifesaving procedure applied in suboptimal environment:

1. The personnel are heterogenous, limited, and sometimes unqualified.
2. The equipment may be suboptimal: not all the airway devices are available, the suction system may not function, the equipment necessary to optimally position the patient is unavailable or inapplicable, the intravenous line may be lost, the monitors and alarms are deficient, confirmation of the endotracheal tube position may be challenging.
3. Time: there is a certain urgency to the management of the nonelective airway. Time is measured in minutes ("emergent") or seconds ("crash"). The procedure is life saving and can not be cancelled.
4. The patient may be "unstable" with limited physiologic reserves. The medical condition of the patient dictates the urgency of the airway management. Patient characteristics other the "airway difficulty" may increase the complexity of the airway management: nonfasted, unresponsive, uncooperative, ineffective preoxygenation, head in neutral position, rigid collar, cricoid pressure, and manual in line stabilization. An uncooperative patient and limited time translates into a substandard airway evaluation.

In the non-elective environment any of the variables can impact the airway management outcome: an "easy" elective airway may become "difficult" with an inexperienced intubator, faulty or unavailable equipment, no time, and/or poor access to a critically ill patient. Specific conditions may dictate to avoid induction or paralytic agents further generating suboptimal laryngoscopic conditions. In this suboptimal environment there is a high incidence of regurgitation and aspiration, rapid desaturation, and difficult or failed direct intubation. Assessment and anticipation of the difficult airway in general and the difficult DI in special is substandard. The nonelective/

emergent airway is "inherently" difficult with a high rate of complications (7).

The non-elective/emergent airway management is performed to resolve a crisis that exists at the beginning of the airway instrumentation. The crisis is not necessarily airway related. Airway management in the nonelective/emergent airway is focused on both the uncontrolled variables and the "airway difficulty".

Considering all the variables (and especially the ability to anticipate a difficult airway) the elective and the nonelective airway are two different propositions. While the former is well served (during induction) by the ASA DAA the latter is not.

### The critical airway

The complexities of the nonelective/emergent airway are best represented by a new paradigm: the critical airway (CA). The CA is an "umbrella" concept that considers all the airway management variables and the dynamics of the nonelective airway ("difficult", "emergent", "crash", and "failed") in the context of a suboptimal environment. The marker of the CA is the degree of hypoxemia, the speed of the oxygen desaturation and the level of consciousness.

Anticipation of clinical entities and patients with high incidence of CA allows preparation at individual (training) and institutional (equipment, policies) level:

- outside the OR: the prehospital, emergency department, intensive care, oversedated patient, recovery room and resuscitation airway;
- in the OR: the "unanticipated" difficult airway, trauma, "full" stomach, obstetric, and the postextubation airway;
- patients at high risk for oxygen desaturation- obese, morbidly obese, and critically ill - need quick intervention as apneic period are poorly tolerated.

The time available for the clinical assessment (consciousness, vital signs, "airway difficulty") may be limited and a decision may be taken with minimal information. The criteria for predicting a difficult DI have questionable accuracy in the cooperative patient for elective procedures (low sensitivity and modest specificity) (8). It is unclear how incomplete information can be used to anticipate difficult DI in the CA (9). In this context even with an anticipated difficult intubation the lack of time and equipment may force the practitioner to deviate from the ASA DAA. In the CA because of lack of time and substandard conditions the airway "difficulty" may reveal itself during the actual emergent instrumentation.

The CA management is defined by the immediate need to oxygenate the patient in a suboptimal environment with limited ability to anticipate the airway difficulty. Mort found in the ICU a significant increase in the rate of airway related complications in critically ill as the numbers of the laryngoscopic attempts increase (<2 versus >2 attempts): hypoxemia (11.8% vs. 70%), regurgitation (1.9% vs. 22%), aspiration (0.85 vs. 13%), bradycardia (1.6% vs. 21%), and cardiac arrest (0.7% vs. 11%). It is the practitioner's responsibility to mitigate the morbidity and mortality related to intubation by limiting the laryngoscopic attempts (10).

The first ventilation device we usually reach for is the FM (familiar, ubiquitous, easy to assemble, noninvasive) and the laryngoscope for DI (familiar, considered the "gold standard"). In the CA management any device can be the "primary" device as long as the practitioner is trained and is comfortable with its use. No airway device is specifically designed as a "rescue" device for a difficult airway scenario.

The common events leading to injury when airway management is centered on DI are inadequate ventilation, esophageal intubation, and difficult tracheal intubation (11). A SGA is in the unique position to assure adequate ventilation, with esophageal intubation (SGA are placed in the upper esophagus) avoiding the trauma of multiple direct intubations. A SGA can be used as a primary device to assure immediate oxygenation or as a rescue device when FMV or intubation attempt failed or is difficult (12). The pre-hospital literature coined the "rapid sequence airway" term to describe the primary use of a SGA (laryngeal mask airway - LMA) in a critical patient during transport after administration of induction and paralytic agent (13). A SGA in situ is a "dedicated airway" that maintains the airway patency and oxygenation while converting it to an endotracheal tube with a fiberoptic scope (14).

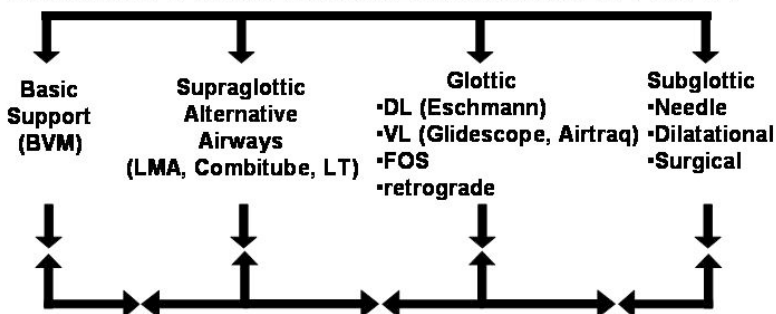
Indirect laryngoscopes (videolaryngoscopes) are new devices that do not need the alignment of the oral-pharyngeal-laryngeal axis for intubation and can be used as the first intubation choice or when direct laryngoscopy and intubation failed. The Airtraq is a disposable optical indirect laryngoscope that was used as the primary technique to manage anticipated difficult airways in elective (OR) and nonelective (ICU) situation (15).

