Sedation: A Primer for Pediatricians
Shobhit Jain, MD, FAAP

ABSTRACT
There has been an increasing use of pediatric procedural sedation and analgesia over the past 20 years, along with numerous medical and technological developments. Sedation can facilitate the smooth completion of otherwise stressful procedures, but it also can be associated with life-threatening complications. Pediatric practitioners need to be familiar with the basic tenets of providing safe and optimal sedation outside the operating room. This review focuses on the current understanding of sedation-related classification, guidelines, and medications, and discusses some special considerations for procedural sedation in common clinical settings. [Pediatr Ann. 2018;47(6):e254-e258.]

Ethical mandates, as well as evidence of improved outcome, warrant that optimal pain relief and sedation be provided for appropriate diagnostic and therapeutic interventions in children; however, historically, the provision of procedural sedation and analgesia has been suboptimal in pediatric patients. Pediatric sedation has experienced an exponential growth over the past 2 decades, due in part to new pharmacologic options and to the emerging role of the sedation provider. Currently, pediatric practitioners from several educational backgrounds provide procedural sedation outside the operating room, including but not limited to pediatricians, pediatric hospitalists, emergency medicine physicians, intensive care physicians, physician assistants, and nurse practitioners.

Several professional groups, including the American Academy of Pediatrics, the American Society of Anesthesiologists (ASA), the American College of Emergency Physicians, and the Joint Commission of Healthcare Organization, have published guidelines for pediatric sedation.1-4 It is imperative for the pediatric sedation provider to adhere with institutional standards and national guidelines for sedation and to maintain the necessary skills. For safe and optimal sedation, it is crucial to have an understanding of choosing appropriate patients, as well as the preparation (including equipment), proper monitoring, and discharge criteria. In this article, we review the basics of short-duration pediatric sedation and analgesia outside the operating room and discuss some special consideration for common clinical locations.

INDICATIONS AND PHARMACOLOGIC AGENTS
Common pharmacologic agents for sedation have one or more of the following properties: anxiolysis, various degree of sedation, amnesia, analgesia, and immobility. To choose the right agent, it is important to determine which property or properties will be most suited to meet the needs of the patient. Table 1 illustrates some common procedures and features desired from the pharmacologic agent. Although the detailed description of all medications is beyond the scope of this review, Table 2 lists the most commonly used.

PROCEDURAL SEDATION CLASSIFICATION
Although the following classification adapted from the ASA is widely agreed upon, it is imperative to remember that sedation is a continuum.2 Even with the same pharmacologic agent, the actual level of sedation may vary during the procedure and may be different from the intended level of sedation. A combination of medications can cause significant additive effects on sedation as well as depression of cardiorespiratory function.

Minimal Sedation
Previously referred to as anxiolysis, minimal sedation is a drug-induced state in which the cognitive and coordination functions may be altered. However, the patient remains responsive to verbal commands and is able to maintain cardiovascular as well as ventilatory function.
Moderate Sedation

Previously referred to as conscious sedation, moderate sedation is a drug-induced depression of the level of consciousness. In this state, the patient responds purposefully to verbal and tactile stimuli, and the cardiovascular and ventilatory functions remain unaffected.

Deep Sedation

In deep sedation, the patient has a depressed level of consciousness and may not be easily arousable. He or she may also require ventilatory support and assistance with maintaining a patent airway. Cardiovascular function is usually maintained.

General Anesthesia

General anesthesia is a drug-induced state in which the patient is not arousable or responsive to even painful stimuli. He or she is unable to reliably maintain ventilatory function, and airway assistance is required. Cardiovascular function may also be impaired.

GUIDELINES

Patient Selection and Pre-Sedation Assessment

Appropriate patient selection is key to providing safe sedation outside the operating room. A thorough pre-sedation assessment focusing on past and current medical problems, and on sedation risks including airway management, is warranted for every patient prior to providing sedation.

