Narrative Review

Managing the difficult airway in an Ophthalmic surgery under monitored anaesthesia care

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Abstract

Many ophthalmic procedures are performed under local anesthesia. However, monitored anesthesia care (MAC) is often requested to ensure patient safety, particularly for high-risk and elderly patients. Some patients may fail to cooperate under local anesthesia or become agitated during the procedure requiring further management. In such situations, presence of difficult airway (DA) can worsen the outcome if not identified and managed properly. It is safer to identify the DA during pre-procedure assessment and be prepared for management than to encounter an unanticipated DA on the operating table.

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Definition and description of difficult airway

DA can be summarized as a clinical situation in which a conventionally trained anesthesiologist encounters difficulty in any technique of airway management, maintenance of oxygenation during airway management, and patient cooperation.[1] The American Society of Anesthesiologists defines a DA when "a conventionally trained anesthesiologist has trouble difficulty with facemask ventilation of the upper airway, difficulty with tracheal intubation, or both. Canadian guidelines are broader and defines it as a situation in which "an experienced provider anticipates or encounters difficulty with any or all of face mask ventilation, direct or indirect (e.g., video) laryngoscopy, tracheal intubation, supraglottic device [SGD] use, or surgical airway". Difficulty of airway management is highly variable depends on several factors including patient

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characteristics, medical and surgical history, airway characteristics, clinical context for which airway management is required (including the nature of any planned surgical procedure), patient's status and vital signs.[2-4]

The range of techniques includes mask ventilation, supraglottic airway (SGAD) insertion, laryngoscopy (direct, video, or flexible video endoscopy), endotracheal intubation, surgical airway and extubation. All these represent anatomically DA. When airway management is associated with potential for compromised oxygenation, it is referred to as physiologically difficult airway. Examples include poor physical status, elderly, syndromic children with congenital heart disease, obesity and cardiorespiratory reserve for any reason. Lastly, the risk of aspiration, inability to cooperate and inability to tolerate supine position also contribute to difficulty in airway management. When the presence of DA is combined with other risk factors, the overall risk to patients is compounded (Table 1).

Table 1- Factors that enhance the risk of complications in presence of DA

1. Poor cardiorespiratory reserve
2. Uncontrolled diabetes and hypertension
3. Morbid obesity
4. Multiple drug therapy for co-morbidity
5. Poor effort tolerance and frailty
6. Inability/difficulty in lying down supine position
7. Anxiety, cognitive dysfunction
8. Failure to recognize difficult airway
9. Delayed gastric emptying
10. Lack of/ dysfunctional equipment
11. Difficult venous access
12. Inadequate monitoring facilities

Spectrum of difficult airway

Diseases associated with DA management include congenital syndromes including Pierre Robin Syndrome, Treacher-Collins syndrome, Goldenhar's syndrome, mucopolysaccharidoses, achondroplasia, and acquired causes morbid obesity, acromegaly, ankylosing spondylitis, tumours involving airway, trauma, infections, previous surgical scars or deformities and old age.

In ophthalmic surgeries, DA is predominantly encountered in the elderly or obese patients. With increasing age, changes in the structure and functioning of the airways result in anatomical features of DA. Face mask seal, maintenance of a patent airway and bag mask ventilation are more difficult due to lack of upper airway muscle tone and floppy lips due to lack of teeth in edentulous elderly patients Elderly are more prone for cervical spine arthritis, which reduces neck movement and makes laryngoscopy, particularly direct laryngoscopy, more difficult. A stiffer chest wall makes ventilating with a bag-valve mask or a rescue airway more challenging (e.g., SGAD).

Many elderly patients have coexisting respiratory diseases (chronic obstructive pulmonary disease [COPD]) and might be suffering from carcinoma of lung which causes intrapulmonary shunting. All these conditions can lead to difficulty in preoxygenation, often rendering it ineffective. In elderly persons, baseline room air oxygen saturation is frequently low, and it should be recognized before induction of anaesthesia or sedation so that perioperative interpretation is more reliable. Elderly patients who are sick (ASA III or more physical status and those with trauma) desaturate more quickly than healthy, younger patients. [Table 2]

