PEDIATRIC EMERGENCY MEDICINE REPORTS

Practical, Evidence-Based Reviews in Pediatric Emergency Care

June 2021 VOL. 26, NO. 6

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Pediatric Procedural Sedation and Analgesia in the Emergency Department

Children in the acute care setting may require nonpharmacologic and pharmacologic adjuncts for anxiety, pain, or to successfully complete diagnostic testing or therapeutic interventions. The authors review the requirements and pharmacologic agents necessary to complete a successful pediatric procedural sedation and analgesia.
— Ann M. Dietrich, MD, FAAP, FACEP, Editor

Introduction

Procedural sedation and analgesia (PSA) has been provided safely to children in the emergency department for decades. When patients are evaluated properly, and adequate equipment, personnel, and medications are used, effective and safe PSA is delivered by the emergency physician (EP), whether in a university or community setting, over a wide range of ages, and with a broad selection of medications.[1-3] This article will review goals and levels of sedation, pre- and post-procedure evaluation, necessary equipment and personnel, as well as medication choices.

PSA is a standard practice of EPs recognized by the American College of Emergency Physicians (ACEP) as integral to the practice of emergency medicine and as a core competency of emergency medicine training.[4] It is defined by the use of pharmacologic agents to provide anxiolysis, analgesia, sedation, and motor control during procedures or diagnostic tests.[5] The need for PSA outside of the operating room (OR) setting has led to its use by many non-anesthesiologist practitioners, both in the inpatient and outpatient settings. From 2007 to 2018, the Pediatric Sedation Research Consortium reported 432,842 sedation encounters in patients younger than 21 years of age.[6] The National Anesthesia Clinical Outcomes Registry reported 349,518 cases in patients aged 19 years and younger from 2010-2013, with lower morbidity and mortality rates than OR cases.[7]

According to the Joint Commission on Accreditation of Healthcare Organizations, "the standards for sedation and analgesia care apply when patients in any setting receive, for any purpose and by any route, moderate or deep sedation."[8] Guidelines for the practice of PSA by non-anesthesiologists were developed by the American Society of Anesthesiologists (ASA) in 2002.[9] Guidelines for PSA in the pediatric population followed. These were developed by the American Academy of Pediatrics (AAP) and the American Academy of Pediatric Dentistry and were updated in 2019.[10]

In contrast to adults, PSA in children often is administered to control behavior in addition to reducing pain to facilitate the safe completion of a procedure. Children's abilities to control their behavior during a procedure depend both on cognitive and developmental age. Children younger than 6 years of age or with developmental delay often require deeper levels of sedation to gain control of their behavior. Children also are particularly vulnerable to medication effects on respiratory drive, airway patency,

EXECUTIVE SUMMARY

- The ideal sedation minimizes the patient's emotional and physical discomfort and maximizes amnesia to any painful elements. It allows the physician to control the patient's behavior adequately, providing for a safe and effective procedure with minimal potential for harm. Risk reduction has been demonstrated with a careful preprocedure review of underlying conditions, adherence to a prescribed process, and minimization of the number of sedating agents.
- Any history of snoring, sleep apnea, or hypoventilation may indicate an increased risk of obstruction or airway compromise with sedation.
- Although the Mallampati score may be useful to help predict a difficult intubation before general anesthesia, there is no specific evidence that it improves on the baseline clinical judgment of a standard airway evaluation prior to procedural sedation and analgesia (PSA).
- Patients with ASA classes I and II generally are acceptable candidates for mild, moderate, and deep sedation outside of the operating room. Patients with American Society of Anesthesiologists physical status class III and above, airway abnormalities, or any additional special needs may benefit from anesthesiology consultation to determine the best and safest location for sedation, which may or may not be the emergency department (ED).
- Fasting times present a challenge to the care of children in the ED, since pediatric patients rarely are fasted and often require urgent or emergent procedures. Several studies have shown no difference in the incidence of adverse events between those who met fasting guidelines and those who did not.
- Child life programs in pediatric settings, including the ED, have become widely accepted and advocated by the American Academy of Pediatrics. With expertise in child behavior and development, child life specialists promote effective coping during stressful situations through play, distraction, psychological preparation, education, and support, potentially decreasing the need for deep sedation.
- Etomidate has been Food and Drug Administration-approved since 1983 and is an ultra-fast and ultra-short acting agent with no analgesic properties. It is a favorite of emergency physicians for sedation for minor, brief procedures. It has been used safely in children as young as 2 years old.
- Intranasal midazolam has a shorter time of onset than oral administration and has been used successfully in conjunction with local anesthesia for laceration repair in pediatric patients.
- Dexmedetomidine is a sedative-hypnotic with an increasing array of applications, including PSA. It is administered intravenously and has a short half-life of six minutes. The lack of respiratory depression distinguishes this medication from opioids, benzodiazepines, and other sedatives.
- Intranasal fentanyl is well-tolerated and provides quick and effective pain control. It has been used successfully in the initial treatment of pediatric orthopedic injuries when determining the need intravenous access and further intervention. Ketamine provides both analgesia and sedation by working at N-methyl-D-aspartate and glutamate receptors.
- Before discharge, the patient should no longer be at risk for airway compromise or cardiopulmonary depression and should return to their baseline level of consciousness.

and hemodynamic stability. A thorough understanding of the unique anatomy and physiology of children is required to perform effective and safe PSA.

Goals of Procedural Sedation and Analgesia

The EP must determine the appropriate level of sedation and/or analgesia required for a particular procedure. Ideal sedation minimizes the patient's emotional and physical discomfort and maximizes amnesia to any painful elements. (*See Table 1.*) It allows the physician to control the patient's behavior adequately, providing for a safe and effective procedure with minimal potential for harm. Risk reduction has been demonstrated with a careful preprocedure review of underlying conditions, adherence to a prescribed process, and minimizing the number of sedating agents.[11]

Upon completing an ideal sedation, patients return to their presedation baseline in a timely manner with minimal postsedation side effects.

Table 1. Goals of Sedation

Maintain patient safety.
Obtain cooperation of the patient.
Minimize emotional and physical discomfort in patient and parent(s).
Decrease anxiety and psychological stress in patient and parent(s).
Maximize amnesia to a painful procedure.
Control behavior to allow for a safe and effective procedure.
Recover to a presedation baseline in a timely manner.

