Procedural Sedation in the Acute Care Setting

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Many patients require sedation during diagnostic or therapeutic procedures. Ideally, procedural sedation minimizes the patient's awareness and discomfort while maintaining the patient's safety. Appropriate monitoring by trained personnel is the key to successful procedural sedation. These techniques should be used only by health care professionals skilled in managing complications, including cardiorespiratory compromise. It is important to take a complete history and perform a thorough physical examination, paying special attention to the selection of pharmacologic agents. Common sedative agents include etomidate, ketamine, fentanyl, and midazolam. These have become the agents of choice for procedural sedation because of their ease of use, predictable action, and excellent safety profiles. All patients requiring procedural sedation should be monitored by qualified staff at the bedside until they have recovered to an age-appropriate baseline mental status and function. (Am Fam Physician 2005;71:85-90. Copyright© 2005 American Academy of Family Physicians.)

Physicians often encounter patients who present with painful conditions such as lacerations, fractures, and dislocations that require the use of painful interventions. Furthermore, certain nonpainful procedures, such as computed tomography in a small child, may require the use of anxiolytic agents or behavioral control. The phrase *procedural sedation* refers to the techniques of managing a patient's pain and anxiety to facilitate appropriate medical care in a safe, effective, and humane fashion.

Definitions of procedural sedation vary.[1-4] Older terminology that includes the phrase *conscious sedation* should be abandoned. Procedural sedation and analgesia (PSAA) is a more accurate and appropriate description.[5]

PSAA produces a suppressed level of consciousness that is adequate to allow the administration of painful or unpleasant diagnostic or therapeutic maneuvers in a way that minimizes patient awareness, discomfort, and memory, while attempting to preserve spontaneous respiration and airway-protective reflexes. PSAA should be viewed as a continuum ranging from light to deep sedation, with the depth of sedation easily titrated by selective administration of sed-

> Procedural sedation and analgesia is a more appropriate description than *conscious sedation*.

atives and analgesics. Because of the range of sedation, it cannot be assumed that spontaneous ventilation will occur at each level.

PSAA can be performed as an outpatient procedure in the urgent care clinic or in the physician's office. Because patients are given medications that suppress consciousness, the physician must be experienced in managing potential complications of the procedure, including vomiting, respiratory depression, hypoxia, hypotension, and cardiac arrest. The most serious complication is respiratory failure from airway obstruction or hypoventilation. Advanced airway-management skills are a mandatory prerequisite for performing these techniques.

General Approach to Procedural Sedation

Many groups have published recommendations for the performance of PSAA.[1-4,6] The most important recommendation involves the person performing the procedure. This person must have an understanding of the medications administered, the ability to monitor the patient's response to the medications given, and the skills necessary to intervene in managing all potential complications. Failure to meet this recommendation should be viewed as an absolute contraindication to PSAA.

The next step is appropriate patient selection. Absolute contraindications are uncommon, but the physician should consider comorbid illness or injury, the ability to manage the patient's airway, and previous problems with PSAA. Patients with significant comorbid cardiac, hemodynamic, or respiratory compromise should be approached with caution, as should patients who may be difficult to intubate or manually ventilate.

Although fasting before PSAA commonly is recommended,[2,3] there are insufficient data to determine whether fasting improves outcomes. The American Society of Anesthesiologists recommends a two-hour fast for clear liquids and a six-hour fast for food.[3]

Recent oral intake is not an absolute contraindication to PSAA, but logic suggests that patients with prolonged fasting are less likely to aspirate than patients who have just eaten.[1,4] The urgency of the procedure, the time of the last meal, and the likelihood of significant aspiration must all be taken into account when deciding whether a particular patient would be a good candidate for PSAA.[3,7]

Published guidelines[1-3] recommend cardiac and pulse-oximetry monitoring for patients undergoing PSAA. The patient should be monitored fully from before the medications are administered until all sedation has worn off and the patient has resumed his or her baseline level of function, with frequent bedside recording of the patient's status and vital signs.[1-4] This should be done by an experienced health care professional, often a nurse, whose only job is to monitor the patient until recovery is complete.