Widely used for sedation-related risk assessment, the “Continuum of Depth of Sedation: Definition of General Anesthesia and Levels of Sedation/Analgesia” was approved by the ASA House of Delegates in 1999 and last amended in 2014. A general assessment of active medical problems using the ASA classification may be an initial step. However, it is important to remember that the ASA physical status classification alone is not a risk classification. A thorough history with details of prior issues with anesthesia, sleep apnea, and chromosomal abnormalities is important.

Assessment of the airway should be performed for every patient, and it must include upper airway, facial symmetry, mouth opening, dentition, neck size, and flexion. Ease of intubation may be predicted using the Mallampati classification.

Fasting Guidelines

Sedative agents have the potential to impair airway reflexes and increase the risk of regurgitation and pulmonary aspiration; however, the actual incidence of aspiration in patients undergoing procedural sedation is not clear. Table 3 offers a guideline for optimal fasting (nil per os [nothing by mouth]) as provided by the ASA. Of note, for emergent procedures the risks of sedation must be balanced with the benefits of competing the procedure.

Preparation for Sedation

The sedation providers should have immediate access to emergency rescue situation personnel and equipment. The most common serious complications associated with sedation are airway-related. In addition to ensuring that the practitioner is skilled in identification and management of these complications (eg, Pediatric Advanced Life Support [PALS] certification), it is crucial to have the appropriate equipment and monitoring facilities available for every sedation. For sedations performed in out-of-hospital settings, it is vital to have a predetermined protocol to activate emergency medical services for the timely transfer to appropriate facilities. Additionally, having a multidisciplinary sedation team can be helpful in policy and protocol development, training, quality assurance, and providing high-quality dedicated sedation service. SOAPME is a commonly used acronym that serves as a checklist to ensure preparation (Table 4).

Monitoring

Appropriate pre-sedation, intra-sedation and post-sedation monitoring is crucial to provision of safe sedation. These practices enable timely identification and management of adverse events.

Pre-sedation/baseline. Before the administration of the sedative agent, a baseline set of vital signs including heart rate, respiratory rate, blood pressure, and oxygen saturation (pulse oximetry) must be obtained. The practitioner must address any abnormal vitals prior to the elective sedation.

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TABLE 1.

Common Procedures and Desirable Sedative Properties from Pharmacologic Agents

<table>
<thead>
<tr>
<th>Procedure Type</th>
<th>Procedure</th>
<th>Desired Property</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invasive</td>
<td>Incision and drainage</td>
<td>Analgesia, anxiolysis, sedation</td>
</tr>
<tr>
<td></td>
<td>Laceration repair, large</td>
<td>Analgesia, anxiolysis</td>
</tr>
<tr>
<td></td>
<td>Fracture reduction</td>
<td>Analgesia, sedation</td>
</tr>
<tr>
<td></td>
<td>Mechanically ventilated child</td>
<td>Sedation, analgesia</td>
</tr>
<tr>
<td></td>
<td>Burn care</td>
<td>Analgesia, sedation</td>
</tr>
<tr>
<td>Distressful</td>
<td>Genitourinary examination after sexual assault, uncooperative patient</td>
<td>Anxiolysis, amnesia</td>
</tr>
<tr>
<td>Noninvasive</td>
<td>Advanced imaging (magnetic resonance imaging/computed tomography)</td>
<td>Anxiolysis, immobility</td>
</tr>
</tbody>
</table>
**FEATURE ARTICLE**

Intra-sedation. Heart rate, respiratory rate, blood pressure, pulse oximetry, and exhaled CO$_2$ must be recorded frequently. Recommended minimum frequency is every 10 minutes for moderate sedation and every 5 minutes for deep sedation. However, because the level of sedation can be variable, we recommend monitoring vitals every 5 minutes for all but minimal sedation. Additionally, continuous capnography is highly recommended for moderate sedations and required for deep sedations. More important than the actual exhaled CO$_2$ number is the continuous waveform, which is helpful in early identification of ventilatory insufficiency, particularly for patients who are difficult to observe.$^5,10$

Post-sedation. After completion of the procedure, close observation and frequent vital sign monitoring should continue in a suitably equipped area until the patient is fully alert. The duration of observation and recovery is also dependent on the half-life of the medication used.