Levels of Sedation

Sedation can be thought of as a continuum of states ranging from minimal sedation (anxiolysis) to general anesthesia, as defined by the ASA. When considering sedation, the EP must first determine the level of sedation needed for a procedure. Analgesia is the relief of pain without intentionally producing a sedated state, but altered mental status may be a secondary effect of analgesic medications. The levels of sedation described are consistent with those defined by the ASA.[9] (*See Table 2.*)

Minimal sedation, or anxiolysis, allows patients to respond normally to verbal commands. While cognitive function and coordination may be impaired, ventilatory and cardiovascular functions remain intact. Most patients generally will not require more than observation and intermittent evaluation of their level of sedation.

Moderate sedation (formerly conscious sedation) allows patients to respond purposefully to verbal commands either alone or accompanied by light touch. Older patients remain interactive while younger

patients will show age-appropriate behaviors (for example, crying or pushing away from painful stimuli). Patients maintain their airway, can ventilate without intervention, and cardiovascular function is maintained.

With deep sedation, patients cannot be aroused easily but respond purposefully to noxious stimulation. These patients may require assistance to maintain their airway and adequate ventilation. Cardiovascular function usually is maintained.

Under general anesthesia, patients cannot be aroused and often require assistance to maintain their airway and positive pressure ventilation for adequate oxygenation. Cardiovascular function may be impaired.

Presedation Evaluation

A thorough presedation evaluation should be completed on all patients, with the primary goal of determining the appropriate anesthetic plan.[12] Any chronic medical conditions, particularly cardiac, respiratory, and metabolic disorders; hospitalizations; medications; and allergies that could affect the patient's safety with sedation should be noted from the medical history. Any history of snoring, sleep apnea, or hypoventilation may indicate an increased risk of obstruction or airway compromise with sedation. Previous experience with anesthesia or sedation and associated complications should be reviewed. A family history of significant problems with anesthesia may indicate the potential for increased risk with sedation. The time and type of last oral intake also should be documented.

The physical examination should focus on areas for potential decompensation under anesthesia. Vital signs, including baseline heart rate, respiratory rate, pulse oximetry, and blood pressure should be documented. Any oral or airway abnormalities (for example, facial dysmorphism, micrognathia, macroglossia, dental anomalies or hardware, or tracheal deviation) that could interfere with resuscitation and intubation should be noted. Wheezing or crackles may indicate decreased pulmonary reserve that sedation could aggravate. An accurate weight should be documented for appropriate medication dosing. Although the Mallampati score may be useful to help predict a difficult intubation before general anesthesia, there is no specific evidence that it improves on the baseline clinical judgment of a standard airway evaluation prior to PSA.[13] Laboratory studies should be ordered only when indicated by the patient's medical status, drug therapy, or the nature of the proposed procedure. Routine studies are not needed in otherwise healthy patients.

Every patient should be assigned an ASA physical status classification. (*See Table 3.*) Patients with ASA classes I and II generally are acceptable candidates for mild, moderate, and deep sedation outside of the operating room. Patients with ASA class III and above, airway abnormalities, or any additional special needs may benefit

Table 2. Levels of Sedation

Level of Sedation	Responsiveness	Airway	Spontaneous Ventilation	Cardiovascular Function
Minimal sedation	Normal	Normal	Normal	Normal
Moderate sedation	Purposeful to voice and touch	Normal	Normal	Typically normal
Deep sedation	Purposeful to painful stimulation	May need support	May need support	Typically normal
General anesthesia	Unarousable	Typically needs support	Typically needs support	May need support

Adapted from American Society of Anesthesiologists. Task force on sedation and analgesia by non-anesthesiologists. Practice guidelines for sedation and analgesia by non-anesthesiologists. *Anesthesiology* 2002;96:1005.

Table 3. American Society of Anesthesiologists Physical Status Classification

Classification	Patient Health	Conditions
Class I	Normal, healthy patient with no significant past medical history	No chronic conditions
Class II	Patient with mild systemic disease	Mild intermittent asthma, controlled diabetes mellitus
Class III	Patient with severe systemic disease	Moderate-severe asthma, poorly controlled diabetes, pneumonia
Class IV	Patient with severe systemic disease that is a constant threat to life	Severe lung disease, advanced cardiac disease
Class V	Moribund patient who is not expected to survive without the procedure	Severe trauma, septic shock

Adapted from Shankar V, Deshpande JK. Procedural sedation in the pediatric patient. *Anesthesiol Clin North Am* 2005;23:639.

from anesthesiology consultation to determine the best and safest location for sedation, which may or may not be the ED.

Fasting times present a challenge to the care of children in the ED, since pediatric patients rarely are fasted and often require urgent or emergent procedures. Several studies have shown no difference in the incidence of adverse events between those who met fasting guidelines and those who did not.[14-16] Outdated fasting guidelines were based on OR patients and, more typically, deep sedation and general anesthesia. Aspiration is associated with deeper levels of sedation, as well as ASA class III or IV. Fasting, as currently practiced, often substantially exceeds recommended time thresholds and has known adverse consequences, including irritability, dehydration, and hypoglycemia. Concerns for aspiration are out of proportion to actual risk, and the frequency of aspiration is lower than during general anesthesia.[14] In urgent and emergent situations in which complete gastric emptying is not possible, moderate PSA should not be delayed based on fasting time alone.[17] Ultimately, the risks, benefits, and urgency of the procedure must be balanced with the anticipated depth of sedation and available fasting time.

