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Endoscopic Sedation: Risk Assessment and Monitoring

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Sedation for endoscopic procedures is done to increase patient comfort and endoscopic performance. Drugs used for sedation suppress respiratory and cardiovascular function, and while the degree of suppression may vary, it may be fatal in certain patients. The aim of this article is to provide an overview and brief summary of pre-sedation risk assessment and monitoring during and after sedation in order to maintain patient safety.

Key Words: Sedation; Endoscopic procedures; Risk assessment; Monitoring

INTRODUCTION

Sedation can be defined as a pharmacologically induced state of a reduced level of consciousness. According to recent nation-wide surveys, the majority of endoscopic procedures are currently performed under sedation.^{1,2} Drugs used for endoscopic sedation vary between centers, as some may use a single agent or mix two sedatives, such as propofol and midazolam, while others may combine a sedative with an analgesic.¹⁻³ The administration of sedatives and analgesics increase the patient's tolerance to discomfort or pain, and therefore improve the outcomes of diagnostic or therapeutic endoscopic procedures.³⁻⁵ A patient under an appropriate depth of sedation should feel comfortable and be able to cooperate with the endoscopist, while being able to maintain his or her airway reflexes and a stable state of spontaneous respiration. This usually corresponds to the level of 'moderate sedation' among the depths of sedation defined by the American Society of Anesthesiologists (ASA), as seen in Table 1.⁶ Although sedatives and analgesics suppress the central nervous system in a dose-dependent manner, patients tend to differ considerably in their responses to different drugs, and therefore, the depth of seda-

tion can be altered rapidly on a continuum of minimal sedation and general anesthesia. An unintended deep level of sedation may cause depressed respiratory and cardiovascular function, which may be fatal in certain patients. Serious cardiorespiratory complications are known to occur in 0.54% of endoscopic procedures performed under sedation,⁷ and a mortality rate as high as 0.05% has been reported.⁸ The patient scheduled for endoscopic procedures under sedation should therefore be carefully evaluated for any medical history and current medical status and closely monitored for any changes in respiratory and cardiovascular instabilities.

PRESEDATION EVALUATION

Because many drugs that are used for sedation and analgesia have a narrow margin of safety, with patients often presenting with different reactions to the same dose of the same drug, careful pre-sedation evaluation is necessary.

Past medical history and current status

Serious complications that can occur during sedation are due to either hypoxemia caused by respiratory depression or hypotension and arrhythmia caused by cardiovascular collapse. Therefore, irrespective of whether the patient has any underlying cardiac or pulmonary disease, and the severity of such comorbidities should always be evaluated. Moreover, any kidney or liver disease that may alter the half-life of certain drugs or increase the effect of sedative metabolites, such as midazolam, should be evaluated.⁹ Sedatives and analgesics should be chosen based on any possible interactions they may

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Table 1. American Society of Anesthesiologists Classification for Sedation and Analgesia

	Minimal sedation	Moderate sedation	Deep sedation	General anesthesia
Responsiveness	Normal response to verbal stimulation	Purposeful response to verbal or tactile stimulation	Purposeful response to repeated or painful stimuli	Unarousable, even with painful stimulus
Airway	Unaffected	No intervention required	Intervention may be required	Intervention often required
Spontaneous ventilation	Unaffected	Adequate	May be inadequate	Frequently inadequate
Cardiovascular function	Unaffected	Usually maintained	Usually maintained	May be impaired

Adapted from American Society of Anesthesiologists Task Force on Sedation and Analgesia by Non-Anesthesiologists. *Anesthesiology* 2002; 96:1004-1017, with permission from American Society of Anesthesiologists.⁶

have with current medications of the patient and a history of drug allergies. Patients who have previously received sedation or general anesthesia should be evaluated for any history of adverse reactions to sedatives or anesthetics and a history of difficult airway management. It should be noted that obese patients or those with obstructive sleep apnea may present with airway obstruction and hypoxia even in the absence of respiratory suppression.¹⁰ Further, the ASA physical status should be documented in every patient, as the risk of serious cardiopulmonary complications is significantly increased in those with an ASA physical status of III or higher.¹¹

Airway evaluation

Because all sedatives have the potential to cause respiratory depression, and thus require emergency tracheal intubation, airway evaluation should be assessed by measuring Mallampati scores and chin-hyoid distance (Fig. 1).¹² Patients with a high Mallampati score, a chin-hyoid distance under 4 cm, or a history of difficult intubation, are all at risk of difficult airway management, and should be carefully managed so as not to fall into unintended deep sedation.

