Procedural Sedation and Analgesia

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Statement of Editorial Purpose
The Hospital Physician Emergency Medicine Board Review Manual is a peer-reviewed study guide for residents and practicing physicians preparing for board examinations in emergency medicine. Each quarterly manual reviews a topic essential to the current practice of emergency medicine.

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INTRODUCTION

Safe and effective sedation practices are significant contributions to the management of painful and unpleasant procedures in the emergency department (ED). Numerous publications in both the pediatric and adult emergency medicine literature have highlighted the increasing role and popularity of procedural sedation,1–4 and investigators have evaluated the efficacy of various agents in the ED setting.5–10 In 1998, the American College of Emergency Physicians published a clinical policy for procedural sedation and analgesia that reviewed the literature for systemic sedation practices.11 The Canadian College of Emergency Physicians published similar guidelines for sedation practice in 1999.12 This review discusses the use of procedural sedation in the ED, including indications, patient assessment and monitoring, documentation, agents, and postprocedure issues.

NOMENCLATURE

Nomenclature in sedation practice has evolved over the past several years. Terms such as “conscious” and “deep sedation” are being replaced by the more general term “procedural sedation and analgesia.”2 Procedural sedation and analgesia (PSA) refers to a technique of administering sedatives or dissociative agents with or without analgesics to induce a state that allows the patient to tolerate an unpleasant procedure while maintaining cardiorespiratory function. PSA is intended to result in a depressed level of consciousness in which the patient is able to maintain airway control independently and continuously during a procedure with little or no pain. Specifically, the drugs, doses, and techniques used are not likely to produce loss of protective airway reflexes.7 Throughout this review, the acronym “PSA” will be used in place of the terms “conscious,” “deep,” or “dissociative” sedation.

INDICATIONS

PSA has a wide role in patient care, especially in pediatric emergency care. Determining whether a given clinical situation warrants the use of PSA is a fundamental skill of emergency medicine physicians. Analgesia clearly is warranted for a painful procedure is obvious, but with an increasingly wider selection of available agents, use of PSA is becoming more common in procedures not previously associated with PSA (eg, pediatric laceration repair). Defining the proper indication for PSA involves several factors: the clinician’s experience, the capabilities of the ED where the procedure will take place, hospital and ED protocols, and patient preparation. With reports of significant oligoanalgesia in the management of ED patients,13 physicians should consider using PSA liberally in the most painful or unpleasant ED experiences. Some of the most reported clinical indications for PSA in the ED setting include orthopedic injuries and reductions, wound débridement, burns care, abscess drainage, tube insertion, pediatric sexual assault examinations, and diagnostic imaging studies.14 This list is not all inclusive but rather illustrates the varied indications for PSA in the ED.

In determining whether PSA is indicated, the physician must evaluate the risks and benefits of sedation. For example, using heavy sedation when treating a simple extremity laceration in a child probably is not warranted as the risks outweigh the benefits. However, a complicated pediatric facial laceration may be treated most effectively when PSA is administered. Although use of PSA appears to be more time consuming, it ultimately may result in greater patient and clinician satisfaction. Physicians must remember that inflicting pain on patients is neither difficult nor respected. The art and skill of PSA in emergency medicine is to have a patient not object to or remember an unpleasant experience. Another caveat to bear in mind is that PSA is for brief painful and unpleasant procedures. Any procedure requiring prolonged sedation or analgesia is probably
best done in the operating room under the expertise of an anesthesiologist. Clinical judgment is the physician’s best guide.

**PATIENT ASSESSMENT**

The assessment of patients in whom PSA is being considered can be divided into 3 components: (1) current medical history with a directed physical examination; (2) past medical and anesthetic history; and (3) consent.

**CURRENT HISTORY AND PHYSICAL EXAMINATION**

It is necessary to conduct a history and a directed physical examination prior to providing PSA because last oral intake, volume status, presence of other drugs or alcohol, associated injuries, and other medication administered in the ED all influence the approach to PSA. Many of these factors will determine whether PSA is indicated and, if it is, which agents should be selected.

