The Airway Approach Algorithm:

Decision Making in Airway Management Planning

William H. Rosenblatt, MD

Professor of Anesthesiology
Yale University School of Medicine
New Haven, Connecticut

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In the world of evidence-based medicine, evaluation of the airway poses a conundrum—the experienced anesthesiologist's "eye" and "gut feeling" prove far more sensitive and specific than any published index. How do we understand, apply, and teach airway evaluation when one operator's perception and skill may be so different from another's? By breaking down and organizing the relevant aspects of evaluation, each clinician can develop a rational approach. One anesthesiologist's challenge may be another's routine—and this is how the art is practiced.

Background

The 2013 and 2015 updated guidelines from the American Society of Anesthesiologists (ASA) and the Difficult Airway Society (DAS), respectively, provide the clinician with tools for managing an often feared, albeit rarely encountered scenario: the unanticipated cannot-intubate/cannot-oxygenate (CICO) patient.[1,2] When this scenario is encountered, it is often caused by poor evaluation and decision making in the preanesthetic setting.[3] The goal of preoperative airway assessment is the development of a plan to safely manage the patient's airway for the support of a damaged physiology and/or to facilitate a surgical procedure. But decision making can be complex and flawed, and must be plastic. External forces, past experiences (cumulative and recent), personnel and device availability, as well as varied patient factors can affect decisions.

Although algorithms can aid in the management of critical situations, preoperative planning is directed at avoiding these scenarios altogether. Whereas the DAS algorithm is a failed airway pathway, exercised when these situations unexpectedly arise during routine management, the ASA and some other expert groups have chosen to offer guidance in the recognized difficult airway scenario.[4] Few, however, provide advice in choosing between a recognized difficult airway and a routine airway pathway, perhaps assuming that all clinicians are equivalent in recognizing the patient at risk. But, as discussed above, many evolving dynamics, including human factors, affect the process. Recognized problems in one aspect of airway management (eg, tracheal intubation as opposed to mask ventilation) can most often be compensated for with careful planning, alternative tools, and techniques. When no alternative route can be planned, awake airway management is recommended by expert groups.[2,4]

The difficult airway cannot be narrowly defined. Tracheal intubation by some means, noninvasive ventilation, risk for aspiration of gastric contents, physiologic tolerance of apnea, and other factors all inform safe airway planning and care. Instead of labeling a patient as a "difficult airway," it is enlightening to explore the components of airway control in an approach that steers the process of selecting a management strategy.

Components of an Airway Evaluation

First, the rationale for controlling a patient's airway must be considered. Taking a patient from a preoperative, self-sustaining state to one dependent on the abilities of the clinician and his or her armamentarium invites risk. The decision to proceed in a process that avoids this risk (eg, regional or infiltrative anesthesia) is not free of jeopardy and may fail, requiring airway management.[3,4] Therefore, all patients presenting for care by the anesthesia provider require thorough evaluation of all aspects of the airway.

Second, tracheal intubation, although only one means of controlling oxygenation and ventilation, is generally considered to be definitive airway management, and mandatory for the patient at risk for aspiration of gastric contents and other conditions.

Evaluation for difficult laryngoscopy and tracheal intubation can be an enigma. The routine methods of airway physical exam have been repeatedly demonstrated to have poor sensitivity, specificity, and positive predictive value.[6,7] Most airway exam indexes are graded by the success of achieving laryngeal visualization, as described by the Cormack and Lehane grade, even though the degree of laryngeal view has never been validated as a suitable predictor of intubation success.[8] Modification of the Cormack and Lehane grading with broad categorization improves discrimination.[8] The value of laryngeal view grade is even more dubious in the era of video laryngoscopy (VL).[9]

Yentis discusses that, apart from having poor predictive value, the tolerance of the operator for failure may influence the sensitivity, specificity, and usability of any index.[7] The best physical exam measure, unless

Figure 1. Lingual tonsil hyperplasia.

Figure 2. Radiation changes to the epiglottis.