Pre-sedation fasting

Decreased airway reflexes during sedation will render a patient more susceptible to aspiration. In order to prevent aspiration during sedation, an appropriate fasting time should be maintained as follows: at least 2 hours for water, pulp-free juice, and tea or coffee without milk, and at least 6 hours for solid foods, including milk. However, obese patients and those with gastroesophageal reflux or diabetes should consider maintaining a longer fasting time.¹³

MONITORING

When an unintended level of deep sedation is reached during an endoscopic procedure, respiratory depression or hypotension may occur. In order to prevent and properly manage such an event, the depth of sedation and cardiorespiratory signs

should be periodically and continuously monitored in all patients. It is of utmost importance that continuous monitoring be carried out by qualified medical personnel other than the endoscopist.

Hemodynamic monitoring

Continuous monitoring of heart rate and blood pressure is essential during sedation, and should be checked and recorded at least every 5 minutes, starting before the administration of sedatives.¹⁴ Hypertension and tachycardia may occur when an appropriate depth of sedation for the procedure is not reached, while hypotension and bradycardia is often observed during oversedation. However, changes in blood pressure and heart rate can vary largely between patients, and close observation for pain and vasovagal reflexes that may affect vital signs is needed.

Pulse oximetry and respiratory rate

Because virtually every sedative is capable of suppressing the central respiratory drive, pulse oximetry monitoring and oxygen supplementation is of the essence during endoscopic sedation.^{15,16} However, pulse oximetry measures arterial oxygen saturation, not alveolar ventilation, and therefore does not immediately reflect respiratory depression. It should be kept in mind that pulse oximetry will not fall before alveolar oxygen partial pressure is first decreased in a patient that is receiving oxygen supplementation. In such cases, pulse oximetry will be overestimated, even in the setting of significant alveolar hypoventilation.^{16,17} Capnography is a noninvasive method that can monitor the carbon dioxide concentration during expiration. Although this is not currently recommended as part of routine monitoring during endoscopic sedation, it may be helpful in patients at high risk for respiratory depression or those requiring deep sedation.¹⁸

Oxygen supplementation and equipment

Providing supplementary oxygen to a patient before respiratory depression occurs is very important for maintaining pa-

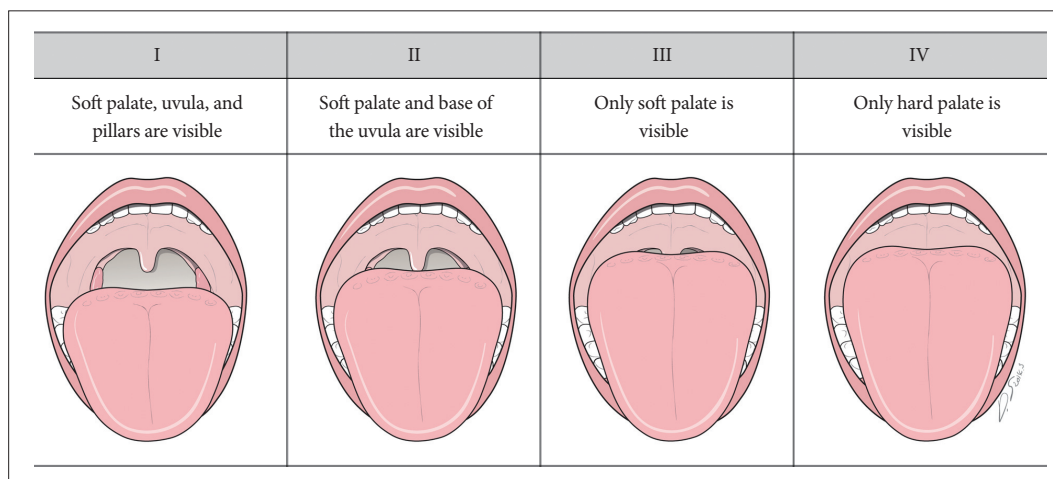


Fig. 1. Mallampati classification system.