High incidence of co-morbidities in elderly is another factor which contributes to increased risk of perioperative anaesthetic complications. High prevalence of risk factors such as hypertension, diabetes, renal insufficiency, chronic heart failure, and COPD) raises the risk of perioperative myocardial ischemia to as high as 31%.[5] Anxiety is fairly prevalent in the elderly patients. Many individuals are apprehensive during ocular surgery, either because they are concerned about their eye or because they are anticipating discomfort and pain.[6]

Even patients with well-controlled hypertension at home may become acutely hypertensive on the day of surgery. Patients with diabetes, particularly those who are insulin- dependent, can experience a similar situation. Hence, ensuring patient's safety during the perioperative period is the priority and responsibility for healthcare practitioners. It necessitates that all medical subspecialists comprehend the ophthalmic process in depth and acknowledge the additional strain on the patient's underlying co-morbidity induced by physiological changes caused by mental stress, surgery, and anaesthesia.

Presbycusis, or age-related hearing loss, is a prevalent chronic illness in older persons. It is linked to cognitive impairment, dementia, and increased risk of falls and therefore it is not surprising that hearing loss affects both the person with hearing loss (PHL) and their communication partners (family and friends). To benefit from visual cues, speak in a well-lit, quiet area. A PHL may not be able to see the speaker's face if the illumination is poor. Background noises like fans might make it harder for PHLs to perceive speech. It is better to speak slowly enough for the PHL to keep up and ask questions. Slowing down communication increases articulation and hence clarity. Use basic language, as complex or medical terminology may be difficult for a PHL to comprehend. Rather than asking "Do you understand?" specifically, give specific replies and clarifications of what was just said. Pausing between words allows PHLs to comprehend and ask questions. Pocket Talkers are portable, easy to use, and affordable. By directly amplifying a speaker's voice, these devices increase speech access. They can also be asked to wear their prescription hearing aids.

Table 2- Difficult airway predictors in elderly – usual patient subsets encountered in eye surgeries under local anaesthesia. [1,2,3]

Risk factors of a difficult airway	Age-related anatomic changes
Limited mandibular protrusion	TMJ disc displacement/OA, Teeth loss
Narrow dental arch	Arch width decreases
Decreased thyromental distance	Arch length decreases
Modified Mallampati class 3 or 4	Sarcopenia of the head, neck and suprahyoid pharyngeal muscles, and the overall height of cervical spines is reduced
Decreased submandibular compliance	Decreased oral soft tissue flexibility
Decreased sternomental distance	Compression of intervertebral discs
Limited head and upper neck extension and fixed cervical spine flexion deformity	Degenerative change of ligament and tendons of the intervertebral-discs, compression of the intervertebral discs, Cervical lordosis increases, Cervical spondylosis
Lack of teeth or poor dentition	Teeth-loss, Alveolar bone resorption
History of neck radiation	Possible
Reduced mouth opening	TMJ disc displacement/OA, Locked jaw
Supra- or extra-glottic pathologies (lingual tonsillar hypertrophy, neck radiation)	sarcopenia of the head, neck and suprahyoid and pharyngeal muscles, Pathologic status
Glottic and subglottic pathologies	Sarcopenia of the head, neck and suprahyoid and pharyngeal muscles, Pathologic status

Obesity might also make breathing more difficult. Because of a combination of anatomical and physiological characteristics, obesity is a strong predictor of airway difficulties. Obese individuals are twice as likely as non-obese patients to get serious airway complications. Patients with a body mass index greater than 40 (i.e., morbidly obese) are four times as likely to develop a serious complication. Physiological hazards such as decreased functional residual capacity and, more importantly, the resultant reduction in the manageable length of apnea must also be considered.

Preoperative identification of difficult airway

DA is identified based on history, clinical examination, and relevant investigations. Common measurements include mouth opening, Mallampati Score, thyro-mental distance, sternomental distance and neck circumference. Once diagnosed, DA is analyzed for its impact on different airway management techniques, including patient cooperation and positioning. Anesthesiologist may ponder on following points while planning for the airway management:

1. Evaluation of affected component of airway management

2. The most suitable method of airway management in a particular patient and the backup plan

3. Ensuring appropriate facilities for the anticipated level of difficulty including expertise and equipment

4. Plan for extubation and oxygenation as well.

Failure to prepare for failure is the most common reason for airway disasters.