100% sensitive for detecting a difficult airway, will leave a small population of patients at risk for airway failure. The operator, based on his or her recent and remote experience, may regard the results of this test differently from a second operator. Likewise, unless 100% specific, a test will return a false-positive result on some number of patients who are not difficult to manage—and although the consequences of this inaccuracy are unlikely to result in patient harm, it may affect the operator's interpretation of the test in future applications.

As Greenland discusses, anatomy unfavorable for direct or indirect laryngoscopy may not be obvious on routine airway exam.[10] This author describes the middle column as the pharynx behind the tongue, hypopharynx, and glottis, which may be occupied by pharyngeal and lingular tonsil hyperplasia (LTH) or other masses, or distorted by external pathology, edema, injuries, or iatrogenically by previous surgery or radiation (Figures 1 and 2). Despite an otherwise normal routine airway physical exam, these structures may render laryngoscopy and intubation difficult or impossible.

Ovassapian et al found that all patients who were unexpectedly difficult to intubate by direct laryngoscopy had LTH.[11] Rosenblatt et al used preoperative endoscopy in the airway planning process when a suspicion of these changes was present.[12] In most instances, preoperative endoscopy served to assuage concerns; but in other patients, unexpectedly hazardous anatomy was revealed and management plans were changed.

Lastly, a variety of tracheal intubation devices are currently available. Apart from direct laryngoscopy, classic acute-anatomic blade VL and flexible endoscopy, channel blade-VL, non–acute-anatomic blade VL, optical/video stylets, and intubating supraglottic airways (SGA; blind and image facilitated) may or may not be available to a particular operator and at a particular time or venue—and that operator may or may not have the appropriate experience with these tools.

Noninvasive ventilation by face mask or SGA may be an induction-only, maintenance or rescue means of oxygenation and ventilation. Each technique alone has a failure rate in the range of 0.15% to 1.1%.[13,14] Independent factors associated with failure of the face mask or SGA have been described.[15,16] Success, as with laryngoscopy and intubation, is highly dependent on operator experience, and at times may require a second skilled operator to facilitate (eg, 2- and 3-handed face mask ventilation).

Face mask and SGA ventilation are contraindicated in situations where there exists a risk for regurgitation of gastric contents and pulmonary aspiration. Although expert groups published guidelines regarding NPO status, many other factors will influence risk.[2,17,18] These factors include body habitus, gastrointestinal disease and symptoms, and a variety of other physiologic factors that determine the risk, including:

- obesity,
- metabolic disease,
- pregnancy,
- advanced age,
- reduced level of consciousness,
- ileus and bowel obstruction,
- history of reflux or hiatal hernia,
- pain and pain therapy,
- advanced liver or renal dysfunction,
- critical illness, including increasing ASA status, and use of pharmacologic agents, such as proton pump inhibitors or prokinetic agents.

Lastly, when making decisions regarding the risk to the patient of airway failure, the tolerance of apnea (ie, safe apneic period; SAP) is considered. A variety of physiologic factors may affect the duration of the SAP: poor preinduction oxyhemoglobin saturation; pulmonary disease; obesity; oxygen deficit in sepsis or other debilitating processes; and pregnancy.[17,18]

Integration

A segregated, factor-by-factor analysis of the distinct components of airway management can aid in removing decision bias. Once each factor has been addressed, an algorithmic means of determining an airway course is possible. The airway approach algorithm (AAA) is a decision tree approach to integrating the individual analyses into a rational plan (Figure 3).[19] The AAA is used to select a routine or awake course of management—the two distinct entry points of the