Table 2. Modified Aldrete Score

Parameter	Description of patient	Score
Activity	Able to move four extremities voluntarily or on command	2
	Able to move two extremities voluntarily or on command	1
	Unable to move extremities voluntarily or on command	0
Respiration	Able to breathe deeply and cough freely	2
	Dyspnea or limited breathing	1
	Apneic	0
Circulation	Blood pressure+20% of preanesthetic level	2
	Blood pressure+20% to 49% of preanesthetic level	1
	Blood pressure+50% of preanesthetic level	0
Consciousness	Fully awake	2
	Arousable on calling	1
	Not responding	0
O ₂ saturation	Able to maintain O ₂ saturation >92% on room air	2
	Needs O ₂ inhalation to maintain O ₂ saturation >90%	1
	O ₂ saturation <90% even with O ₂ supplement	0

Adapted from Aldrete JA. *J Perianesth Nurs* 1998;13:148-155, with permission from Elsevier.¹⁹

tient safety during sedation. Because most drugs used for endoscopic sedation are short-acting, most episodes of respiratory depression do not exceed several minutes, and external stimulations such as the insertion of the endoscope are required for patients to recover from them.¹⁹ As mentioned earlier, achieving a significant increase in arterial oxygen partial pressure by supplying oxygen to the patient will help maintain arterial oxygen saturation in the setting of transient alveolar hypoventilation. Closely monitoring the patient for signs of respiratory depression, such as decreased respiratory rate, and prompt management of such events can prevent significant hypoxemia during sedation. Other than oxygen supply, aspirators, face masks, oral and nasal airways, reservoir bags, laryngoscopes, and endotracheal tubes, drugs for cardiopulmonary resuscita-

tion and antidotes to sedatives and opioids, such as naloxone and flumazenil, should always be prepared in the sedation unit regardless of the type of procedure being carried out.

Monitoring during recovery and discharge

Even after the endoscopic procedure is finished, the patient may still be at risk of cardiopulmonary complications, depending on the duration of sedatives or analgesics used for sedation and the general condition of the patient. The cessation of external stimulation from the endoscopic procedure may cause an unexpected fall in blood pressure or heart rate. Therefore, patients should be monitored for changes in vital signs and mental status by qualified staff members after the procedure until the patient is fully awake and able to maintain stable vital

signs. Although there is not a standardized guideline for post-procedure monitoring, the estimated duration of effect for the sedatives that were used and the general condition of the patient should be taken into consideration before discharge. Postprocedure monitoring should include blood pressure and pulse oximetry, which should be continued until discharge. Among the various scoring systems for the assessment of recovery, the Aldrete scale is most commonly used.²⁰ The Aldrete scale consists of a scoring system for respiration, oxygen saturation, blood pressure, consciousness, and activity, which are each graded with a score of 0 to 2 (Table 2). A patient presenting with a score of 8 or higher, including a score of 2 for respiration, is considered fit for discharge to the general ward. However, the patient should also be able to walk without assistance, drink fluids, be free of excessive pain or nausea, and have an adult caregiver that is able to escort the patient home when they are directly discharged from the hospital. Patients should also be provided with written instructions explaining the possible complications and who to contact if needed.²¹

CONCLUSIONS

For an endoscopic sedation to be successful, the patient should be able to undergo the procedure safely and comfortably. This requires careful and meticulous monitoring, individually tailored administration of sedatives and analgesics, thorough preparation for emergency situations, and well-trained professional staff members. Under the current circumstances of the medical community, it is difficult to have board-certified anesthesiologists involved in all sedation procedures outside of the operating theater. Nonanesthesiologists that are performing sedation for endoscopic procedures should be well-informed and trained in the use of sedatives, analgesics and their antidotes, basic patient monitoring, airway management techniques, and cardiopulmonary resuscitation in order to provide safe and successful sedation to patients.

Conflicts of Interest

The author has no financial conflicts of interest.

