THE EFFECT OF NEUROMUSCULAR AGENTS ON THE DIFFICULT AIRWAY MANAGEMENT

Zekeriyya Alanoglu*

It is widely recognized that the two most important tasks for anesthetists are the management of a difficult airway and the maintenance of oxygenation (1). Problems related to difficult airway are considered to be leading cause of life threatening anesthesia related accidents (1, 2). Even though, most cases of unanticipated difficult intubation are managed very well by the anesthesiologist a common sense and an objective approach needed for a similar clinical scenario. Many algorithms were established by different Anesthesiology Societies (3-9). The most widely used difficult airway algorithm is "Practice guidelines for management of the difficult airway An updated report by the American Society of Anesthesiologists Task Force on Management of the difficult Airway" published by American Society of Anesthesiologists (4). Most of the national societies published their own algorithms but the influence of the ASA`s guideline may clearly be observed. In this presentation the ASA`s guideline is used and referred unless otherwise is stated. The first impact of the algorithms was setting the definitions for the difficult airway. Setting the definitions helps the clinicians to speak in the same language for the same clinical problems.

There are four common definitions set by the ASA (4).

Difficult Airway: It is the clinical situation in which a conventionally trained anesthesiologist experiences difficulty with face mask ventilation of the upper airway, difficult with tracheal intubation or both.

Difficult face mask ventilation: Insufficiency in mask ventilation due to inadequate mask seal, excessive gas leak or excessive resistance to the ingress or egress of gas. Kheterpal S. et al. (10) reported the incidence of

* *Ankara University School of Medicine, Department of Anesthesiology and ICM*

difficult mask ventilation and impossible mask ventilation as 1.4 % (n=313) and 0.16 %, respectively in a large scale study (n=22 600). On the other hand Yildiz et al reported a slightly higher incidence of difficult face mask ventilation (7.8 %).

Difficult laryngoscopy: It is not possible to visualize any portion of the vocal cords after multiple attempts at conventional laryngoscopy. The incidence of difficult larygoscopy was reported as 1.5-13 %.

Difficult tracheal intubation: Tracheal intubation requires multiple attempts, in the presence or absence of tracheal pathology. The incidence of difficult intubation varies as the concept may be split into two a predicted and unpredicted. The incidence of predicted and unpredicted difficult intubation is 4.5-7.5 % and 1%.

Failed intubation: Placement of the endotracheal tube fails after multiple intubation attempts.

Can`t ventilate Can`t Intubate (CV/CI): As it is so clear by the definition itself, this is a nightmare scenario of an anesthesiologist.

The main role of the anesthesiologist is the effective oxygenisation of the patient. However, this may be a very challenging task especially in patients with difficult airway. That`s why this difficult task may lead life threatening situations and a common basis for legal actions. On the other hand during the management of the difficult airway much more common complications such as trauma to lip and/or face, damaging the teeth and the airway, severe hypoxia and hypoperfusion, surgical airway may occur.

Unfortunately there is no "Standard recipe" for the management of the difficult airway. A wide spectrum of different approaches was described in the medical literature. Every individual clinician should practice the decision making process before they experience a difficult airway situation. The options may be affected by the patient characteristics, availability of clinical applications and anesthesiologists capabilities, experience and preferences. After the establishment of the difficult airway guidelines the number of closed claims was decreased (12). Moreover the incidence of anesthesia related severe complications and death during the induction phase was decreased (12). Eventhough we have such a strong evidence of the positive impact of the guidelines on mortality and morbidity, what are the factors limiting the use of guidelines or algorithms in critical decision making? It is obvious that the clinicians are having hard times to remember the guidelines when they need them most. It may be because the guidelines were not integrated to their training and to their daily routine practice. So, the guidelines are hard to be remembered when they are needed. The guidelines should influence