Required equipment includes cardiac and pulse-oximetry monitors; oxygen and appropriate delivery systems, ranging from nasal cannula to high-flow oxygen mask (nonrebreather); bag-valve mask; suction; appropriately sized oral airways and endotracheal tubes; laryngoscope with appropriate blades; and medications and equipment for cardiac resuscitation. All of the equipment should be at the bedside before the first dose of sedative is given.

Agents for Procedural Sedation

Many medications are available to facilitate PSAA. The ideal agent possesses analgesic and amnestic properties, has rapid onset and short duration of action, is safe, and allows rapid recovery and discharge. Recent trends have favored the use of medications such as etomidate and ketamine, while familiar agents such as fentanyl and midazolam continue to be used widely. Common indications for the use of PSAA are listed in *Table 1*.

Strength of Recommendations

Key clinical recommendation	Label	References
Published guidelines recommend cardiac and pulse-oximetry monitoring for patients undergoing procedural sedation and analgesia.	C	1-4
Based on limited retrospective evidence, etomidate can be used as a sedative for brief procedures in the emergency department.	B	11, 12
Based on limited evidence, ketamine can be used to sedate children for procedures in the emergency department.	B	15

A = Consistent, good quality patient-oriented evidence; B = inconsistent or limited-quality patient-oriented evidence; C = consensus, disease-oriented evidence, usual practice, opinion, or case series. See page 19 for more information.

ETOMIDATE

Etomidate is an imidazole derivative that possesses little analgesic effect. Intravenous use produces a hypnotic state, usually within one minute. The duration of effect is brief, lasting three to five minutes at standard dosages. Etomidate is metabolized rapidly by the liver, and the duration of effect may be longer in patients with liver failure.[8]

The only contraindication to etomidate is hypersensitivity to the medication, but caution should be taken during pregnancy (etomidate is a pregnancy category C drug), and the general precautions regarding procedural sedation and patient selection also should be considered.

Adverse events are relatively uncommon in patients receiving etomidate. The medication has few to no hemodynamic effects, and its neutral cardiovascular profile is one of the most appealing aspects of this agent. Adrenocortical suppression has been reported after the use of a single bolus of etomidate,[9] but the significance of this effect is believed to be inconsequential.[10] Muscle twitching generally is well tolerated, and emergence nausea and vomiting have been reported. Respiratory depression and hypoxia are possible. The incidence appears to be 3 to 15 percent.[11-14] Patients have responded well to supplemental oxygen; in rare instances, patients have required bag-valve-mask–assisted ventilation.[11-13] Etomidate has been shown to be safe and effective for PSAA, and is an excellent choice of agent.[11-14]

KETAMINE

Ketamine has gained favor for PSAA in children because of its reliable effects and strong safety profile. Ketamine is a rapidly acting dissociative anesthetic that produces a