It is important to assess oral intake status in patients because vomiting or regurgitation coupled with loss of protective airway reflexes theoretically can lead to aspiration and development of aspiration pneumonitis. Consensus guidelines specifying “nothing by mouth” (NPO) intervals and requirements have been published; however, recent reviews have pointed out that little evidence exists to support any particular time interval. Although gastric volume and acidity originally were implicated as the primary causes of aspiration pneumonitis, this assumption recently has been called into question. Due to the lack of evidence to support any particular NPO duration, the American Society of Anesthesiologists (ASA) shortened their fasting recommendation in 1999. The current consensus recommendations are 2 hours for clear liquids in adults and children and 6 hours for solids. Patient acuity may alter these recommendations. Also, because patients who present to the ED frequently need urgent care that cannot be delayed, ED physicians may have to make significant alterations to these guidelines.

Recent food intake can affect the choice of agent and depth of PSA. In most PSA situations, however, the protective reflexes are maintained and the risk of aspiration is minimal. A good practice is to keep a patient NPO from the initial triage if the condition will possibly require PSA. For example, placing a reminder sticker with “Nothing to drink or eat for me” on a child with a laceration will frequently prevent a delay should PSA be required.

A preprocedural airway assessment also is essential.

**Table 1. American Association of Anesthesiologists Physical Status Classification System**

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Healthy, no systemic disease</td>
</tr>
<tr>
<td>II</td>
<td>Mild systemic disease</td>
</tr>
<tr>
<td>III</td>
<td>Severe systemic disease</td>
</tr>
<tr>
<td>IV</td>
<td>Sever systemic disease that is a threat to life</td>
</tr>
<tr>
<td>V</td>
<td>Moribund patient. Not expected to survive without operation</td>
</tr>
<tr>
<td>VI</td>
<td>Brain dead. Operation for organ harvesting</td>
</tr>
</tbody>
</table>


**PAST MEDICAL HISTORY**

Chronic medical conditions, allergies, current medications, previous problems with anesthesia, and psychiatric disorders are all crucial pieces of information that must be obtained prior to administering anesthesia. Although care must be exercised in patients with chronic cardiac, pulmonary, hepatic, and renal disorders, a patient should not be automatically excluded because of a given medical condition. Conversely, one should not overextend the ED’s resources and abilities in order to save a trip to the operating room.

**PATIENT CONSENT**

Patient consent for the PSA should be sought separately from the primary procedure that is being performed. Benefits, risks, possible complications, and alternatives should be outlined. A clear explanation, especially to parents of pediatric patients, is critical. It is important to use concise, nonmedical language and to allow time for questions, if possible. A note detailing the discussion and consent should be placed in the medical record.

**MONITORING AND DOCUMENTATION**

Equipment to assess vital signs, a pulse oximeter, and resuscitative equipment should be present whenever a
patient undergoes PSA. Optimal monitoring and resuscitative apparatus are listed in Table 2. It is best to have a second provider present who will be responsible for patient monitoring while the primary provider performs the procedure. If the patient can follow commands and the physician can clearly see the patient during the procedure, one person may perform the PSA and procedure. However, if the patient is draped or the physician needs to concentrate solely on the procedure, a second provider dedicated to monitoring the patient is warranted. All support personnel should have a clear understanding of PSA and the skills necessary for monitoring and resuscitation. It is recommended that patients receive supplemental oxygen for PSA. Preoxygenating the patient also provides a margin of safety if an unexpected apneic period occurs. Although capnography has not been fully embraced for PSA, it may allow for better patient monitoring in real time.18

In regard to sedation depth, PSA is a point on a continuum ranging from light sedation to general anesthesia. The endpoint in PSA is relief of discomfort and pain without loss of protective airway reflexes. Obviously, patients may undergo a deeper state of sedation; however, deeper sedation is not the intent in PSA, and when it does occur, it is generally transient and well monitored. There is little evidence that PSA done in the ED has a higher complication rate than PSA done in the operating room or procedural suite.11 Policymaking, however, necessitates a defined continuum. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) has adopted the 4 sedation levels defined by the ASA (Table 3). PSA administered to a well-prepared patient in an endoscopy lab is different from PSA administered in the ED. ED patients may be undergoing emergent procedures with little time for preparation. The nature of emergency medicine makes emergency physicians well qualified to monitor, identify, and rescue patients from deep sedation. Rarely, deep sedation may be required in the ED under certain circumstances and for brief periods, but this should be the exception rather than the rule for PSA.