Essential components of the routine airway assessment should include:

1. Past history: Examine past medical records including any previous anaesthesia issues and talk to the patient or his or her family to ascertain disorders of the major organ systems (e.g., cardiac, renal, pulmonary, neurologic, sleep apnoea, metabolic, endocrine), adverse experience with sedation/analgesia, as well as regional and general anaesthesia, history of DA, current medications, history of smoking, alcohol intake, substance abuse, gastroesophageal reflux disease and obstructive sleep apnoea.

2. Preoperative assessment: a thorough preoperative assessment helps to provide the best possible patient preparation. Physical examination of the patient, examination of the airway, lungs. Further workup is based on patient's medical condition, physical examination, and other factors depending on impact of such findings on perioperative management will impact management of mild sedation/analgesia. If the assessment was done several days or more than a week earlier, always re-evaluate the patient prior to the operation.

3. Educate patient or primary caregivers about the benefit, risks, and limitations of moderate sedation/analgesia, as well as feasible options, prior to the procedure, and solicit their opinions.

4. Inform patients or legal guardians about the fasting guidelines for the day of surgery

5. Assess the timing and nature from the last oral intake on the day of the procedure. When considering (1) the target level of sedation and (2) whether the procedure should be postponed, consider the risk of pulmonary aspiration of gastric contents.

Ophthalmic challenges

Ophthalmic surgeries are among most common procedures in elderly population and are rarely life-threatening. Cataract surgery can drastically improve an elderly patient's eyesight and thereby quality of life by reducing the risk of damage from falls. Many ophthalmic procedures, particularly cataract and retinal procedures, have undergone significant technical improvisation. Similarly, revolutionary technological advancements and safety initiatives have resulted in reduced incidence of major complications. Further, even patients with multiple co-morbidities also can undergo eye procedures safely.

Because of the low incidence of large volume blood loss, and the lack of major fluid shifts

or prolonged duration, ophthalmic surgical procedures are considered low risk surgery (except for some complex procedures such as complicated corneal or combined retinal surgery and corneal transplantation, which can be last up to 4 to 5 hours). [4]

Ophthalmic procedures, on the other hand, are associated with distinctive complications, such as the oculo-cardiac reflex (a trigemino-vagal reflex that can cause a variety of arrhythmias, including cardiac arrest) and brain stem injection of local anaesthetics during retrobulbar block. The latter can result in not only respiratory failure requiring intubation, but also profound hypotension and tachycardia or profound hypertension needing intubation.[5]

Limitations in managing a difficult airway under LA in ophthalmic surgeries

Patient factors-

- Facial drape to cover the adjacent sites.
- Apprehension and anxiety.
- Feeling of suffocation.
- Discomfort in supine position.
- Difficulty in keeping the head immobile.
- Need to manage airway while surgery is going on during emergency.
- Potential for catastrophe or complications.

Basic preparation for difficult airway management includes:

(1) Decision making with patient involvement and informed consent

(2) Equipment for management of a difficult airway (i.e., portable storage unit)

(3) Assigning an individual to help as required

(4) Careful and controlled sedation, clear communication

(5) Apnoea recognition and management

(6) Know when and whom to call for help

Types of anaesthesia for eye surgeries

Cataract surgery is by far the most common ocular surgery operation. Most of these procedures are done under local anaesthesia, and since the introduction of phaco-emulsion, they can be done with no or little sedation. Other eye surgical procedures, such as vitrectomy, laser surgery for retinal ablation, ocular muscle and oculoplastic surgery, require moderate sedation while performing orbital block. The trend in anaesthesia for cataract and other ophthalmic surgical procedures has shifted over time, from general anaesthesia with tracheal intubation and relaxation to laryngeal mask without paralysis, then regional blocks, intraconal (retrobulbar), extraconal (peribulbar), and sub Tenon's blocks to topical anaesthesia. [6,7]

The goals of regional anaesthesia are to render procedure painless by anaesthetizing the globe and conjunctiva, produce akinesia, and to lower the intra-orbital and intraocular pressures. The main benefit of local anaesthetic is that it has less systemic side effects, but it is also important to consider the

surgeon's preferences; some clinicians want to communicate with the patient throughout operation, while others like complete silence and total ocular immobilization.[8,9] Although topical anaesthesia does not provide as complete pain control as needle-based local techniques, it does avoid common serious complications like retrobulbar haemorrhage, globe damage, and the spread of the local anaesthetic to unusual locations, which can lead to life-threatening complications.[10]