TABLE 1
Common Indications for Procedural Sedation and Analgesia

Indication	First-line agent	Pharmacologic alternatives	Notes
Foreign-body removal			
Ear, children	Ketamine	Etomidate, fentanyl and midazolam	Use when suction, irrigation, or other physical measures have failed.
Rectal, adults	Etomidate	Fentanyl and midazolam, ketamine	
Zipper–penile entrapment, children	Ketamine	Etomidate, fentanyl and midazolam	Consider local anesthesia.
Incision and drainage of abscess			Use if subcutaneous anesthesia is judged to be inadequate.
Adults	Etomidate	Fentanyl and midazolam, ketamine	
Children	Ketamine	Etomidate, fentanyl and midazolam	
Imaging in children			
Acute, no suspected increase in intracranial pressure	Ketamine	Fentanyl and midazolam	Consult with on-site radiologist or subspecialist when available, timing of procedural sedation and anesthesia with imaging is key.
Acute, concern for elevated intracranial pressure	Fentanyl and midazolam	Thiopental	
Outpatient younger than six years	Ketamine	Fentanyl and midazolam, chloral hydrate	Defer to preference of consulting radiologist or other subspecialist present at time of procedure.
Outpatient older than six years	Ketamine	Fentanyl and midazolam	Defer to preference of consulting radiologist or other subspecialist present at time of procedure, consider mild oral anxiolytic.
Laceration repair in children	Ketamine	Fentanyl and midazolam	Use other alternatives when possible or necessary, such as topical or subcutaneous anesthetics, topical skin adhesives, or controlled physical restraint.
Reduction, joint without fracture			Consider digital block or regional nerve block.
Adults	Etomidate	Fentanyl and midazolam, ketamine	
Children	Ketamine	Etomidate, fentanyl and midazolam	
Reduction, fracture with dislocation			Consider hematoma block,* digital block, or regional nerve block.
Adults	Etomidate	Fentanyl and midazolam, ketamine	
Children	Ketamine	Etomidate, fentanyl and midazolam	
Wound management			Consider digital or regional nerve block.
Debridement, significant pain, large surface area, severe burn			
Adults	Etomidate	Fentanyl and midazolam, ketamine	
Children	Ketamine	Etomidate, fentanyl and midazolam	

*—Local anesthetic infiltration into the fracture site.

> **Ketamine produces rapid anesthesia and profound analgesia in children.**

profound analgesic effect. Onset, duration, and dosage vary according to the route of administration. The dose may be repeated and titrated to effect with no cumulative adverse risk profile.

Ketamine is contraindicated in patients who are hypersensitive to the medication, and in those in whom a hypersympathetic state might be deleterious, such as patients with elevated intracranial or intraocular pressure, or those with coronary artery disease. Care must be taken in any patient with upper or lower respiratory tract pathology because of the low risk for airway compromise. Ketamine is a pregnancy category C medication.

Adverse effects of ketamine include recovery agitation, transient airway complications such as laryngospasm, and emesis.[15] Excessive salivation also may occur and can be treated with anticholinergics.[16] Although the use of benzodiazepine adjuncts to ketamine sedation commonly is recommended, it has not been demonstrated to be useful in preventing recovery agitation in children.[17,18] Ketamine is safe for use in adults, but careful patient selection is mandatory.[19] Concomitant use of midazolam should be considered in adults to blunt the potential sympathomimetic effects of ketamine and to reduce the likelihood of emergence reactions.[20] Ketamine should be avoided in patients who are predisposed to psychotic behavior.

Respiratory depression is uncommon with ketamine; however, as with all agents, it can occur, and the physician must be prepared to manage the patient's airway.[15,19] Laryngospasm has an incidence of 0.4 percent in patients receiving ketamine, but it is generally transient, and patients can be ventilated manually via bag-valve mask when necessary.[20] Overall, ketamine has an excellent safety record with use in children and adults.

FENTANYL AND MIDAZOLAM

The combination of fentanyl and midazolam has been used for many years. These medications have a rapid onset and a short duration of action, and are safe and effective for PSAA.

Midazolam is a benzodiazepine that can be delivered by a number of different routes, but intravenous administration provides the fastest onset of action. Midazolam undergoes hepatic metabolism and renal excretion, and prolonged effects may be seen with dysfunction of either organ system. It is a pregnancy category D medication. Midazolam is a sedative, amnestic, and anxiolytic medication with no analgesic properties. For this reason, it is used commonly with an opioid analgesic such as fentanyl.[21]

Fentanyl is a synthetic opioid. When given intravenously, the time of onset is one to two minutes and the duration of clinical effect is about 30 to 60 minutes. Fentanyl is metabolized by the liver, but its short duration of effect is attributable to rapid redistribution from the central nervous system. It is a pregnancy category C drug. Because fentanyl is a pure analgesic, it should not be used alone for PSAA.[22]

Fentanyl and midazolam are titrated easily and are widely available. The biggest drawback of this combination is the potential for cardiac and respiratory depression. The medications should be given in slow, incremental doses rather than using bolus administration. Respiratory depression may occur in 25 percent or more of patients.[23,24]

REVERSAL AGENTS

One unique advantage to the combination of fentanyl and midazolam is that both agents have antagonists that can be used to reverse the effects. Naloxone and flumazenil effectively terminate the effects of fentanyl and midazolam, respectively.