Equipment and Monitoring

Age-appropriate equipment for airway management and resuscitation should be immediately available at the location of sedation. (*See Table 4.*) This includes oxygen, suction, a bag-valve mask device with age and size appropriate masks, and intubation equipment. AAP guidelines use the acronym SOAP-ME in the planning and preparation of a procedure. (*See Table 5.*) Patients requiring deep sedation should have intravenous (IV) access for administration of multiple doses of sedatives and resuscitation medications, as needed. If

Table 4. Emergency Equipment for Patient Resuscitation

Intravenous equipment:
- Peripheral intravenous catheters
- Assorted syringes (e.g., 1, 3, 5, and 10 mL)
- Intravenous tubing
- Intravenous fluids (lactated Ringers, normal saline, dextrose-containing fluids)
- Pediatric intravenous boards
- Intraosseous bone marrow needle
- Sterile gauze pads, alcohol preps, tourniquets

Airway management equipment (various sizes):
- Face masks
- Bag-valve-mask device with age- and size-appropriate masks
- Oropharyngeal airways
- Nasopharyngeal airways
- Laryngeal mask airways
- Laryngoscope handles (with extra batteries)
- Laryngoscope blades (with extra light bulbs) — Miller and Macintosh
- Videolaryngoscope
- Endotracheal tubes
- Stylets (appropriate sizes for endotracheal tubes)
- Suction catheters
- Shoulder roll
- Orogastric or nasogastric tubes

Adapted from Cote CJ, Wilson S. Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: An update. *Pediatrics* 2006;118:2602.

Table 5. Planning and Preparation for Procedural Sedation and Analgesia: SOAP-ME

S (suction)	• Suction catheters and suction apparatus
O (oxygen)	• Oxygen supply, flow meters/other delivery devices
A (airway)	• Face mask and bag-valve-mask (various sizes) • Nasopharyngeal and oropharyngeal airways (various sizes) • Laryngoscope blades • Endotracheal tubes with stylets • Videolaryngoscope (if available)
P (pharmacy)	• Intubation medications and adjuncts • Drugs needed to support life during an emergency, including antagonists as indicated (e.g., epinephrine, reversal agents)
M (monitors)	• Pulse oximeter • Noninvasive blood pressure monitor • End-tidal carbon dioxide • Electrocardiogram • Stethoscope
E (equipment)	• Additional special equipment or drugs (e.g., defibrillator)

Adapted from Cote CJ, Wilson S. Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: An update. *Pediatrics* 2006;118:2593.

access is not obtained initially, trained personnel and equipment should be immediately available to establish vascular access. With lighter sedation given orally, nasally, rectally, or intramuscularly, vascular access is not required, but it should be available for adverse reactions.

Designated personnel trained to manage potential complications of sedation, including hemodynamic instability, respiratory depression, apnea, and airway compromise, should closely monitor and continuously visualize the patient. Both AAP and ACEP guidelines call for practitioners to have "the skills to rescue the patient from a deeper level than intended" with any sedation.[8,10] Medical providers must be able to rescue patients and provide cardiopulmonary support if needed. At least two trained providers should be present for each sedation, with one person dedicated to the continuous monitoring of the patient while the other performs the procedure. The provider ultimately responsible for airway management must be able to recognize early signs of respiratory depression, apnea, obstruction, or bronchospasm and act appropriately to address and reverse problems.

Continuous pulse oximetry and cardiac monitors should have audible and visual signals. Vital signs should be recorded at specific intervals, including at the start of the procedure, after administration of any medications, when the procedure is completed, during the recovery period, and when recovery is completed. If deep sedation is used or patients have significant underlying illness, measure vital signs at least every three to five minutes.

End-tidal capnography is a noninvasive way to monitor a patient's ventilatory status. Respiratory gases are sampled either from a chamber attached in-line to an endotracheal tube or at the nares via nasal cannula. Output is analyzed and given a numeric value and waveform. Increases in end-tidal carbon dioxide ($ETCO_2$) with respiratory depression are detected before hypoxemia is, particularly in those who are receiving supplemental oxygen. Respiratory depression caused by oversedation will manifest as an abnormally high or low (when respirations are not reliably detected) $ETCO_2$ level well before pulse oximetry detects a declining oxyhemoglobin saturation, especially in patients receiving supplemental oxygen.[18] However, several review articles and meta-analyses demonstrated a lack of convincing evidence that capnography in ED PSA reduced the rate of adverse events, although one analysis showed less mild and severe oxygen desaturation, which may have avoided needing assisted ventilation.[18-20]

Bispectral (BIS) index monitoring is another noninvasive method of evaluating a patient's level of sedation. The BIS monitor uses highly processed electroencephalogram (EEG) signals that are obtained from a probe placed on the patient's forehead. EEG waveforms change with a patient's level of alertness. These EEG waveforms are high frequency and low amplitude when a patient is awake and low frequency and high amplitude when a patient is deeply sedated. Based on a study of healthy adult volunteers, a numeric scoring system was developed, known as the BIS index, that ranges from 0 to 100.[21] A BIS index of 0 denotes coma, 0 to 40 denotes a deep hypnotic state, 40 to 60 is general anesthesia, 60 to 70 is deep sedation, 70 to 90 is light to moderate sedation, and 100 is awake.[22] The ASA critically reviewed BIS data and found that "a specific numerical value may not correlate with a specific depth of anesthesia."[23] Several studies have found inconsistent BIS scores and levels of sedation in pediatric patients.[24,25] BIS monitoring may prove to be a useful adjunct in evaluating the status of the sedated patient, but, at present, data do not support its regular use in PSA.

Child Life Programs

Child life programs in pediatric settings, including the ED, have become widely accepted and advocated by the AAP. With expertise in child behavior and development, child life specialists promote effective coping during stressful situations through play, distraction, psychological preparation, education, and support, potentially decreasing the need for deep sedation.[26-28] This, in turn, has been shown to increase patient satisfaction and lower associated hospital costs.[29] Preparation is patient-focused and includes sensory aspects of the procedure (what the child will see, feel, hear, smell, and touch) and what the child can do during the procedure (count, read, watch television, etc.). Frequently, teaching dolls are used to help children understand where on the body a procedure will be performed. These techniques are known to decrease fear, anxiety, and discomfort during painful procedures. Child life specialists also provide support to parents and help families support their children through anxiety-inducing and/or painful procedures.

Pharmacologic Agents

There are five general categories of agents used in PSA: sedative-hypnotic, analgesic, dissociative, inhalational, and antagonistic. (*See Table 6.*) Sedative-hypnotics are the most widely used and include benzodiazepines, barbiturates, and unique agents, such as propofol, etomidate, and chloral hydrate. When used in combination, lower dosages of these agents can achieve similar results. For example, when opioids and benzodiazepines are used together, they exhibit synergy not only in the desired effects, but also in side effects, such as respiratory depression.