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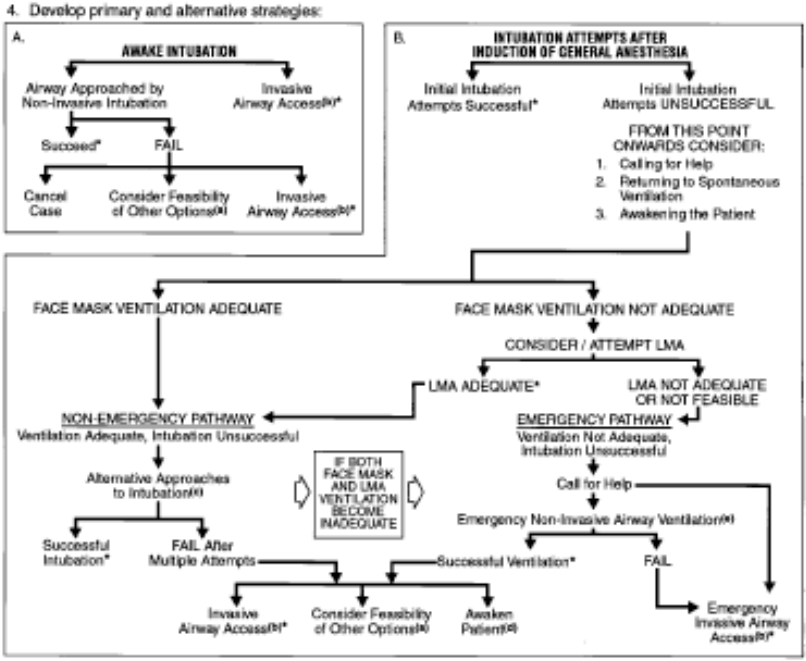
DIFFICULT AIRWAY ALGORITHM

1. Assess the likelihood and clinical impact of basic management problems:
   - A. Difficult Ventilation
   - B. Difficult Intubation
   - C. Difficulty with Patient Cooperation or Consent
   - D. Difficult Tracheostomy
2. Actively pursue opportunities to deliver supplemental oxygen throughout the process of difficult airway management
3. Consider the relative merits and feasibility of basic management choices:
   - A. Awake Intubation —vs— Intubation Attempts After Induction of General Anesthesia
   - B. Non-Invasive Technique for Initial Approach to Intubation —vs— Invasive Technique for Initial Approach to Intubation
   - C. Preservation of Spontaneous Ventilation —vs— Ablation of Spontaneous Ventilation
4. Develop primary and alternative strategies:



*** Confirm ventilation, tracheal intubation, or LMA placement with exhaled CO_2**

a. Other options include (but are not limited to): surgery utilizing face mask or LMA anesthesia, local anesthesia infiltration or regional nerve blockade. Pursuit of these options usually implies that mask ventilation will not be problematic. Therefore, these options may be of limited value if this step in the algorithm has been reached via the Emergency Pathway.

b. Invasive airway access includes surgical or percutaneous tracheostomy or cricothyrotomy.

c. Alternative non-invasive approaches to difficult intubation include (but are not limited to): use of different laryngoscope blades, LMA as an intubation conduit (with or without fiberoptic guidance), fiberoptic intubation, intubating stylet or tube changer, light wand, retrograde intubation, and blind oral or nasal intubation.

d. Consider re-preparation of the patient for awake intubation or canceling surgery.

e. Options for emergency non-invasive airway ventilation include (but are not limited to): rigid bronchoscope, esophageal-tracheal combitube ventilation, or transtracheal jet ventilation.

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our daily practice and it should be the senior consultants to teach the young colleagues to use them during the decision making process.

After a quick review of the difficult airway algorithm one will realize that the end points are waking up the patient or keeping the spontaneous ventilation. Restoring the spontaneous respiration and waking up the patient considered to be a safe and secure option for the management of difficult airway. So major questions raise for the use muscle relaxants in patients with difficult airway. Other questions are "Is restoring the spontaneous ventilation really preventive for critical events?", "What is the impact/role of muscle relaxants in airway management?", "Does the effects of muscle relaxants same in patients with or without difficult airway?", "How do we facilitate intubation without muscle relaxants?".

A common daily practice during the anesthesia induction is to check the mask ventilation before the administration of muscle relaxant agent. Goodwin et al demonstrated that senior anesthesiologists are not willing to secure the mask ventilation before the muscle relaxants compared to junior anesthesiologists (13). Moreover, the authors also evaluated the impact of the muscle relaxants on effective mask ventilation and found no significant difference among the groups with or without muscle relaxants. Kheterpal S et al in their large scale study showed that most patients who were hard to be mask ventilated were easy to be intubated (10). This finding made the Calder and Yentis`s comments very valuable (14). Calder and Yentis commented that patients with difficult mask ventilation are rarely wakened up but most of the time anesthesiologists go on with the anesthesia induction. They also stated that administering less medication (most of the time muscle relaxants) may be one the factor contributing the difficult mask ventilation. They strongly recommend the use of muscle relaxants and stated that not administering the muscle relaxants will compromise the patient safety.