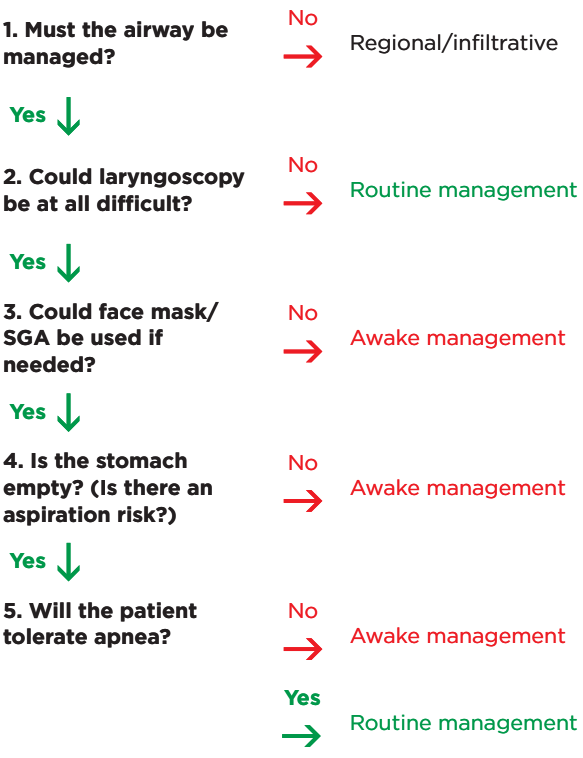

Figure 3. The Airway Approach Algorithm.[19]

SGA, supraglottic airways

ASA's algorithm. Once this judgement is made, the specifics of management are determined by the predilections of the operator. Importantly, the AAA is exercised before airway management is initiated, and most often in the preoperative holding area.

1. Must the airway be managed? As per the discussion above, if the surgical procedure is best supported with regional or infiltrative anesthesia, a rational airway plan should still be developed in the event that these modalities are not available or fail.

2. Will laryngoscopy be (at all) difficult? As per the discussion above, the level of difficulty encountered during laryngoscopy may vary with the operator. If no difficulty is expected, the operator proceeds as clinically appropriate. The prototype case is the patient requiring rapid sequence induction. Should laryngoscopy fail, the algorithms of expert groups, such as those of the ASA and DAS, provide clinical guidance.[1,2] If there is an indication that laryngoscopy and intubation may be at all difficult, the operator proceeds to question 3.

3. Can face mask/SGA ventilation be used if needed (eg, for rescue)? As per the discussion above, success in face mask/SGA use is operator dependent. In the preoperative evaluation, if the operator concludes that face mask/SGA rescue might be difficult, the answer "no" is registered. This brings the operator to a conclusion that both intubation and noninvasive ventilation may be difficult or impossible. Prudently, and to avoid significant risk, an awake intubation is chosen as the management technique. If no indicators appear that face mask/SGA ventilation will be difficult, the operator proceeds to question 4 (Figure 4).

4. Is the stomach empty? (**Is there an aspiration risk?):** Although the aspiration of gastric contents is a rare event with the use of SGAs, a risk is considered a contraindication to their use. If a risk is present, difficulty or contraindication with both intubation and face mask/SGA ventilation has been deduced and an awake intubation is chosen. If there is no aspiration risk, the operator proceeds to question 5.

5. Will the patient tolerate an apneic period? As discussed previously, some patient groups will not tolerate airway management failure well. It is prudent to assume that in some cases an error in judgment may have occurred. Operator correction of these errors may not be timely in apnea-intolerant patients, and awake management techniques should be considered from the outset. In a selected group of patients, rapid

Figure 4. Patient with near complete mechanical trismus.

This patient is lean, does not snore, does not appear to have other risks for difficult mask ventilation, and is not an aspiration risk. With thorough preoxygenation, her safe apneic period is expected to be several minutes. This patient underwent an intravenous induction and flexible scope nasal intubation. The AAA allows another clinician to interpret her risk for oxyhemoglobin desaturation otherwise, and proceed as deemed appropriate.

AAA, airway approach algorithm

correction of hypoxemia and hypercapnea may be possible via invasive techniques. These patients may proceed to routine management.

Conclusion

Expert groups have provided substantial leadership in exercising care of the failed-airway patient, but there is less guidance in the preoperative identification of patients who should be approached with alternative airway management plans. A segregated and stepwise process in decision making can eliminate bias, reinforce conclusions, and offer alternative pathways.

The AAA is a premanagement cognitive exercise for determining a safe airway management plan prior to the induction of anesthesia with the aim of avoiding failed airway pathways.[19]

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