Sedative-Hypnotics

Chloral hydrate use has decreased significantly, both because the only commercially available product in the United States was discontinued in 2012 and because of the increased availability of alternatives. However, some hospitals continue to compound an available oral suspension for pediatric sedation. Chloral hydrate is a nonreversible agent that does not provide analgesia. It has decreased efficacy in children older than 48 months.[30] It may cause paradoxical excitement and may predispose patients to airway obstruction.[31] Because of its depressive effects on myocardial contractility, chloral hydrate is contraindicated in patients with severe cardiac dysfunction and those on vasopressor support. Rectal use has been described, but absorption is erratic.[32]

Etomidate has been Food and Drug Administration (FDA)-approved since 1983 and is an ultra-fast and ultra-short acting agent with no analgesic properties. It functions at the gamma-aminobutyric acid receptor and offers relative cardiovascular stability compared to many other agents in this group. It is a particular favorite of EPs for rapid sequence intubations as well as sedation for minor, brief procedures. It has been used safely in children as young as 2 years old. It may cause adrenal suppression four to 24 hours after administration and should be avoided when adrenal insufficiency is a concern, as in sepsis. Side effects include myoclonus, nausea, and vomiting.[33]

Benzodiazepines provide sedation without analgesia, and paradoxical excitement

Table 6. Pharmacologic Agents Used in Procedural Sedation and Analgesia for Children

Medication	Dose and Route	Onset (Minutes)	Duration (Minutes)	Contraindications
Sedative-hypnotic				
Chloral hydrate	Oral: 25-100 mg/kg, may repeat 25-50 mg/kg after 30 min, max 2 g or 100 mg/kg (whichever is less), single use only in neonates	15-30	60-120	Cardiac dysfunction
Etomidate	IV: 0.1-0.3 mg/kg; repeat if inadequate	< 1	5-15	Adrenal insufficiency
Midazolam	IV (6 months to 5 years of age): 0.05-0.1 mg/kg, titrate to max 0.6 mg/kg	2-3	45-60	Hypotension
	IV (6-12 years of age): 0.025-0.05 mg/kg, titrate to max 0.4 mg/kg			
	IM: 0.1-0.15 mg/kg	10-20	60-120	
	Oral: 0.5-0.75 mg/kg	15-30	60-90	
	Intranasal: 0.2-0.5 mg/kg	10-15	60	
	Rectal: 0.25-0.5 mg/kg	10-30	60-90	
Methohexital	IV: 0.5-1 mg/kg	10-15	60	Porphyria
	Rectal: 25 mg/kg			
Pentobarbital	IV: 1-6 mg/kg, titrate 1-2 mg/kg doses every 3-5 min	3-5	15-45	Porphyria
	IM: 2-6 mg/kg, max 100 mg	10-15	60-120	
	Oral or rectal (< 4 years of age): 3-6 mg/kg, max 100 mg	15-60	60-240	
	Oral or rectal (> 4 years of age): 1.5-3 mg/kg, max 100 mg			
Thiopental	Rectal: 25 mg/kg	10-15	60-120	Porphyria
Propofol	IV: 1 mg/kg, titrate 0.5 mg/kg doses	< 1	5-15	Egg, soy, or sulfite allergy
Dexmedetomidine	IV: 0.5-2 mcg/kg/dose over 10 minutes; repeat if sedation is not adequate	5-10	60-120	Age < 6 months
	Intranasal: 2-3 mcg/kg as a single dose 30 to 60 minutes prior to procedure	45-60		

(Continued on page 71)

has been described. Midazolam acts as a sedative, anxiolytic, hypnotic, muscle relaxant, antegrade amnestic, and anticonvulsant. Intranasal midazolam has a shorter time of onset than oral administration and has been used successfully in conjunction with local anesthesia for laceration repair in pediatric patients.[34,35] Benzodiazepines can cause respiratory depression as well as hypotension, so close monitoring should continue until the patient has returned to baseline. Paradoxical excitement also has been described, with patients becoming more agitated after administration, particularly in preschool-age patients. As an adjunct to ketamine, midazolam decreases the incidence of emesis, but not of emergence reactions, and is not recommended for routine prophylaxis.

Barbiturates, such as methohexital, pentobarbital, and thiopental, can cause hypotension and respiratory depression. Methohexital, whether administered intravenously, intramuscularly, or rectally, and pentobarbital can provide effective and safe sedation for painless procedures, such as imaging studies.[36] However, keep in mind that paradoxical excitation can occur in pediatric patients. Barbiturates are contraindicated in patients with porphyria, which they can exacerbate. Of note, this class of drugs is not reversible.

Propofol is the most commonly used anesthetic agent for pediatric procedures. Despite its popular use in the pediatric ED, it was only approved by the FDA for use in children younger than 3 years of age in 2017. Propofol has minimal to no analgesic properties and should be used in combination with short-acting opioids or ketamine for brief, painful procedures. Its site of action is believed to be at the gamma-aminobutyric acid receptor. Propofol is known to depress mitochondrial function by uncoupling oxidative

Table 6. Pharmacologic Agents Used in Procedural Sedation and Analgesia for Children (Continued)

Medication	Dose and Route	Onset (Minutes)	Duration (Minutes)	Contraindications
Analgesic				
Fentanyl	IV: 1 mcg/kg up to 50 mcg/dose, repeat every 3-5 min	3-5	30-60	
	IN: 1-2 mcg/kg/dose, max 100 mcg	6-7		
Morphine	IV: 0.05-0.15 mg/kg up to 3 mg/dose, repeat every 3-5 min	5-10	120-180	
Dissociative				
Ketamine	IV: 1-1.5 mg/kg, repeat every 10 min	1	15-60	Age < 3 months
	IM: 4-5 mg/kg, repeat 2-4 mg/kg after 10 min	3-5	15-150	
	IN: 3-6 mg/kg, half dose in each nostril	5-8	30-60	
Inhalational				
Nitrous oxide	Preset mixture with minimum 30% oxygen	2-3	< 5	Pregnant medical provider, bleomycin use, reductase deficiency
Antagonistic				
Naloxone	IV or IM: 0.1-0.4 mg, max 2 mg/dose, repeat every 3 min, max 10-20 mg	IV: 2	IV: 20-40	
Flumazenil	IV: 0.02 mg/kg/dose, repeat every 1 min up to 1 mg	1-2	30-60	Long-term benzodiazepine use

Key: IV: intravenous; IM: intramuscular

Adapted from Krauss B, Green SM. Procedural sedation and analgesia in children. *Lancet* 2006;367:772.

phosphorylation and should be used with caution in children with mitochondrial defects. It has side effects of hypotension and pain at the site of infusion.