In fact successful intubation and great intubation condition can be gained by using a rapid acting hypnotic, opioid and without the use of muscle relaxants. A combination of propofol or thiopental, rapid acting opioid such as fentanyl or remifentanil with lidocaine or ketamine will provide good to excellent intubation conditions in majority of the patients (15-18). The point is that every clinician should prepare themselves for a combination they are familiar with to use just in case. According to the literature almost any combination fits more or less good to perfect for a endotracheal intubation without muscle relaxants. Matching the right patient with the right combination still stays as the "state of art". The experience of the anesthesiologist may be the most important determining factor of this choice.

If we choose to use muscle relaxant the next question may be which one?

The options are very limited as the ideal muscle relaxants for difficult airway should be rapid acting and should have a very short duration of action. Only succinylcholine fulfills these criteria. As we all know succinylcholine is a depolarizing agent with a very rapid start of action and short action duration. That`s why the use succinylcholine became a common practice in patients with difficult airway and where rapid sequence anesthesia induction (RSAI) is needed. The recovery of spontaneous ventilation in a CV/CI scenario in a very short period of time, before any critical accident develops, is a general concept with the use of succinylcholine. However there are number potential problems with the use of succinylcholine (Hypercalemia, fasiculations, increase in intracranial pressure, histamine release, prolonged paralysis [acetilcholine estherase deficiency/malfunction), Malignant Hyperthermia] and rapid recovery of spontaneous respiration might be a myth especially patients with co existing disease. Succinylcholine in 1 mg/kg dose provides excellent intubation conditions and considered as a "golden standard for RSAI". The potential problem with the 1 mg/kg dose may lead a prolonged suppression of spontaneous ventilation. Heier et al. (19) challenged the optimal dose of succinylcholine in RSAI and demonstrated that mean duration of apnea with 1 mg/kg succinylcholine is 5.2 minutes. In the same study, one third of the healthy volunteers experienced severe hypoxemia (SpO_2< 80%). In patients with co-morbidities the incidence of severe hypoxemia after 1 mg/kg succinylcholine shown to be more frequent and much more rapid compared to healthy patients (20). In order to decrease the risk of hypoxia the dose of succinylcholine may be reduced. This hypothesis was studied by Kopman AF et al. A 40% reduction in succinylcholine dose offers three minutes reduction to reach T1/T4=0.9 %. Moreover Naquib M et al (22) studied different doses of succinylcholine and estimated the dose for 95 % good-excellent intubation conditions. The calculated dose of succinylcholine is 0.56 mg.kg-1 (0.43– 0.73).

Rocuronium may be a challenging alternative to succinylcholine with its unique features. Rocuronium in 3 x ED_{95} (1 mg/kg) dose provides good to excellent intubation conditions in 60 seconds. Alanoglu et al studied in two different studies the potential of rocuronium for RSAI (23-24). The main outcomes of these studies are combination of rocuronium with remifentanil provides superior intubation conditions, 1 mg/kg rocuronium is almost as effective as equipotent succinylcholine and remifentanil offers opportunities as an adjunct.

Sugammadex is a revolutionary, new reversal agent, providing great flexibility to the clinician for the use of massive doses of rocuronium. The risk of prolonged block in patients with CV/CI scenario sugammadex offers rapid

reversal in couple of minutes. So rocuronium and sugammadex combination might be an answer to most questions in difficult airway management.

As a conclusion, what should we keep in mind for the management of difficult airway?

- Airway algorithms are IMPORTANT in our daily practice...
- Failed mask ventilation and failed intubation is LIFE THREATING situation...
- Avoid administering LESS...
- Preoxigenisation SHOULD be a MUST in your practice...
- The apnea duration of Succinylcholine might be long enough to lead a critical desaturation episode...
- Rocuronium with adjuncts provides effective intubation conditions...
- Rocuronium Sugammadex combination offers great options in life threating situations...

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