Documentation of PSA should be complete, with enough detail to reflect the comprehensive nature of the care provided and not merely a small addendum to the procedure documentation. A separate PSA note is best, and a time-based flow sheet can be helpful (Figure). Ongoing recordings of vital signs, pulse oximetry, patient sedation level, and medication dosing are important parts of PSA. JCAHO has mandatory reporting requirements for PSA complications.19 Although complications are infrequent in PSA, clear documentation of adverse events and interventions is an important part of patient care and continuous quality improvement. Documentation should reflect the consent, preparation, drugs used, patient response, and any complications.

### PSA AGENTS

Various agents are available to emergency medicine physicians for use in PSA. Each clinical situation may warrant a different agent with a different sedation profile. The ideal PSA agent has a large therapeutic index; has minimal effect on hemodynamics; preserves protective reflexes; provides amnesia, relaxation, and analgesia; has a rapid onset and offset; and is titratable and reversible.

Two pharmacologic approaches to the administration of PSA can be used. One is the single agent approach in which a single agent meets the sedation requirements of a given clinical situation (eg, methohexitol for a shoulder dislocation). The other is a balanced agent approach in which 2 or more agents are titrated together to achieve the desired clinical effect (eg, midazolam and fentanyl). The advantage the single agent approach has over the balanced approach is the overall predictability of the agent. Some of the agents that will be discussed here are more suited for use with the balanced approach, while others are safest when used as a single agent (Table 4).

### OPIATES

Opiates offer effective analgesia and some sedative properties. As a class, they frequently are used as part of a balanced approach to sedation. Opiates also are very useful in the pre- and postprocedure period.

| Table 2. Optimal Equipment for Monitoring Patients During Procedural Sedation and Analgesia |
| Monitoring |
| Pulse oximeter |
| Blood pressure cuff |
| Electrocardiography monitor |
| End-tidal CO2 monitor (if available) |
| Resuscitative |
| Airway equipment |
| Suction |
| Functional intravenous line |
| Oxygen |
| Reversal agents, if appropriate |

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Morphine

**Pharmacology and dose.** Morphine sulfate is the prototypical opiate analgesic. It is a nonselective opiate that binds to all central nervous system (CNS) opiate receptors. It undergoes hepatic metabolism and renal excretion. Morphine administration causes histamine release in some patients. The pharmacologic profile of morphine is consistent in pediatric, adult, and elderly patients, making it a predictable opiate. Onset of action of an intravenous (IV) dose is 1 to 3 minutes, with a half-life of 3 to 5 hours.

- **Intravenous**
  - Adult: 0.02 to 0.15 mg/kg, titrated to clinical response every 5 to 10 minutes
  - Pediatric: 0.1 to 0.2 mg/kg, titrated to clinical response

There is no role for intramuscular (IM) administration of morphine in PSA.

**Adverse effects.** As with all opiates, respiratory depression is the primary complication of morphine use. Hypotension and histamine release are also known complications. The respiratory depression can be reversed with naloxone. The hypotension primarily is due to venodilation and is more pronounced in elderly and volume-depleted patients. Consequently, administration of fluids prior to the procedure may be useful.

**Use in PSA.** Many clinicians are very comfortable with the predictable profile of morphine. The long duration of action may be a desired effect if postprocedure pain is anticipated. Administration of morphine for PSA, however, can leave a patient too somnolent to be considered stable for discharge soon after the procedure. Therefore, if rapid offset is desired, an opiate of shorter duration (eg, fentanyl) should be used.

