

Airway Assessment for Office Sedation/ Anesthesia

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Whenever a patient is about to receive sedation or general anesthesia, no matter what the technique, the preoperative assessment of the airway is one of the most important steps in ensuring patient safety and positive outcomes. This article, Part III in the series on airway management, is directed at the ambulatory office practice and focuses on predicting the success of advanced airway rescue techniques.

Key Words: Airway management; Airway evaluation; Emergency rescue; Sedation; Anesthesia.

A thorough and focused assessment of the airway prior to the planned administration of moderate sedation or deep sedation/general anesthesia (GA) is of vital importance. Over the years, studies of closed claims have focused on the association of respiratory and airway issues with mortality and severe morbidity in hospital and off-site locations.¹⁻³ The Closed Claims Project of the American Society of Anesthesiologists (ASA) evaluated adverse anesthetic outcomes obtained from the closed claim files of 35 U.S. liability insurance companies. This database dates from 1985 and accrues about 300 cases per year. One of the first reviews of this data evaluated respiratory events, the most common cause of adverse outcomes.⁴ This study found that respiratory events were the single largest class of injury and accounted for 34% of all claims. Eighty-five percent of these adverse outcomes resulted in death or brain damage. Critical review found that most could have been prevented. It is not surprising that 30% of the mortalities in these claims were attributable to anesthetic malpractice and were the result of an inability to establish an airway, ventilate, and/or oxygenate patients when airway loss occurred. More recent examination of the

data looked at outcomes from perioperative airway claims filed between 1985 and 1999. In this series, 57% of claims resulted in brain damage or loss of life, with the difficult airway being encountered upon induction.

In an effort to improve management of the difficult airway, the ASA released their original difficult airway algorithm in 1993 and have updated it more than once to include newer advanced airway adjuncts.⁵⁻⁷ This algorithm is recognized as a national standard and begins by stressing the importance of assessing the likelihood and clinical impact of basic airway management problems during the induction of anesthesia. It systematically provides alternative pathways for airway rescue for both known and unsuspected difficult airways (Figure). Positive findings during this preoperative examination will determine whether the patient is suitable for treatment in the outpatient setting, the risk/benefit ratio of various sedative/anesthetic techniques including airway maintenance adjuncts available to the clinician, and the skill set required of the professional necessary to rescue the patient if the airway becomes obstructed or compromised (Tables 1 through 5).⁸

PREDICTING DIFFICULTY IN BAG-VALVE-MASK VENTILATION

A challenging airway may present as difficulty with mask ventilation, difficulty with tracheal intubation, or both.

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DIFFICULT AIRWAY ALGORITHM

1. Assess the likelihood and clinical impact of basic management problems:
 - Difficulty with patient cooperation or consent
 - Difficult mask ventilation
 - Difficult supraglottic airway placement
 - Difficult laryngoscopy
 - Difficult intubation
 - Difficult surgical airway access
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:
 - Awake intubation vs. intubation after induction of general anesthesia
 - Non-invasive technique vs. invasive techniques for the initial approach to intubation
 - Video-assisted laryngoscopy as an initial approach to intubation
 - Preservation vs. ablation of spontaneous ventilation
4. Develop primary and alternative strategies:

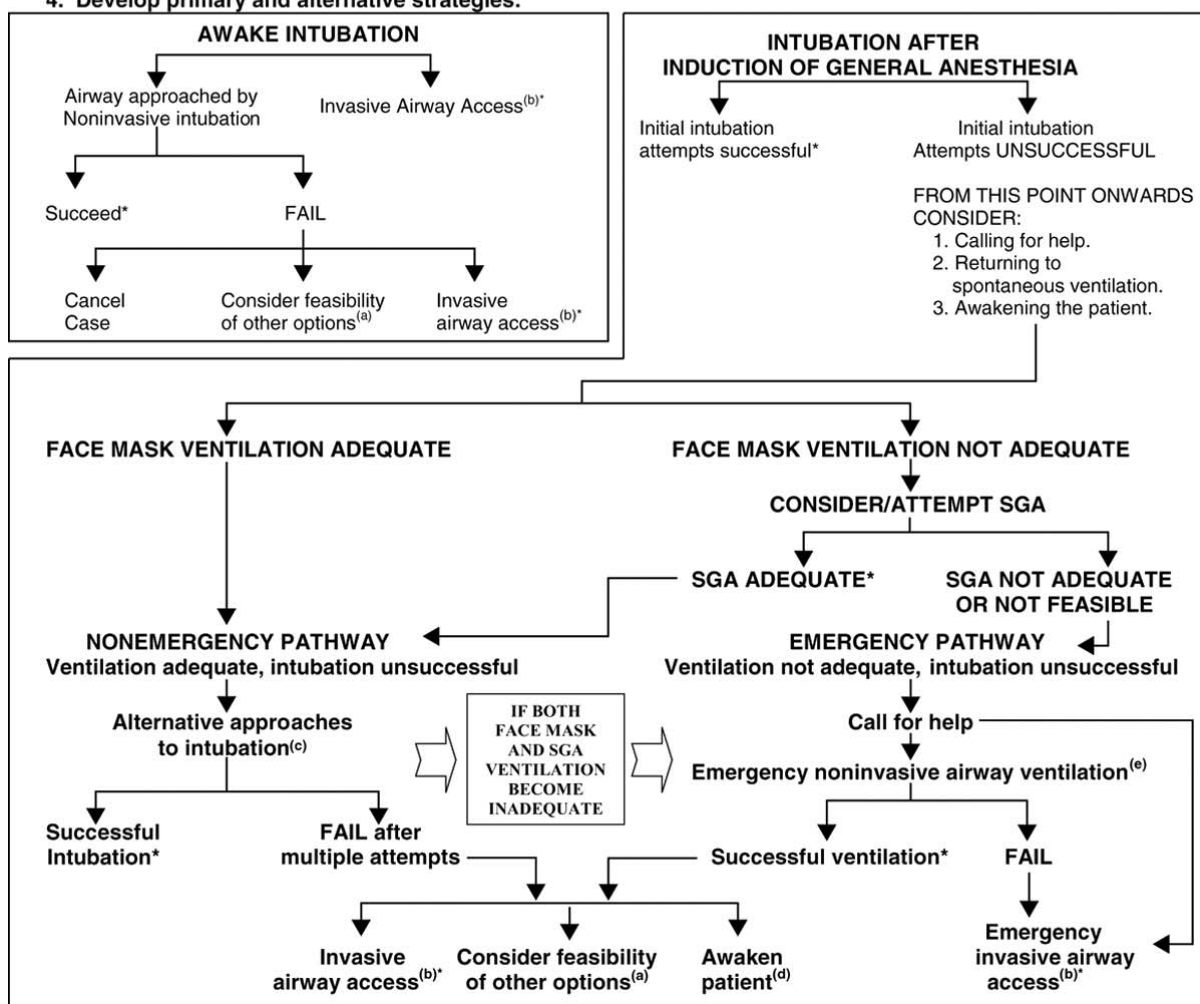


Table 1. Airway Evaluation Considerations*

Airway history and evaluation should be conducted prior to initiation of sedation/anesthesia.
The airway history review assists with detection of any potential for a difficult airway.
The physical examination should be thorough and focused. Multiple predictive tests may be useful.
Results of the airway history and evaluation may dictate a risk/benefit analysis as to suitability of the patient with respect to appropriate surgical location, qualifications and training of the practitioner, technique, and availability of emergency airway rescue equipment.