To prevent infusion pain, EPs may consider premedicating patients with IV lidocaine 0.5 mg/kg, 30 to 120 seconds before propofol infusion with a rubber tourniquet applied. This prevents pain in 60% of patients treated.[37] Propofol use in the ED has been well-documented and proven to be effective and safe.[38] Recent studies suggest that the risk of adverse reactions to propofol in children with egg and soy allergies may be minimal.[39,40] Fospropofol is a newer prodrug that is metabolized to propofol with less pain on initial injection, fewer allergic reactions, and less hyperlipidemia. The onset of action is slightly delayed, and the duration of action is longer than for propofol, with a peak effect in eight minutes and a clinical effect lasting four to 13 minutes. Sedation-related hypoxemia and hypotension occur in a dose-dependent fashion, but they are less frequent and less intense than with propofol.[41]

Dexmedetomidine is a sedative-hypnotic with an increasing array of applications, including PSA. It is administered intravenously and has a short half-life of six minutes. Other routes of administration described include intramuscular, oral, buccal, subcutaneous, and intranasal. The lack of respiratory depression distinguishes this medication from opioids, benzodiazepines, and other sedatives. Respiratory rate, carbon dioxide levels, and oxygen saturation generally are maintained during dexmedetomidine sedation in children. Side effects include hypotension and bradycardia.[42,43] There may be a neuroprotective effect.

Analgesics

At higher doses, opioids, such as fentanyl and morphine, can cause sedation in addition to analgesia. Intranasal fentanyl is well-tolerated and provides quick and effective pain control.[44] It has been used successfully in the initial treatment of pediatric orthopedic injuries when determining the need for an IV and further intervention. Side effects include respiratory depression, hypotension, nausea, and pruritus. When opioids are combined with propofol, effective and safe PSA can be provided.[30] Traditionally, remifentanil has been used in combination with other agents, such as propofol, and in an elective setting. Currently, there is a lack of high-quality data on the use of remifentanil in the ED, particularly in children.[45]

Dissociative

Ketamine provides both analgesia and sedation by working at N-methyl-D-aspartate (NMDA) and glutamate receptors. Seizure disorder is not a contraindication, and ketamine has even demonstrated anticonvulsant properties.[46] Involuntary movements may occur, and

ketamine should be avoided for imaging studies, such as computerized tomography and magnetic resonance imaging. An emergence reaction occurs in a significant minority of patients, and other side effects include hypersalivation, bronchorrhea, laryngospasm, and nausea. Anticholinergic agents, such as glycopyrrolate and atropine, traditionally have been administered as adjuncts to limit excessive mucosal secretions, but they have not been found to be effective in the ED setting.[46-48] For laceration repairs, IV ketamine in combination with midazolam, as well as intramuscular ketamine used alone, were superior to intranasal midazolam in terms of sedation onset and efficacy.[36]

Inhalational

Nitrous oxide is combined with 30% to 70% oxygen and inhaled by a demand-valve mask, requiring a cooperative patient to generate sufficient negative inspiratory pressure.[5] Used by pediatric dentists for many years, nitrous oxide has been increasing in use across pediatric EDs. Systemic opiates or regional or local anesthesia usually also are provided, since there is only mild analgesia if nitrous oxide is used alone.

Continuous flow delivery has been described, but it requires two physicians — one to deliver the agent and one to perform the procedure — which may be impractical in many ED settings.[49] There is an association with spontaneous abortions in medical providers who administer nitrous oxide for more than three hours per week in the absence of scavenging equipment.[50] Other rare contraindications include the use of bleomycin and a history of 5,10-methylenetetrahydrofolate reductase deficiency.[51,52] Nausea and vomiting occur in 0.5% of patients, and more often with longer administrations, increased nitrous oxide concentrations, and fluctuations in nitrous oxide levels.[10] Higher nitrous oxide concentrations, from 50% to 70%, appear to be safe and effective in children as young as 1 year old.[53]

Antagonistic

Naloxone is a short-acting opioid antagonist and can be administered intravenously, intranasally, and intramuscularly. It has a long safety record of use in children. Higher doses should be used when treating respiratory depression and not central nervous system depression alone.[54]

Flumazenil is the only benzodiazepine antagonist available and is short-acting. It should not be used in patients with a history of long-term benzodiazepine use, since it may precipitate withdrawal symptoms and seizures. It should also be avoided when drugs that lower the seizure threshold have been ingested, such as cyclosporine, isoniazid, lithium, propoxyphene, theophylline, and tricyclic antidepressants.

Other

Ketofol is a preformed mixture combining equal parts ketamine at 10 mg/mL and propofol at 10 mg/mL. The combined agent is administered in 1-mL to 3-mL doses, with the median dose being 0.75 mg/kg. It has shown promise in PSA, since subdissociative amounts of ketamine and less-than-typical amounts of propofol are used with success, although further research is needed.[55]

Post-Procedure Assessment and Discharge

Children receiving any form of sedation should be observed in an appropriately staffed and equipped recovery area after the conclusion of the procedure. One database study showed that the highest risk of serious adverse events occurred within 25 minutes of receiving the last dose of intravenous medication.[56] Before discharge, the patient should no longer be at risk for airway compromise or cardiopulmonary depression and should return to their baseline level of consciousness. Cardiac monitors and pulse oximetry should continue to monitor the patient during observation. Recommended discharge criteria are provided by the AAP (*see Table 7*); based on these, it should be noted that a return to pre-sedation ambulatory status is not required.[10]

The patient should be discharged to a responsible adult who will accompany the child and be able to monitor and react to any post-procedural complications. Discharge instructions should be reviewed prior to discharge with an emphasis on the signs of respiratory distress.