Documentation

Maintaining thorough documentation is an important part of proper patient care as well as for compliance with local and national guidelines for obtaining and maintaining privileges and billing purposes.

Pre-sedation. The practitioner must obtain informed consent from the legal guardian in compliance with institutional guidelines after discussion of risks, benefits, and alternatives. The anticipated behavioral change during and soon after the sedation can be distressing to the uninformed observer and must be described ahead of time. Health status, including ASA classification, airway assessment including Mallampati score, fasting time, and key family and personal medication effects must be clearly recorded.

Sedation. A focused timeout should be performed and documented just prior to the sedation, with patients’ identifying information and the procedure. Keeping a time-based record of the medication administration is im-

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**TABLE 2. Commonly Used Medications for Sedation**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Routes of Administration</th>
<th>Common Indications</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ketamine</td>
<td>IV, PO, PR, IN</td>
<td>Invasive and distressful procedures</td>
<td>Can cause increased intracranial and intraocular pressure. Use with caution in patients with psychiatric history. Expect hypertension, nystagmus, nausea, and hallucinations. Good sedation, analgesia, and amnesia</td>
</tr>
<tr>
<td>Midazolam</td>
<td>PO, IV, IN, PR</td>
<td>Distressful procedures, premedicant</td>
<td>Sedative and amnestic. No analgesic property. Short acting. Can cause mild depression of ventilatory drive</td>
</tr>
<tr>
<td>Dexametomidine</td>
<td>IV, IN, PO</td>
<td>Noninvasive procedures</td>
<td>Rapid onset, titratable. Dose-dependent effect on cardiovascular function. No respiratory depression. Poor analgesic effect</td>
</tr>
<tr>
<td>Pentobarbital</td>
<td>IV</td>
<td>Noninvasive procedures</td>
<td>Rapid onset, deep sedation. Can cause depression of cardiovascular and respiratory function. Contraindicated in porphyria. Poor analgesic</td>
</tr>
<tr>
<td>Propofol</td>
<td>IV</td>
<td>Noninvasive procedures</td>
<td>Sedative and amnestic. Poor analgesic effect. Depression of cardiovascular and respiratory function likely</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>IV, IN</td>
<td>Invasive procedures</td>
<td>Strong analgesic. Mild sedation. Rapid administration associated with chest wall rigidity and apnea. Additive sedation with benzodiazepines</td>
</tr>
<tr>
<td>Etomidate</td>
<td>IV</td>
<td>Noninvasive procedures</td>
<td>Expect deep sedation, no analgesia. May cause respiratory distress. Transient adrenocortical insufficiency and myoclonus</td>
</tr>
<tr>
<td>Morphine</td>
<td>IV</td>
<td>Invasive procedures</td>
<td>Strong analgesia, mild sedation. May depress cardiorespiratory function. Additive sedative effects with benzodiazepine. May cause itching and flushing</td>
</tr>
<tr>
<td>Chloral hydrate</td>
<td>PO, PR</td>
<td>Noninvasive procedures</td>
<td>Sedative effect can be very long. No analgesia. Oral route more effective. Most effective in children younger than age 2 years. May cause mild cardiorespiratory depression</td>
</tr>
</tbody>
</table>

Abbreviations: IN, intranasal; IV, intravenous; PO, per os (by mouth); PR, per rectum.
portant, along with behavior and vital signs. It is important that a detailed record of any complication (and its management) be maintained.

**Post-sedation.** A record of vital signs and level of consciousness should be maintained until the patient is ready for discharge. It helps to have objective criteria to determine readiness for discharge, such as the University of Michigan Sedation Scale and the State Behavioral Scale. The ability to stay awake without stimulation for 20 minutes is also a good measure of adequate recovery. It is prudent to remember the duration of action of the sedative agent when determining readiness for discharge. Medications with a longer half-life may have a delayed recovery period as well as risk of re-sedation. When discharging home, the family should be provided with education about post-sedation care at home.