* Adapted from the American Society of Anesthesiologists (ASA) difficult airway guidelines 2013.⁸

The ASA practice guidelines for management of the difficult airway defined difficult ventilation as a circumstance in which “it is not possible for the unassisted anesthesiologist to prevent or reverse signs of inadequate ventilation during positive pressure ventilation.”⁷ For apnea, hypoventilation, or soft tissue obstruction encountered in moderate or deep sedation or the “open airway” office-based GA that is commonly used in contemporary dental practice, the ability to ventilate using a bag-valve-mask (BVM) is the primary and most important airway rescue technique.⁹ It should be appreciated that even good BVM technique may fail when excess soft tissue is the cause of obstruction and not initially relieved by an oropharyngeal or nasopharyngeal airway. Unfortunately, comparatively few evidence-based studies have assessed preoperatively whether BVM rescue techniques will be easily accomplished when needed. This is in direct contrast to the vast amount of literature attempting to predict the ease or

difficulty of securing the airway with an endotracheal tube.

The precise frequency of difficult mask ventilation is unknown, but an Australian study indicated that 15% of difficult intubations were also associated with difficult mask ventilation.¹⁰ An evaluation of 22,600 attempts at mask ventilation at the University of Michigan reported that 1.4% (313 cases) were difficult to ventilate and 0.16% (37 cases) were impossible to ventilate. Twenty-eight percent (84/313 cases) of the difficult-to-mask and impossible-to-mask cases were also observed to be difficult intubations.¹¹ Of note is that this review was performed prior to the widespread adaptation and use of laryngeal mask airways and video laryngoscopy. A more recent study reported a significant decrease in oxygen saturation during difficult airway episodes. The anatomical factors that were noted to negatively impact the ability to intubate were obesity, limited neck motion, and limited mouth opening. Better outcomes were attributed to the integration of crisis resource management into anesthetic care with the ability to obtain skilled assistance during airway emergencies.¹²

A detailed history and physical examination can give insight into the possibility of BVM ventilation difficulty, should it be needed. However, in a large prospective study in which 5% of the patients were found to be difficult to ventilate by mask, it was found that anesthesiologists did not accurately predict difficult mask ventilation during the preoperative visit. When a multivariate analysis was conducted, 5 criteria were recognized as independent risk factors for difficult mask ventilation, and the presence of 2 of these risk factors indicated a high likelihood of difficult mask ventilation.¹³

Table 2. Components of the Preoperative Airway Physical Examination*,†

<i>Airway Examination Component</i>	<i>Nonreassuring Findings</i>
Length of upper incisors	Relatively long
Relationship of maxillary and mandibular incisors during normal jaw closure	Prominent “overbite” (maxillary incisors anterior to mandibular incisors)
Relationship of maxillary and mandibular incisors during voluntary protrusion of mandible	Patient cannot bring mandibular incisors anterior to (in front of) maxillary incisors
Interincisor distance	Less than 3 cm
Visibility of uvula	Not visible when tongue is protruded with patient in sitting position (eg, Mallampati class II or III)
Shape of palate	Highly arched or very narrow
Compliance of mandibular space	Stiff, indurated, occupied by mass, or nonresilient
Thyromental distance	Less than 3 ordinary finger breadths
Length of neck	Short
Thickness of neck	Thick
Range of motion of head and neck	Patient cannot touch tip of chin to chest or cannot extend neck

* This table displays some findings of the airway physical examination that may suggest the presence of a difficult intubation. The decision to examine some or all of the airway components shown in this table is dependent on the clinical context and judgment of the practitioner. The table is not intended as a mandatory or exhaustive list of the components of an airway examination. The order of presentation in this table follows the “line of sight” that occurs during conventional oral laryngoscopy.

† ASA practice guidelines.