Table 7. Pre-Discharge Checklist

The patient's airway and cardiovascular status are safe and stable.
The patient can be aroused easily and their protective reflexes are intact.
The patient is able to answer age-appropriate questions (if applicable).
The patient can sit unassisted (if applicable).
For a young child or one with a developmental delay, the child should return as close as possible to their pre-sedation level of consciousness.
The patient should be hydrated adequately.

Adapted from Cote CJ, Wilson S. Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: An update. *Pediatrics* 2006;118:2602.

Special Considerations

The EP must remain vigilant and recognize adverse outcomes in PSA, which appear to occur more often in nonhospital-based, non-emergency department settings. This may be a reflection of the specialty and experience of the practitioner and/or the ability to recognize and treat adverse events, such as desaturation, apnea, and laryngospasm.[57] The ASA only differentiates between anesthesiologists and non-anesthesiologists, despite the considerable variability of training and experience among non-anesthesiologists to rescue patients from unintended levels of sedation as well as to perform cardiopulmonary resuscitation when needed.[58]

Agitation may occur with PSA, even when standard regimens and doses are used. Although rare, intraprocedural agitation appears to be associated with an increased risk of adverse outcomes, such as cardiovascular compromise, allergic reaction, use of reversal agents, and need for resuscitation.[58,59]

The EP also should consider other methods of analgesia that may not affect a patient's level of sedation, such as topical anesthetics, local anesthetic injection, regional anesthesia, and oral sucrose for neonates. These may be used alone or in conjunction with anesthetic agents. Nonpharmacologic interventions are listed in Table 8.[60-63]

Table 8. Nonpharmacologic Interventions to Reduce Pain and Distress with Procedures	
Distraction	For infants, try a pacifier, bubbles, or toys. For toddlers, try bubbles, songs, pop-up books, party blowers, kaleidoscopes, or toys. For school-age children, try videos, video games, searching for objects in pictures, stories, joking, counting, or nonprocedural conversation. For adolescents, try music by headphones, video games, nonprocedural conversation, or focusing on objects.
Deep breathing	Have the child breathe rhythmically with slow deep breaths.
Blowing	Have the child blow out imaginary candles or take a deep breath and "blow away the pain." Party blowers have been used successfully.
Suggestion	Help the child put on a "magic glove" that does not allow pain, or apply "magic invisible cream" or turn off a "pain switch."
Superhero imagery	Have the child imagine that he or she is a superhero and the procedure is a special mission.
Guided imagery	Help the child imagine a favorite place or activity, concentrating on all the associated sensations.
Thought-stopping and positive self-statements	Teach the child to think or say "Stop!" when feeling pain and then to think and say, "I can handle this," or similar positive self-statements.
Rewards	Let the child know that rewards such as stickers, decorative bandages, small trophies, certificates, or prizes are available. Make behavior such as cooperation a goal, but give all children the reward.
Spot pressure or counterirritation	Rub the surrounding skin or provide spot pressure to the surrounding skin.
Sweet solution or pacifier or breastfeeding	Useful for infants for minor procedures. Give 2 mL of 30% sucrose or 30% glucose immediately before or during the procedure. Allow sucking on pacifier or breastfeeding during the procedure.
Cognitive behavior therapy	Prepare patients with dolls or other materials, role playing, role modeling, practicing desirable behavior, desensitization (slow introduction to subparts of procedure), hypnosis, guided imagery, progressive muscle relaxation, memory alteration.
Reprinted with permission from Young KD. Pediatric procedural pain. *Ann Emerg Med* 2005;45:166.	

References

1. Miller AF, Monuteaux MC, Bourgeois FT, et al. Variation in pediatric procedural sedations across children's hospital emergency departments. *Hosp Pediatr* 2018;8:36-43.
2. Grunwell JR, Travers C, Stormorken AG, et al. Pediatric procedural sedation using the combination of ketamine and propofol outside of the emergency department: A report from the Pediatric Sedation Research Consortium. *Pediatr Crit Care Med* 2017;18:e356-e363.
3. Daud YN, Carlson DW. Pediatric sedation. *Pediatr Clin North Am* 2014;61:703-717.
4. Beeson MS, Ankel F, Bhat R, et al. The 2019 model of the clinical practice of emergency medicine. *J Emerg Med* 2020;59: 96-120.
5. Krauss B, Green SM. Procedural sedation and analgesia in children. *Lancet* 2006;367:766-780.
6. Kamat PP, McCracken CE, Simon HK, et al. Trends in outpatient procedural sedation: 2007-2018. *Pediatrics* 2020;145:e20193559.
7. Chang B, Kaye AD, Diaz JH, et al. Interventional procedures outside the operating room: Results from the National Anesthesia Clinical Outcomes Registry. *J Patient Saf* 2018;14:9-16.
8. Godwin SA, Caro DA, Wolf SJ, et al. Clinical policy: Procedural sedation and analgesia in the emergency department. *Ann Emerg Med* 2005;45:177-196.
9. 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.
10. Cote CJ, Wilson S, American Academy of Pediatrics, American Academy of Pediatric Dentistry. Guidelines for monitoring and management of pediatric patients before, during, and after sedation for diagnostic and therapeutic procedures. *Pediatrics* 2019;143:e20191000.
11. Krieser D, Kochar A. Paediatric procedural sedation within the emergency department. *J Paediatr Child Health* 2016;52:197-203.
12. Practice guidelines for moderate procedural sedation and analgesia 2018: A report by the American Society of Anesthesiologists Task Force on Moderate Procedural Sedation and Analgesia, the American Association of Oral and Maxillofacial Surgeons, American College of Radiology, American Dental Association, American Society of Dentist Anesthesiologists, and Society of Interventional Radiology. *Anesthesiology* 2018;128:437-479.
13. Green SM, Roback MG. Is the Mallampati score useful for emergency department airway management or procedural sedation? *Ann Emerg Med* 2019;74:251-259.
14. Green SM, Leroy PL, Roback MG, et al. An international multidisciplinary consensus statement on fasting before procedural sedation in adults and children. *Anaesthesia* 2020;75:374-385.
15. Roback MG, Bajaj L, Wathen JE, et al. Preprocedural fasting and adverse events in procedural sedation and analgesia in a pediatric emergency department: Are they related? *Ann Emerg Med* 2004;44:454-459.
16. Bhatt M, Johnson DW, Taljaard M, et al. Association of preprocedural fasting with outcomes of emergency department sedation in children. *JAMA Pediatr* 2018;172: 678-685.
17. American Society of Anesthesiologists Task Force on Preoperative Fasting. Practice

guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: Application to healthy patients undergoing elective procedures. *Anesthesiology* 1999;90:896-905.
18. Saunders R, Struys MM, Pollock RF, et al. Patient safety during procedural sedation using capnography monitoring: A systematic review and meta-analysis. *BMJ Open* 2017;7:e013402.
19. Dewdney C, MacDougall M, Blackburn R, et al. Capnography for procedural sedation in the ED: A systematic review. *Emerg Med J* 2017;34:476-484.
20. Wall BF, Magee K, Campbell SG, Zed PJ. Capnography versus standard monitoring for emergency department procedural and analgesia. *Cochrane Database Syst Rev* 2017;3:CD010698.
21. Sigl JC, Chamoun NG. An introduction to bispectral analysis for the electroencephalogram. *J Clin Monit* 1994;10:392-404.
22. Rosow C, Manberg PJ. Bispectral index monitoring. *Anesthesiol Clin North Am* 2001;19:947-966, xi.
23. American Society of Anesthesiologists. Practice advisory for intraoperative awareness and brain function monitoring. *Anesthesiology* 2006;104:847-864.
24. Gamble C, Gamble J, Seal R, et al. Bispectral analysis during procedural sedation in the pediatric emergency department. *Pediatr Emerg Care* 2012;28:1003-1008.
25. Dag C, Bezgin T, Özalp N, Aydın GG. Utility of bispectral index monitoring during deep sedation in pediatric dental patients. *J Clin Pediatr Dent* 2014;39:291-296.
26. Hall JE, Patel DP, Thomas JW, et al. Certified child life specialists lessen emotional distress of children undergoing laceration repair in the emergency department. *Pediatr Emerg Care* 2018;34:603-606.
27. Durand DJ, Young M, Nagy P, et al. Mandatory child life consultation and its impact on pediatric MRI workflow in an academic medical center. *J Am Coll Radiol* 2015;12:594-598.
28. Tyson ME, Bohl DD, Blickman JG. A randomized controlled trial: Child life services in pediatric imaging. *Pediatr Radiol* 2014;44:1426-1432.
29. Cristal NS, Staab J, Chatham R, et al. Child life reduces distress and pain and improves family satisfaction in the pediatric emergency department. *Clin Pediatr* 2018;57:1567-1575.
30. Mace SE, Brown LA, Francis L, et al. Clinical policy: Critical issues in the sedation of pediatric patients in the emergency department. *Ann Emerg Med* 2008;51:378-399.
31. Doyle L, Colletti JE. Pediatric procedural sedation and analgesia. *Pediatr Clin North Am* 2006;53:279-292.
32. Flood RG, Krauss B. Procedural sedation and analgesia for children in the emergency department. *Emerg Med Clin North Am* 2003;21:121-139.
33. Sacchetti A, Stander E, Ferguson N, et al. Pediatric procedural sedation in the community emergency department: Results from the ProSCED registry. *Pediatr Emerg Care* 2007;23:218-222.
34. Mellion SA, Bourne D, Brou L, et al. Evaluating clinical effectiveness and pharmacokinetic profile of atomized intranasal midazolam in children undergoing laceration repair. *J Emerg Med* 2017;53:397-404.
35. Klein EJ, Brown JC, Kobayashi A, et al. A randomized clinical trial comparing oral, aerosolized intranasal, and aerosolized buccal midazolam. *Ann Emerg Med* 2011;58:323-329.
36. Mace SE, Barata IA, Cravero JP, et al. Clinical policy: Evidence-based approach to pharmacologic agents used in pediatric sedation and analgesia in the emergency department. *Ann Emerg Med* 2004;44:342-377.
37. Picard P, Tramer MR. Prevention of pain on injection with propofol: A quantitative systematic review. *Anesth Analg* 2000;90:963-969.
38. Mallory MD, Baxter AL, Yanosky DJ, et al. Emergency physician-administered propofol sedation: A report on 25,433 sedations from the Pediatric Sedation Research Consortium. *Ann Emerg Med* 2011;57:462-468.
39. Mehta P, Sundaram SS, Furuta GT, et al. Propofol use in pediatric patients with food allergy and eosinophilic esophagitis. *J Pediatr Gastroenterol Nutr* 2017;64:546-549.
40. Sommerfield DL, Lucas M, Schilling A, et al. Propofol use in children with allergies to egg, peanut, soybean or other legumes. *Anaesthesia* 2019;74:1252-1259.
41. Khurmi N, Patel P, Kraus M, et al. Pharmacologic considerations for pediatric sedation and anesthesia outside the operating room: A review for anesthesia and non-anesthesia providers. *Paediatr Drugs* 2017;19:435-446.
42. Mahmoud M, Barbi E, Mason KP. Dexmedetomidine: What's new for pediatrics? A narrative review. *J Clin Med* 2020;9:2724.
43. Sulton C, McCracken C, Simon HK, et al. Pediatric procedural sedation using dexmedetomidine: A report from the Pediatric Sedation Research Consortium. *Hosp Pediatr* 2016;6:536-544.
44. Schoolman-Anderson K, Lane RD, Schunk JE, et al. Pediatric emergency department triage-based pain guideline utilizing intranasal fentanyl: Effect of implementation. *Am J Emerg Med* 2018;36:1603-1607.
45. Kisilewicz M, Rosenberg H, Vaillancourt C. Remifentanil for procedural sedation: A systematic review of the literature. *Emerg Med J* 2017;34:294-301.
46. Grunwell JR, Travers C, McCracken CE, et al. Procedural sedation outside of the operating room using ketamine in 22,645 children: A report from the Pediatric Sedation Research Consortium. *Pediatr Crit Care Med* 2016;17:1109-1116.
47. Green SM, Roback MG, Krauss B, et al. Predictors of emesis and recovery agitation with emergency department ketamine sedation: An individual-patient data meta-analysis of 8,282 children. *Ann Emerg Med* 2009;54:171-180.
48. Brown L, Christian-Kopp S, Sherwin TS, et al. Adjunctive atropine is unnecessary during ketamine sedation in children. *Acad Emerg Med* 2008;15:314-318.
49. Luhmann J, Kennedy R, Porter F, et al. A randomized clinical trial of continuous flow nitrous oxide and midazolam for sedation of young children during laceration repair. *Ann Emerg Med* 2001;37:20-27.
50. Rowland AS, Baird DD, Shore DL, et al. Nitrous oxide and spontaneous abortion in female dental assistants. *Am J Epidemiol* 1995;141:531-537.
51. Fleming P, Walker PO, Priest JR. Bleomycin therapy: A contraindication to the use of nitrous oxide-oxygen psychosedation in the dental office. *Pediatr Dent* 1988;10:345-346.
52. Selzer R, Rosenblatt D, Laxova R, et al. Adverse effect of nitrous oxide in a child with 5,10-methylenetetrahydrofolate reductase deficiency. *N Engl J Med* 2003;349:45-50.
53. Babl FE, Oakley E, Seaman C, et al. High-concentration nitrous oxide for procedural sedation in children: Adverse events and depth of sedation. *Pediatrics* 2008;121:e528-e532.
54. Henry K, Harris CR. Deadly ingestions. *Pediatr Clin North Am* 2006;53:293-315.
55. Grunwell JR, Travers C, Stormorken AG, et al. Pediatric procedural sedation using the combination of ketamine and propofol outside of the emergency department: A report from the Pediatric Sedation Research Consortium. *Pediatr Crit Care Med* 2017;18:e356-e363.
56. Newman DH, Azer MM, Pitetti RD, et al. When is a patient safe for discharge after procedural sedation? The timing of adverse effect events in 1,367 pediatric procedural sedations. *Ann Emerg Med* 2003;42:627-635.
57. Leroy PLJM, Schipper DM, Knape HJTA. Professional skills and competence for safe and effective procedural sedation in children: Recommendations based on a systematic review of the literature. *Int J Pediatr* 2010;2010:934298.
58. Bhatt M, Johnson DW, Chan J, et al. Risk factors for adverse events in emergency department procedural sedation for children. *JAMA Pediatr* 2017;171:957-964.
59. Bellolio MF, Puls HA, Anderson JL, et al. Incidence of adverse events in paediatric procedural sedation in the emergency department: A systematic review and meta-analysis. *BMJ Open* 2016;6:e011384.
60. Birnie KA, Noel M, Chambers CT, et al. Psychological interventions for needle-related procedural pain and distress in children and adolescents. *Cochrane Database Syst Rev* 2018;10:CD005179.