These concepts are built in the CA Flowsheet presented in Fig. 3: the practitioner has to recognize the indication for airway management, assess the airway ("difficulty"), assess the urgency ("emergent" or "crash"), call for help, attempt preoxygenation and positioning of the patient, titrate the pharmacologic agents, optimally apply the airway device of choice (Plan A), immediately diagnose a "failed" ventilation or intubation attempt, monitor

oxygenation, and be able to apply a timely Plan B, C. Rapid development of severe hypoxemia (with bradycardia) is an indication of imminent intervention with an invasive cricothyroid membrane technique.

## Rapid Clinical Assessment

### Determination of the Initial Airway Management Approach ("Plan A")



#### ***Failed initial attempt:***

- 1) Can initial attempt be improved?**
- 2) Rapid progression to "Plan B"**

Fig.3. The Critical Airway Flowsheet: any of the options can be used as the "primary device"-face mask, supraglottic airway, direct and indirect intubation, and cricothyroid membrane techniques.

### Optimal first attempt (instrumentation)

The CA management should provide maximum oxygenation with minimum instrumentation. An optimal first attempt with an airway device may mitigate the limited ability to anticipate the "difficult" airway.

The FMV is a "blind" technique: manipulation of bony structures (mandible and cervical vertebrae) will relieve the obstruction generated by pharyngeal soft structures (soft palate, tongue, and epiglottis). Face mask ventilation in the CA usually means ventilation of an unprotected airway in a "full" stomach patient. An optimal FMV attempt consists of an effective seal and a patent airway. Airway patency has to be maintained during inspiration and expiration using a validated airway maneuver by increasing the mentum-sternum distance (for one handed technique: chin lift with head extension and for the two handed technique: jaw thrust). The goal is adequate ventilation (~ 500cc with high oxygen concentration) with minimal inspiratory airway pressure to minimize stomach inflation and regurgitation (16).



The SGA are classified in the cuffed perylaryngeal sealers (the "LMA" family) and the cuffed pharyngeal sealers (the "Combitube" family). Ventilation of the "full" stomach patient may be better served by a SGA that offers access to both the respiratory and digestive tract (the ProSeal LMA, the LMA Supreme, the I-Gel, and the Combitube, the EasyTube, and the Laryngeal Tube-S) (Fig. 4).



Fig 4. Supraglottic airway devices with access to both the respiratory and digestive tract.

The ProSeal LMA insertion is optimized by using an Eschmann bougie placed in the digestive port and a laryngoscope for insertion of the bougie in the esophagus. Sliding the ProSeal LMA along the bougie will assure that the cuff will not fold over and the tip of the cuff will be wedged in the esophagus both key elements for the proper placement of the device (17) (Fig. 5).

A rapidly growing field in the airway management is the indirect laryngoscopy. There are two categories of indirect laryngoscopes: un-channeled and channeled. The Airtraq is a "channeled" battery operated disposable optical indirect laryngoscope. It has the screen incorporated in the device and the channel on the right side acts for the housing of the endotracheal tube (Fig. 6). The Airtraq is easy to learn and is superior to the Macintosh blade in both difficult intubation and cervical immobilization cases (18,19).



*Fig. 5. The optimized insertion of the ProSeal LMA with an Eschmann bougie and a Macintosh laryngoscope.*

A technique not mentioned in airway algorithms is the combination of advanced airway devices. The fiberoptic scope was used in combination with the Macintosh blade, SGA ("dedicated airway"), and indirect laryngoscopes.



*Fig. 6. The AIRTRAQ: the disposable indirect optical laryngoscope with a built in screen and the endotracheal tube housed in the lateral channel.*

## Conclusions

The CA is a new paradigm proposed to assist the nonelective/emergent airway management in and outside the OR. The CA is focused on the oxygenation and not the intubation of the patient and contrasts the elective with the nonelective airway. The ultimate goal of the practitioner is to be able to adapt to the suboptimal conditions of the nonelective environment and to use quickly and optimally the airway device of choice to achieve oxygenation and intubation without complication (aspiration, cardiac and neurological complications).

In the elective airway the ASA DAA assists the practitioner to avoid the "can not ventilate - can not intubate" (CV-CI) situation. At the other end of the airway management spectrum the nonelective/emergent "CA" is not well served by this algorithm. The CA paradigm assists the practitioner to avoid the "can not oxygenate - can not intubate" (CO-CI) situation. This should be read as "can not oxygenate after an optimized FMV and/or SGA attempt and can not intubate after an optimized direct and/or indirect intubation attempt". These options should be exhausted in a timely manner. The CO-CI is an indication for a lifesaving invasive cricothyroid membrane technique.

Training for advanced airway skills acquisition is a personal effort build on the available Guidelines and should take place in the OR in an elective environment. Controlling the variables of the airway management is an institutional effort.

It is very unlikely that further research will improve our clinical ability to assess the CA "difficulty". Further research should focus on our ability to improve the variables surrounding the CA management, the pharmacology of the CA, and in defining the "optimal" use of devices (in a suboptimal environment) in all four dimensions: FMV, SGA, direct and indirect intubation and cricothyroid membrane techniques.

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