Table 3. Difficult Airway Categories

Known or expected difficult airway
History of difficult or failed intubation
History of difficult or failed mask ventilation
Conditions associated with difficult airway
Acquired
Congenital
Potentially difficult airway
Limited neck extension
Limited mouth opening
Receding mandible
Revised Mallampati class III or IV ²⁵
Short thyromental distance
Obesity
Unexpected difficult airway
Unknown supraepiglottic mass
Hyperplasia of lingual tonsils
Supraepiglottic cyst or tumor
Missed evidence of difficult airway
Poor preoperative evaluation
Ignored presence of evidence

1. Age older than 55 years
2. Body mass index >26 kg/m²
3. Beard
4. Lack of teeth
5. History of snoring

Other studies have included a history of radiation therapy, obesity, decreased thyromental distance, and a high Mallampati score as additional risk factors.¹⁴ Technical factors that may make up for inadequate mask ventilation include a good mask fit; proper positioning of the head, neck, and jaw (head tilt/chin lift); and insertion of an oropharyngeal or nasopharyngeal airway or an advanced supraglottic device. An inability to ventilate the lungs or intubate the trachea may of course also be caused by poor technique and/or lack of technical expertise or ongoing clinical experience.¹⁵

Unfortunately, there are no universally recognized or adopted predictors of the difficulty of insertion of advanced supraglottic airways that are important airway adjuncts as part of the airway rescue algorithm.^{16,17} There appears to be no correlation between the success of laryngeal mask placement and the Mallampati scoring system.¹⁸ Some physical findings that may predict a difficult airway are listed in Table 6.

PREDICTING THE DIFFICULTY OF ENDOTRACHEAL INTUBATION

Whether or not endotracheal intubation is envisioned as part of the anesthetic plan, evaluation of the airway to predict the difficulty of advanced airway management, whether elective or emergent, is a vital aspect of

Table 4. Difficult Intubation Tests

External anatomic features
Head and neck movement (atlantooccipital joint)
Jaw movement (temporomandibular joint)
Mouth opening
Subluxation of mandible
Receding mandible
Protruding maxillary incisors
Obesity
Thyromental distance
Sternomental distance
Visualization of the oropharyngeal structures
Anterior tilt of larynx
Radiographic assessment

preoperative evaluation. This assessment begins with a detailed history that focuses upon past airway issues during sedation and GA. Although endotracheal intubation is usually not in the skill set of the moderate sedation provider, the exercise of advanced airway assessment can only result in a greater understanding of potential airway issues.

A focused physical examination should include evaluation of oral opening, thyromental distance, neck extension, and oropharyngeal soft tissue structures. Further evaluation of neck circumference, restrictions in other neck movement, temporomandibular joint issues, and loose or protruding teeth may also be appropriate. A large neck circumference, which is often associated with obstructive sleep apnea, may be a predictor of difficult intubation in obese patients.^{19,20} Palpating the neck to locate the cricothyroid membrane will provide valuable information should an emergent cricothyrotomy become necessary.

There is consensus that airway management is more difficult in the morbidly obese patient. Body weight may not be as critical as the location of excess weight, however. Massive weight in the lower abdomen and hip area may be less important than excess weight in the upper body. A short, thick, immobile neck caused by cervical spine fat pads will interfere with rigid laryngoscopy. Furthermore, the redundancy of soft tissue structures inside the oropharyngeal and supralaryngeal area may make mask ventilation and intubation difficult. When high positive pressure is required to ventilate the obese patient, the chance of insufflating the stomach is increased. Rapid oxygen desaturation during apnea, secondary to reduced functional residual capacity, limits the time to achieve adequate ventilation with either a BVM or intubation before hypoxemia occurs.²¹

Certain medical conditions may also predispose to airway management difficulty. Airway assessment of patients with rheumatoid arthritis, for example, should be based on an understanding of the pathologic changes affecting the airway. In patients with advanced rheuma-