Meperidine

**Pharmacology and dose.** Meperidine is similar to morphine in action but has one eighth the potency of morphine and a shorter half-life (90 minutes to 2 hours). It is metabolized primarily in the liver by demethylation. Normeperidine is the active metabolite, which is renally excreted. Meperidine is thought to have CNS toxicity when given in high concentrations or in patients with renal impairment. Normeperidine-associated seizures have been described. The sedative effects of meperidine are less predictable than those of morphine.

- **Intravenous**
  - Adult: 0.25 mg to 0.5 mg/kg, titrated every 10 to 15 minutes
  - Pediatric: not reported
**Figure.** Time-based flow sheet for documenting procedures involving procedural sedation and analgesia.
Adverse effects. In equipotent doses, meperidine has an effect on respiratory drive and blood pressure similar to morphine. Hallucination, tremors, and dysphoria have been reported with meperidine. Meperidine should not be used in patients taking monoamine oxidase inhibitors, as fatal reactions have been reported.

Use in PSA. Although frequently used in the past, meperidine currently has a limited role in PSA. If post-procedure analgesia is desired, morphine is a better choice because of its longer half-life. If rapid offset is desired, a short-acting opiate such as fentanyl is more desirable. Compared with either morphine or fentanyl, IV meperidine results in a more erratic patient response and is more difficult to titrate effectively.

Fentanyl

Pharmacology and dose. Fentanyl is a synthetic pure-agonist opiate. It is highly lipophilic and has rapid serum clearance. After a single dose, brain concentrations of fentanyl fall in conjunction with serum levels, giving it predictable pharmacokinetics. Multiple doses will lead to a prolonged recovery. Fentanyl does not cause histamine release and is not associated with hypotension, which can make it an ideal agent for use in the hypotensive patient. Fentanyl is 100 times more potent than morphine. Its duration of action is 30 to 40 minutes, shorter than either morphine or meperidine. These attributes make it a very useful agent in PSA.

Intravenous

Adult: 1 to 2 mcg/kg, titrated over 30 to 60 minutes (usual initial dose, 50 to 200 mcg)

Pediatric: 0.5 to 1.0 mcg/kg, titrated over 60 minutes

Fentanyl has a wide therapeutic index. It can be titrated in 0.5 mcg/kg increments (50 mcg in an average adult) until an adequate level of sedation is achieved.

Adverse effects. As with all opiates, respiratory depression is the most common adverse effect with fentanyl. Rapid infusion of higher doses has been associated with a rigid chest wall phenomenon, which is characterized by difficulty with ventilatory mechanics and effort. Although the phenomenon typically is associated with doses in excess of 15 mcg/kg, it has been reported with doses around 10 mcg/kg, which is higher than most sedation doses. Treatment of the rigid chest wall phenomenon requires paralytics and mechanical ventilation. The ED complication rate of fentanyl has been reported at less than 1%.6

Use in PSA. Fentanyl has been used extensively in both pediatric and adult sedation. Fentanyl is a very effective agent as part of a balanced approach with a benzodiazepine. A survey of academic EDs reported that fentanyl (in conjunction with midazolam) was the leading analgesic used for PSA.14 A short duration of action makes it an excellent agent for ED use. It has minimal effect on hemodynamics, making it a useful agent in geriatric patients in whom cardiovascular effects are a greater consideration.

BENZODIAZEPINES

The sedative and amnestic properties of benzodiazepines make them important components of a balanced approach. Although they possess no intrinsic analgesic properties, they provide an excellent level of sedation when combined with an opiate analgesic. It is imperative that clinicians understand the pharmacology and adverse effects of this drug class to ensure their safe and effective use in ED sedation.

Midazolam

Pharmacology and dose. Midazolam is a water-soluble benzodiazepine that produces both sedation and amnesia but has no analgesic properties. IV administration rarely causes pain or thrombophlebitis. It has an onset of action of approximately 60 seconds and a half-life of 60 minutes. It produces anterograde amnesia but no retrograde amnesia. Midazolam is metabolized in the liver and excreted by the kidneys. The water solubility of midazolam allows for both oral and intranasal use. These alternative routes can be very efficacious in children.