REFERENCES

- Cohen LB, Wechsler JS, Gaetano JN, et al. Endoscopic sedation in the United States: results from a nationwide survey. *Am J Gastroenterol* 2006; 101:967-974.
- Riphaus A, Rabofski M, Wehrmann T. Endoscopic sedation and monitoring practice in Germany: results from the first nationwide survey. *Z Gastroenterol* 2010;48:392-397.
- Muller M, Wehrmann T. How best to approach endoscopic sedation? *Nat Rev Gastroenterol Hepatol* 2011;8:481-490.
- Abraham NS, Fallone CA, Mayrand S, Huang J, Wiczorek P, Barkun AN. Sedation versus no sedation in the performance of diagnostic upper gastrointestinal endoscopy: a Canadian randomized controlled cost-outcome study. *Am J Gastroenterol* 2004;99:1692-1699.
- McQuaid KR, Laine L. A systematic review and meta-analysis of randomized, controlled trials of moderate sedation for routine endoscopic procedures. *Gastrointest Endosc* 2008;67:910-923.
- American Society of Anesthesiologists Task Force on Sedation and Analgesia by Non-Anesthesiologists. Practice guidelines for sedation and analgesia by non-anesthesiologists. *Anesthesiology* 2002;96:1004-1017.
- Arrowsmith JB, Gerstman BB, Fleischer DE, Benjamin SB. Results from the American Society for Gastrointestinal Endoscopy/U.S. Food and Drug Administration collaborative study on complication rates and drug use during gastrointestinal endoscopy. *Gastrointest Endosc* 1991; 37:421-427.
- Quine MA, Bell GD, McCloy RE, Charlton JE, Devlin HB, Hopkins A. Prospective audit of upper gastrointestinal endoscopy in two regions of England: safety, staffing, and sedation methods. *Gut* 1995;36:462-467.
- Miller RD. *Anesthesia*. 7th ed. Philadelphia: Elsevier Churchill Livingstone;2009.
- Shin S, Lee SK, Min KT, Kim HJ, Park CH, Yoo YC. Sedation for interventional gastrointestinal endoscopic procedures: are we overlooking the "pain"? *Surg Endosc* 2014;28:100-107.
- Miller MA, Levy P, Patel MM. Procedural sedation and analgesia in the emergency department: what are the risks? *Emerg Med Clin North Am* 2005;23:551-572.
- Mallampati SR, Gatt SP, Gugino LD, et al. A clinical sign to predict difficult tracheal intubation: a prospective study. *Can Anaesth Soc J* 1985; 32:429-434.
- Smith I, Kranke P, Murat I, et al. Perioperative fasting in adults and children: guidelines from the European Society of Anaesthesiology. *Eur J Anaesthesiol* 2011;28:556-569.
- Waring JP, Baron TH, Hirota WK, et al. Guidelines for conscious sedation and monitoring during gastrointestinal endoscopy. *Gastrointest Endosc* 2003;58:317-322.
- Hutton P, Clutton-Brock T. The benefits and pitfalls of pulse oximetry. *BMJ* 1993;307:457-458.
- Arakawa H, Kaise M, Sumiyama K, Saito S, Suzuki T, Tajiri H. Does pulse oximetry accurately monitor a patient's ventilation during sedated endoscopy under oxygen supplementation? *Singapore Med J* 2013;54: 212-215.
- Fu ES, Downs JB, Schweiger JW, Miguel RV, Smith RA. Supplemental oxygen impairs detection of hypoventilation by pulse oximetry. *Chest* 2004;126:1552-1558.
- Qadeer MA, Vargo JJ, Dumot JA, et al. Capnographic monitoring of respiratory activity improves safety of sedation for endoscopic cholangiopancreatography and ultrasonography. *Gastroenterology* 2009;136: 1568-1576.
- Qadeer MA, Lopez AR, Dumot JA, Vargo JJ. Hypoxemia during moderate sedation for gastrointestinal endoscopy: causes and associations. *Digestion* 2011;84:37-45.
- Aldrete JA. Modifications to the postanesthesia score for use in ambulatory surgery. *J Perianesth Nurs* 1998;13:148-155.
- Ead H. From Aldrete to PADSS: reviewing discharge criteria after ambulatory surgery. *J Perianesth Nurs* 2006;21:259-267.