61. Corwin DJ, Kessler DO, Auerbach M, et al. An intervention to improve pain management in the pediatric emergency department. *Pediatr Emer Care* 2012;28:524-528.
62. Krauss BS, Calligaris L, Green SM, et al. Current concepts in management of pain in children in the emergency department. *Lancet* 2016;387:83-92.
63. Ali S, McGrath T, Drendel AL. An evidence-based approach to minimizing acute procedural pain in the emergency department and beyond. *Pediatr Emerg Care* 2016;32:36-45, quiz 43-44.

CME/CE Questions

1. The goals of sedation include:
   a. minimizing emotional and physical pain and discomfort.
   b. controlling behavior to allow for a safe and effective procedure.
   c. recovering to a pre-sedation baseline in a timely manner.
   d. All of the above
2. Deep sedation is achieved when the patient:
   a. responds normally to verbal commands.
   b. cannot be aroused easily but responds purposefully to noxious stimulation.
   c. requires assistance to maintain airway and positive pressure ventilation.
   d. becomes amnestic to the procedure.
3. An example of an American Society of Anesthesiologists (ASA) class II patient includes:
   a. a patient with an abscess with no past medical history.
   b. a toddler with diabetes in diabetic ketoacidosis.
   c. a patient status-post heart transplant in severe heart failure.
   d. a patient with asthma that is well-controlled on medications with a femur fracture.
4. Patients should be considered for anesthesiology consultation when:
   a. Mild or moderate sedation is planned
   b. Patients are free of airway abnormalities
   c. A brief procedure is anticipated
   d. Patients have an ASA class ≥ III
5. End-tidal capnography is effective in detecting which of the following?
   a. Hypoxia
   b. Hypoventilation
   c. Cardiac arrhythmias
   d. Allergic reactions
6. Essential components of the pre-sedation assessment include which of the following?
   a. Chest radiograph
   b. Electrocardiogram
   c. Detailed history and focused physical examination
   d. Vascular access
7. In the sedative-hypnotic class of medications:
   a. Etomidate has both analgesic and sedative properties
   b. Ketamine has both analgesic and sedative properties
   c. Reversible agents include chloral hydrate, methohexital, and propofol
   d. Hypotension is not a recognized side effect of propofol use
8. When can nitrous oxide can be used in the emergency department?
   a. When the patient is agitated and uncooperative
   b. Only in children older than 8 years of age
   c. When antiemetics are administered as adjuncts, since nausea is a concern at higher concentrations of nitrous oxide
   d. In combination with analgesics such as opioids, since it only has mild analgesic properties
9. When considering ketamine use:
   a. Anticholinergic agents as adjuncts to limit excessive mucosal secretions are not effective in the ED setting.
   b. Midazolam should be used as an adjunct to prevent emergence reactions.
   c. It is an ideal agent for procedural sedation and analgesia (PSA) when movement must be minimized during imaging.
   d. Its use is contraindicated in patients with seizure disorder.
10. Discharge criteria after PSA include:
    a. Adequate hydration status
    b. Ability to talk and sit unaided, if age appropriate
    c. Stable cardiovascular function and airway patency
    d. All of the above

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