Intravenous

Adult: 0.02 to 0.1 mg/kg, titrated to effect

Pediatric: 0.02 to 0.05 mg/kg, titrated to effect
Oral and intranasal
Pediatric: 0.5 to 0.75 mg/kg orally; 0.2 to 0.4 mg/kg intranasally

Adverse effects. As with all benzodiazepines, respiratory depression and hypotension are the most common complications with midazolam. In well-monitored situations, the complication rate of midazolam is less than 1%. Geriatric patients may be more susceptible to its effect; consequently, the dosage should be adjusted accordingly. Both respiratory depression and hypotension are reversed with flumazenil, a benzodiazepine-reversing agent.

Use in PSA. Midazolam has been a common agent in outpatient PSA since its introduction. Early reports regarding complications with midazolam were the result of inadequate monitoring, not the agent. ED experience with midazolam is considerable, and the drug’s safety and efficacy have been proven. When combined with a short-acting opiate, it provides excellent sedation for painful procedures. As mentioned, midazolam is 1 of the 2 most frequently used agents for PSA in the ED. Midazolam possesses many of the characteristics of the ideal sedation agent and should be familiar to all emergency physicians.

Diazepam

Pharmacology and dose. Diazepam is a lipid-soluble benzodiazepine that induces sedation and amnesia. It has a very long half-life (20 to 30 hours) due to its active metabolites. Diazepam has a more profound effect on blood pressure and respirations than midazolam, and it cannot be mixed with other agents for IV administration.

Intravenous
Adult: 0.05 to 0.1 mg/kg
Pediatric: 0.05 to 0.1 mg/kg

Adverse effects. Diazepam has a higher rate of pain at injection site and a higher incidence of thrombophlebitis than other benzodiazepines. Superficial painless phlebitis was reported in 15% of cases. Its long half-life can make management of oversedation a problem. As with all benzodiazepines, respiratory depression and hypotension can occur, especially with rapid injection.

Use in PSA. Although previously the preeminent benzodiazepine for PSA, diazepam is now used much less frequently since the introduction of midazolam. Longer half-life, potential phlebitis, and inability to mix with other agents make it a much less versatile agent in the ED.

Barbiturates

Barbiturates have become popular for PSA. Several possess profiles that make them very effective for certain procedures. Barbiturates have no intrinsic analgesic properties but are short acting, have excellent relaxation effects, and have good safety profiles in the ED.

Methohexitol

Pharmacology and dose. Methohexitol is an ultra-short-acting barbiturate with very fast onset and short duration of action. Onset of action is 10 to 15 seconds, with the duration of action from 5 to 10 minutes. It is metabolized primarily by the liver and can cause histamine release.

Intravenous
Adult: 1 to 2 mg/kg; may be repeated
Rectal: 25 mg/kg (200 mg maximum)

Adverse effects. As with all barbiturates, methohexitol causes respiratory depression and possibly transient apnea in a minority of patients. Hypotension can occur in volume-depleted patients, while bronchospasm can occur in patients with an asthma history. Methohexitol also appears to lower seizure threshold and should be used with caution in patients with a seizure history.

Use in PSA. Methohexitol has become very popular in PSA. One series demonstrated that it was safe and efficacious in a well-monitored ED setting. This agent’s excellent relaxation properties can make it especially effective in orthopedic reductions. Physicians may consider combining a barbiturate with an opiate since barbiturates have no inherent analgesic property.

Pentobarbital

Pharmacology and dose. Pentobarbital is another ultra–short-acting barbiturate. Its metabolism is similar to methohexitol and other barbiturates. It can be dosed IV, IM, or rectally (PR). It is used primarily for pediatric sedation. Duration for pentobarbital is 1 to 3 hours when administered PR and IM but much shorter when given IV.