Routine use of reversal agents should be avoided. Because the duration of effect of the sedative agents may exceed that of the reversal agents, a reversed patient may appear recovered temporarily then return to a sedated state. Reversal agents should be administered only to prevent a major complication, such as aspiration or cardiorespiratory compromise, and should be followed by a long observation period to ensure recovery. Physicians

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TABLE 2
Commonly Used Agents for PSAA

Agent	Recommended dosing	Onset	Duration	Comments
Etomidate	Sedation in adults: 0.2 mg per kg over 30 to 60 seconds	Less than one minute	Three to five minutes	Advantages: single agent, reliable, no cardiovascular or respiratory depression, first-line agent in adults Disadvantages: limited data with PSAA, action too short for some procedures
Ketamine	Sedation in children: 1 to 2 mg per kg intravenously	One minute	10 to 20 minutes	Reliable, established safety in children, intramuscular route, first-line agent in children; not approved by the U.S. Food and Drug Administration for children younger than 16 years*
	Sedation in children: 2 to 4 mg per kg intramuscularly	Five minutes	15 to 45 minutes	Nystagmus, hypersecretions, agitation, emergence delirium, vomiting, myoclonus, laryngospasm, cardiovascular stimulation, may require concurrent atropine sulfate in children younger than five years† Contraindications: hypertension, ischemia, increased intracranial or intraocular pressure, active respiratory infection, psychosis, infants younger than three months
Atropine sulfate	Children: 0.01 mg per kg intravenously/ intramuscularly Minimum: 0.1 mg Maximum: 0.5 mg	Less than one minute intravenously Five minutes intramuscularly	2 hours	Use in children younger than five years to counteract vagal effects of ketamine.*
Fentanyl	Initial dose in adults: 1 to 1.5 mcg per kg intravenously Titrate: 1 mcg per kg every three minutes intravenously	One to two minutes	30 minutes	Familiarity, availability, reversibility, proven safety record, minimal cardiovascular depression* Cough, hiccup, itching, vomiting, respiratory depression, requires another agent for sedation, poor reliability, repeat dosing usually required†
Midazolam	Initial dose in adults: 0.02 mg per kg Titrate: 1 mg intravenously every three minutes Initial dose in children six months to five years of age: 0.1 mg per kg	One to two minutes	30 minutes	Familiarity, availability, proven safety record* Requires another agent for analgesia, poor reliability, repeat dosing usually required, respiratory depression, hypotension†
Naloxone	Adults: 0.1 to 2.0 mg intravenously	One minute	15 to 30 minutes	Opiate reversal, very safe, but routine use NOT recommended
Flumazenil	Adults: 0.2 mg per minute intravenously Maximum: 1.0 mg every 20 minutes	One minute	45 minutes	Benzodiazepine reversal, use discouraged, potential for benzodiazepine withdrawal or status epilepticus

PSAA = procedural sedation and analgesia.

—Benefits/advantages.

†—Side effects/disadvantages.

should be especially careful with flumazenil because its use can be associated with status epilepticus, mainly in patients with unidentified benzodiazepine abuse or seizure disorder.

Commonly used agents for PSAA are listed in *Table 2.*

Recovery from PSAA

Patients recovering from PSAA should be approached with the same diligence as when they are induced. Once the noxious stimuli from the procedure are removed, the cardiorespiratory depressant effects of the medications may

become more dominant. Therefore, all patients should be monitored by trained personnel at the bedside until no risk of cardiorespiratory depression remains. Patients should be recovered to an age-appropriate baseline mental status before being discharged.

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