Table 5. Physical Findings Suggestive of Difficult Airway Management

<i>Finding</i>	<i>Implication</i>
Obesity	Easily obstructed airway, aspiration risk, diminished chest wall compliance, difficult laryngoscopy because of macroglossia and immobile head, obstructive sleep apnea
Pregnancy	All the problems associated with obesity, especially aspiration risk; large breasts impair laryngoscope insertion; swollen mucosa bleed easily
Ascites	Aspiration risk, diminished chest wall compliance
Whiskers, flat nasal bridge, large face	Difficult mask seal
Mouth opens less than 40 mm	Glottic exposure blocked by maxillary teeth
Cervico-occipital extension limited to an angle at the hyoid less than 160°	Difficult to align mouth and pharynx for glottic exposure
Short, thick, muscular neck	Predisposed to soft tissue obstruction, difficult to extend neck for intubation or mask ventilation
Thyromental distance less than 60 mm, receding chin	Difficult to mobilize tongue for glottic exposure, glottis too anterior to visualize
Maxillary gap from missing incisors with other teeth present to the right	Laryngoscope fits into gap, but adjacent teeth, lip, or gums block view of glottis and passage of tracheal tube
Edentulous with atrophic mandible	Small face and furrowed cheeks impair mask fit; tongue and soft palate block exhalation
Prominent or protruding maxillary incisors	Teeth block view of glottis
Advanced caries, loose teeth, caps, bridges	Dentition can be damaged or aspirated, rough edges can tear tube cuff
Stridor, retractions	Risk of insurmountable airway obstruction
Hoarseness	Chance of vocal cord dysfunction or airway masses
“Underwater” voice	Vallecular or epiglottic cysts
Nasogastric tube in situ	Difficult to seal mask
Poorly visualized soft palate and fauces in upright patient with mouth fully open (Mallampati sign)	Difficult to expose glottis with rigid laryngoscopy
Large goiter or immobile tumor displacing trachea	Difficult to expose glottis, airway obstruction, or tracheal collapse
Tracheostomy scar	Possible tracheal stenosis

Table 6. Physical Examination Findings Suggestive of a Difficult Airway in Office-Based Sedation/Anesthesia

<i>Finding</i>	<i>Implication</i>
Obesity	Easily obstructed airway, aspiration risk, diminished chest wall compliance, risk of obstructive sleep apnea
Beard, flat nasal bridge, large face	Difficult mask seal
Mouth opens less than 40 mm	Glottic exposure blocked by maxillary teeth
Limited cervico-occipital extension (due to arthritis or cervical spine surgery)	Difficult to align mouth and pharynx for glottic exposure
Short, thick, muscular neck	Prone to soft tissue obstruction, difficult to extend neck for intubation or mask ventilation
Thyromental distance less than 60 mm (receding chin, cervical spine problems)	Difficult to mobilize tongue for glottis exposure, glottis too anterior to visualize
Maxillary gap from missing incisors with other teeth present to the right	Laryngoscope fits into gap while adjacent teeth, lip, or gums block view of glottis and passage of tracheal tube
Edentulous with atrophic mandible	Small face, sunken cheeks impair mask fit
Prominent or protruding maxillary incisors	Teeth block view of glottis
Advanced caries, loose teeth, caps, bridges	Danger of aspiration
Stridor, retractions	Risk of insurmountable airway obstruction
Hoarseness	Chance of vocal cord dysfunction or airway masses
“Underwater” voice	Vallecular or epiglottic cysts
Poorly visualized soft palate and fauces in upright patient when mouth is fully open (Mallampati sign)	Possible difficulty in exposing glottis
Large goiter or immobile tumor displacing trachea	Difficult to expose glottis, airway obstruction, or tracheal collapse
Tracheostomy scar	Possible tracheal stenosis

toid arthritis and spondylosis, airway management may be extremely difficult. Rheumatoid arthritis may present as limited movement in any joint of the body, including the cervical spine, temporomandibular joint, and cricoarytenoid joint. A change in voice, dysphagia, dysarthria, stridor, or a sense of fullness in the oropharynx may indicate laryngeal involvement. Physical examination should include palpation of the larynx and trachea for evidence of deviation and/or limitation. While chin lift and jaw thrust are commonly used to improve mask ventilation and oxygenation, these maneuvers may be difficult in those with arthritic restrictions and may increase the possibility of spinal cord compression and damage.²²