Topical anaesthesia may cause difficulties due to uncontrolled eye movement and inadequate pain control, and this group is more likely to require sedation, but intravenous sedation has been shown to increase the risk of adverse events. Friedman and colleagues reported that 72% patients preferred a block to topical anaesthetic and two-thirds chose oral to intravenous sedation in a research on patient preference.[11] Katz and colleagues observed that while sedation alone reduced discomfort during surgery, 3.4 % of patients experienced intraoperative pain, and 2.7 % were dissatisfied. Drowsiness affected 2.7% patients, while nausea and vomiting affected 4.1% patients. The use of an opioid during surgery dramatically reduced pain, reduced sleepiness, and improved patient satisfaction.[12,13]

Sedatives and analgesics cause sleepiness and relieve fear, anxiety, and pain without impairing verbal communication.[14] Sedation must be achieved with cardiovascular stability, minimal or no respiratory depression, appropriate operating conditions, a rapid return to the patient's baseline physical and mental state, with no residual effects. Appropriate backup facilities should be available for patients who are likely to require inpatient care or admission to ICU. If sedation is the primary plan, still the preparation must be the same as for general anaesthesia, with adequate intravenous access and a designated recovery area with monitors, resuscitation facilities and experienced staff.

Supplemental oxygen is administered through a solid tent mask, which keeps the drape from covering the face, reducing hypoxia and claustrophobia. Despite enough oxygen delivery, re-breathing can occur behind the draperies According to a meta-analysis of RCTs, supplementary oxygen versus no supplemental oxygen is related to a lower frequency of hypoxemia during moderate sedation procedures.[9] Sedation level should be continuously monitored to prevent excessive or deep sedation which can lead to agitation, restlessness and airway obstruction rendering the patient unstable, hypoxic and difficult to manage.

Monitored anaesthesia care

- Keeping a watchful eye on the patient's level of consciousness
- During moderate sedation, evaluate a patient is responding to verbal commands at regular intervals (e.g., at 5-minute intervals). Patient can be instructed preoperatively regarding the expected response from him/her during the procedure.

It can be a thumbs up sign as it is easy to understand and perform. A verbal response when the eye procedure is going on may not be feasible. Differently abled patients and those with hearing loss and cognitive dysfunction may not be able to appropriately respond. Hence clinical monitoring such as observation of breathing rate and pattern and monitoring must be used in such patients for assessing the level of sedation.

- Oxygenation of the patient should be continuously monitored with pulse oximeter. Fall in oxygen saturation can be a late phenomenon and careful observation of chest movements and EtCO2 values help to anticipate and detect hypoxia early. Low flows (2 l/min) of oxygen through securely positioned nasal cannula can be continuously administered. However, the risk of hypoxic drive being abolished leading to hypercarbia in elderly with chronic obstructive lung disease must be remembered.
- Observe qualitatively clinical symptoms to monitor ventilator function constantly. Unless the nature of the patient, technique, or equipment prevents or invalidates it, continuously monitor ventilatory function by capnography. Capnography should be used for uncooperative individuals once moderate sedation has been obtained.
- Hemodynamic Monitoring- A baseline measurement of pulse rate, blood pressure and oxygen saturation breathing room air must be obtained in every patient before initiation of sedation and subsequent changes are interpreted more meaningfully. Continuously monitor electrocardiography, blood pressure (e.g., at 5-min intervals) and heart rate during the procedure until mild sedation/analgesia has been achieved, unless such monitoring interferes with the surgery (e.g., where stimulation from the blood pressure cuff could arouse an appropriately sedated patient). Even direct arterial blood pressure monitoring may be considered in patients with poor cardiac status.
- Patients' state of awareness, ventilatory and oxygenation status, and hemodynamic variables should be recorded on a regular basis, depending on the type and amount of medication given, the length of the procedure, and the patient's overall condition. This should occur at a minimum (1) before administration of sedative/analgesic agents; (2) following the administration of sedative/analgesic agents; (3) at regular intervals during the procedure; (4) during initial recovery; and (5) immediately before discharge. Set device alerts to notify the care team of any significant changes in the patient's condition.