**MISCELLANEOUS: SPECIAL CONCERNS FOR SEDATION IN DIFFERENT LOCATIONS**

**Clinic/Urgent Care Center**

These settings are generally unsuited for administering moderate or deep sedation. The occasional procedure done in these settings may be facilitated with mild sedation. Monroe et al. described sedation by pediatricians using data from the Pediatric Sedation Research Consortium. Usually, a single agent is used for procedures such as small laceration repair, bladder catheterization, and dental care (generally a short-acting benzodiazepine, opioid, or nitrous oxide). The practitioner must be adequately trained and have access to a PALS-certified provider. It is important to adhere to predetermined protocols for inadvertent higher level of sedation and for adverse events.

**Diagnostic Imaging Areas**

Anxiolysis and behavioral modification to encourage immobility are the characteristics often desired from sedations performed in these areas for facilitating studies such as magnetic resonance imaging and computed tomography scans. Sedative hypnotic medications (eg, pentobarbital, midazolam, propofol, dexmedetomidine) are commonly used. When moderate or deep sedation is performed, added caution needs to be exercised in monitoring (including but not limited to the use of capnography) because the responsible practitioner may be spatially separated from the patients and be unable to perform frequent assessments.

**Emergency Departments**

A variety of procedures are performed with the assistance of different levels of sedation with the appropriate characteristics (Table 1). Due to its safety profile, ketamine is the most commonly used drug in the emergency department, and it produces dissociative anesthesia. It is important to have one practitioner dedicated to sedation and another for the procedure. If the patient does not meet fasting criteria, then the risks, benefits, and alternatives must be clearly discussed.

**TABLE 3.**

<table>
<thead>
<tr>
<th>Ingested Material</th>
<th>Minimum Fasting/NPO Time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear fluids</td>
<td>2</td>
</tr>
<tr>
<td>Human milk</td>
<td>4</td>
</tr>
<tr>
<td>Infant formula</td>
<td>6</td>
</tr>
<tr>
<td>Light meal</td>
<td>6</td>
</tr>
</tbody>
</table>

Abbreviation: NPO, nil per os (ie, nothing by mouth). Adapted from American Society of Anesthesiologists.

**TABLE 4.**

**SOAPME: An Acronym to Ensure Proper Preparation**

- S: Suction equipment, including size appropriate catheter
- O: Oxygen supplies and delivery equipment
- A: Airway equipment (including bag-valve-mask, nasopharyngeal and oropharyngeal airways, laryngeal mask airways, endotracheal tube, laryngoscope with blades and stylets)
- P: Pharmacologic agents (including appropriate reversal agents in addition to life-saving drugs)
- M: Monitors (pulse oximeter, end-tidal CO₂ monitor, frequent vital signs monitoring devices)
- E: Equipment and drugs, miscellaneous (such as defibrillator, electrocardiogram)

Consultation from anesthesia must be sought for all high-risk cases (including ASA class III and above).

**Intensive Care Units**

The most common situation in intensive care units requiring sedation is for the mechanically ventilated child, and the period of sedation is often longer than other clinical areas. This warrants regular assessment of sedation level, which may be facilitated by validated tools such as the State Behavioral scale and the COMFORT scale. Weaning from sedation to avoid tolerance and physical dependence, and restorative sleep promotion during and after the sedated state are unique to the intensive care areas. Several strategies may be used, but they are beyond the scope of this review. The practitioner must be cognizant that prolonged and frequent sedations are also associated with long-term developmental issues (further information may be obtained from www.SmartTots.org).
CONCLUSION

Procedural sedation is an important adjunct to high-quality care, and it can be performed by a variety of sedation providers in different clinical settings. It is crucial to have a thorough understanding of the optimal sedation process, including patient assessment, choosing the appropriate agent(s), monitoring, and documentation. It is important to work within systems-based practice with adequately trained personnel, and to perform quality assurance and improvement activities regularly.

REFERENCES