Likewise, many of the syndromic anomalies may also be associated with anatomic abnormalities of the head, neck, or upper airway that may limit mask ventilation or the ability to easily control the airway via endotracheal intubation. Crouzon, Goldenhar, Pierre Robin, and Treacher Collins are examples of syndromes that may feature grossly abnormal head and neck anatomy. Patients with these congenital malformations often exhibit micrognathia, retrognathia, and macroglossia; have a smaller oropharyngeal cross section; and are prone to soft tissue–related upper airway obstruction.²³ Patients with severe congenital anomalies that affect the airway are often not candidates for office sedation/GA procedures.

PREDICTIVE TESTS OF DIFFICULT INTUBATION

Over the years, a number of tests have been described to predict difficult intubation. These clinical examinations are straightforward. Although they are a useful adjunct in airway evaluation, all are associated with relatively high rates of false-positive and false-negative predictions.

Of all of these tests, the Mallampati scoring system has become the most popular, despite its shortcomings. The Mallampati score has become a standard part of a comprehensive airway evaluation, although its predictive value for difficult intubation has proven to be low. The Mallampati score is based upon visualization of anatomical oropharyngeal structures and relates them to intubation difficulty. While seated, a patient is asked to open the mouth as widely as possible and maximally protrude the tongue. The patient does not say “ahhh.” The visibility of the faucial pillars, soft palate, and uvula are noted. The airway may be classified into 3 categories: class I—soft palate, fauces, uvula, and pillars are visualized; class II—soft palate, fauces, and pillars are visualized, but the uvula is masked by the base of the tongue; and class III—only the soft palate can be visualized. In class III, visualization of the glottis with rigid laryngoscopy is expected to be difficult.²⁴

The various modifications of the Mallampati scoring system include that of Samssoon and Young, which extends the descriptions of oropharyngeal exposures to include a fourth class.²⁵ This 4-category system is in common use and classified as follows: class I—soft palate, fauces, uvula, and pillars are visualized; class II—soft palate, fauces, and uvula are seen; class III—only the soft palate and base of the uvula are observed; class IV—the soft palate is not visible.

CONCLUSION

Prior to patient sedation or anesthesia, it is critical to evaluate the airway for potential difficulties in mask ventilation, ventilation with a laryngeal mask or other supraglottic airway, and/or endotracheal intubation if the patient becomes apneic and an emergency airway rescue algorithm is necessary. Despite the introduction of newer laryngeal masks and video laryngoscope devices, it is the practitioner's detailed preoperative airway assessment and preparedness that can make the difference if emergency airway rescue is needed. Best practices of airway assessment combine a thorough history and physical examination, in addition to predictive tests.^{1,26} The practitioner must also assess his or her own clinical abilities with advanced airway devices and algorithms. It is only after these assessments are made that risk/benefit decisions can be made to improve patient safety and outcomes.

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CONTINUING EDUCATION QUESTIONS

- The Mallampati scoring system is used to assess:
 - the thyromental distance
 - possibility of a difficult intubation
 - presence of nasal polyps
 - ability to insert a nasopharyngeal airway
 - history of obstructive sleep apnea
- The Sampsoon and Young classification describes
 - the degree of flexion
 - a history of obstructive sleep apnea
 - the ability to insert a laryngeal mask airway
 - the presence of protruding maxillary teeth
 - 4 classes of airway structure visualization
- All of the following are potential risk factors for achieving good mask fit except:
 - age older than 55 years
 - presence of a beard
 - lack of teeth
 - hypertension and tachycardia
 - obesity
- The primary airway rescue device is a(n):
 - laryngeal mask airway
 - bag-valve-mask
 - oropharyngeal airway
 - nasopharyngeal airway
 - endotracheal tube and laryngoscope
- The Mallampati scoring system is done with the:
 - patient in a sitting position
 - patient in a supine position
 - aid of a laryngoscope
 - jaw extended and head tilted backwards
 - neck flexed at a 90-degree angle