Monitoring sedation level

A drug-induced state in which patients respond properly to verbal commands is known as minimum sedation. Cognitive and coordination abilities may be mildly impaired and respiratory and cardiovascular

systems are unchanged and airway patency is unaffected. During moderate sedation, patients respond purposefully to verbal commands, either alone or in combination with gentle tactile stimulation. The patient's airway and cardiovascular function are both preserved without the need for intervention. Airway patency and spontaneous respiration are preserved during moderate sedation. Deep sedation can be unintentionally produced during intended moderate sedation if the patient is more sensitive to sedatives and this can lead to airway obstruction and hypoxia. During deep sedation patients can develop cardiovascular instability. Maintaining sedation between a minimal and moderate level is the goal and is a challenging task that demands regular care. [10-14] The analgesic is included to alleviate patient discomfort during the block, as well as during the peri and postoperative periods. BIS monitoring improves sedative titration and reduces procedure time. The BIS measures sedation objectively, safely, and reliably, without disturbing patient or operator. When combined with other clinical signs, the BIS can help anaesthetists adjust sedation levels. This may also help lessen patient sedation. BIS monitoring improves patient care and should be used to supplement conventional evaluation.

Although having weak validity and reproducibility, clinical observation offers an approximate differentiation between appropriate, excessive, and inadequate sedation. Accurate assessment of sedation level necessitates a reliable and valid tool while also being simple to use in the operating room. The Ramsay Sedation Scale (RSS) and the Observer's Assessment of Alertness/Sedation (OAA/S) are two clinical assessment measures that are commonly used in clinical settings. [15-17] The RSS is a simple bedside clinical technique for measuring drowsiness in ocular surgery patients. It's a single ordinal scale that determines a person's state of consciousness subjectively. (Figure 2)

Sedation Level	Score
Patient is anxious and agitated or restless, or both	1
Patient is co-operative, oriented, and tranquil	2
Patient responds to commands only	3
Patient exhibits brisk response to light glabellar tap or loud auditory stimulus	4
Patient exhibits a sluggish response to light glabellar tap or loud auditory stimulus	5
Patient exhibits no response	6

Figure 2- RSS scoring system according to patient's response.

Choice of sedatives

The ideal sedative has a brief onset and duration, does not accumulate, is non-toxic, has a high therapeutic index, consistent effects, and is affordable.[18] Unfortunately, no drug currently exists that meets all these requirements. Benzodiazepines, intravenous anaesthetic induction agents (e.g. propofol), opiates, and alpha 2 agonists such as dexmedetomidine or clonidine are among the medications available. These medications can be taken orally, sublingually, intranasally, trans-dermally, trans-mucosally, rectally, intramuscularly, or intravenously, as summarised in Table 3. The drug can be given as a bolus injection, continuous infusion, or patient-controlled bolus injections (patient-controlled analgesia (PCA); patient-controlled sedation (PCS)) or a target-controlled infusion via the intravenous method (TCI)

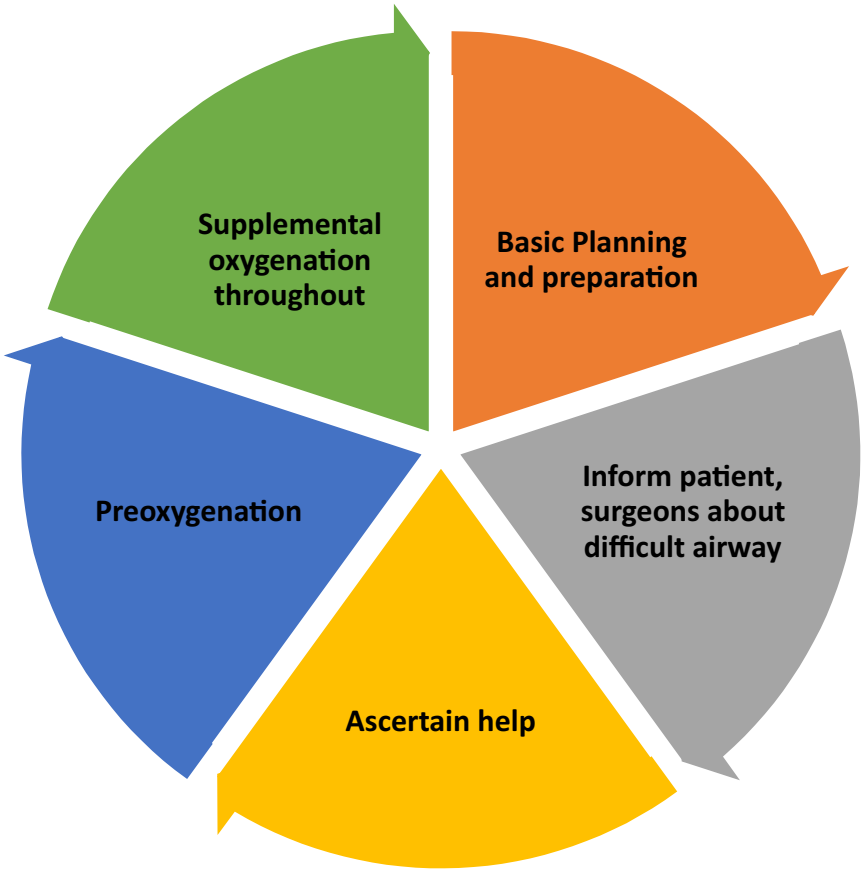
Table 3 Summary of drugs used for conscious sedation

Class of drugs	Utility	Administration	Dosage and duration of action	Miscellaneous
Benzodiazepines[19]	Amnesia, Anxiolysis, Hypnosis	Orally, intravenously	Midazolam: 1 mg or 0.02-0.1 mg/kg IV. Onset- 1-2 min Duration- 30-60 min Half-life- 2 hours	In individuals over the age of 60, it is recommended that the dose be lowered by 30%.
Induction agents				
Propofol [20,21,22]	Sedative Induction, quick onset and a quick, obvious recovery	IV bolus, infusions, on-demand sedation via a PCA	0.5-1 mg/kg IV loading dose; may repeat by 0.5-mg/kg increments q3-5min. Infusion at 20mg/kg/hour Onset- <1 min Duration- 3-6 min	minor risk of nausea and vomiting. Respiratory depression Hypotension, Injection pain,
Analgesics				
Fentanyl	Powerful narcotic analgesic supplemental effects on analgesia and sedation, increasing patient comfort and surgeon satisfaction	IV injection, infusions, On-demand analgesia via a PCA	1-2 mcg/kg slow IV push. PCA with (0.5 g bolus doses with a 5-minute lockout period after an intravenous loading dose of 0.7 g /kg) Onset- 1-2 min Duration- 30-60 min	Side effects like chest wall rigidity, apnea, respiratory depression, myoclonus or hypotension
Other agents *(centrally acting -adrenergic agonist)*				
Dexmedetomidine	sedative and analgesic	No significant haemodynamic fluctuation	loading dose of 2.5 g /kg/ h over 10 minutes, followed by a 0.4 g/kg/h infusion until 30 minutes before completion the operation Onset- <1 min Duration- 3-6 min	Bradycardia, heart block, hypotension
Clonidine	sedative and analgesic, lowers sympathetic outflow	IV	0.5 to 2.0 g/kg	decrease in IOP, increased duration of akinesia

Intra operative conversion of cases to GA may be required in case of-

- Excessive sedation
- Respiratory depression
- Complications secondary to local anaesthetics- LAST, anaphylaxis
- Deterioration due to co-morbidities
- Severe Agitation
- Convulsion (vascular spread)

Figure 3- Key points in managing patients with DA undergoing ophthalmic procedures



Points to be remembered in DA

- Carefully avoid deep sedation
- Never use technique that you are not familiar with
- Don't render the patient apnoeic unless you are sure of bag and mask ventilation(Fig. 4)
- Oxygenation is always a priority, fall in saturation may be a late sign of hypoxia
- Avoid multiple attempts at intubation in case GA is necessary, consider alternates like supraglottic airway devices

Conclusion

To summarize, adequate training, experience, risk assessment, and clinical judgement are required to estimate the difficulties of preserving and managing an airway. A skilled specialist should be able to treat a basic airway without difficulty. Advanced airway may be challenging, requiring unconventional procedures and a team with specific additional skills or equipment. However, real-world airway assessment is typically highly subjective, and even specialists have trouble anticipating which instances will be difficult. An anesthesiologist encountering such cases of difficult airways must have a clear understanding of the risks involved and a clear definition of the type and likelihood of difficulty which may be experienced. One should avoid deep sedation during monitored anesthesia care.

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Conflicts of interest

There are no conflicts of interest.

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