Pediatric
Intravenous: 1 to 2 mg/kg
Rectal: 2 to 4 mg/kg
Intramuscular: 2 to 4 mg/kg

Adverse effects. Oversedation and respiratory depression are the primary concerns with pentobarbital. It does not lower the seizure threshold unlike methohexitol.

Use in PSA. This drug is very useful for pediatric sedation, especially for imaging procedures (eg, computed tomography scans). Rectal dosing is safe and well tolerated. Adequate monitoring is still required, especially when the patient is traveling for procedures outside of the ED.
DISSOCIATIVE

Ketamine

Pharmacology and dose. Ketamine is a phencyclidine analog that induces a unique dissociative state resulting in amnesia, analgesia, and sedation. The patient assumes a trance-like state and is unresponsive to stimuli, including pain. Because protective reflexes are maintained when the agent is titrated correctly, ketamine is used extensively in developing countries for operative procedures. It is metabolized by the liver and is water-soluble and lipid-soluble. Its elimination half-life is 2 hours, with a 30-minute duration of action. It can be mixed with other agents such as midazolam and atropine. It has a transient sympathomimetic effect.

Intravenous
Adult: 1 to 2 mg/kg, titrated to effect
Pediatric: 1.0 to 1.5 mg/kg, titrated to effect
Intramuscular
Adult and pediatric: 3 to 4 mg/kg

Adverse effects. The most common concerning effect with ketamine is the emergence phenomenon, a state characterized by hallucinations, dysphoria, and nightmares. In adults, the incidence has been reported to range from 0% to 50%. In children, the incidence is much lower, ranging from 0% to 15%. The concomitant use of benzodiazepines reduces the likelihood of an emergence reaction in adults. Transient laryngospasm also has been reported but usually is self-limited and responsive to simple positive-pressure ventilation with a bag-valve-mask. Hypersalivation also is common. Atropine is very effective in reducing salivation and commonly is coadministered with ketamine (atropine dose, 0.02 mg/kg, maximum dose of 0.5 mg). Ketamine should not be used in pregnancy, hyperthyroidism, or infants or patients with increased intracranial or intraocular pressure. For the above reasons, ketamine is best suited for pediatric PSA.

Use in PSA. Ketamine is an excellent agent for use in pediatric sedation. A published series of more than 1000 children who received intramuscular ketamine demonstrated the agent’s efficacy and safety. It can be used as a single agent for painful procedures due to its analgesic properties. Ketamine, atropine, and midazolam can be mixed in the same syringe and administered intramuscularly as a very effective balanced agent.

OTHER SEDATIVE AGENTS

Etomidate

Pharmacology and dose. Etomidate is an ultra–short-acting hypnotic sedative in a class by itself. It commonly is used as an induction for rapid-sequence intubation (RSI). Etomidate has a rapid onset and offset, with a duration of action between 5 and 10 minutes. It does not cause histamine release and does not have significant cardiovascular or hemodynamic effects. Etomidate possesses no analgesic properties.

Intravenous
Adult and pediatric: 0.1 to 0.3 mg/kg (0.3 mg/kg is the RSI dose)

Adverse effects. Etomidate may cause myoclonic jerking and cortisol suppression from prolonged use. The cortisol suppression has little clinical relevance in PSA or ED patients. Respiratory depression is the primary adverse effect of etomidate.

Use in PSA. There is increasing experience with the use of etomidate. Myoclonic jerking has been one of the reported difficulties with etomidate.

Propofol

Pharmacology and dose. Propofol is an ultra–short-acting sedative that is unrelated to the barbiturates. It has a rapid onset and short duration of action. It can be titrated to maintain sedation without prolonging the recovery time. Patients are generally awake and responsive within 8 minutes of discontinuation. Propofol may cause a transient apnea in 40% of patients. It lowers intracranial pressure and can cause hypotension, particularly in the hypovolemic patient.

Intravenous
Adult and pediatric: bolus of 0.5 to 1.0 mg/kg, followed by incremental infusions of 25 to 100 mcg/kg/min

Adverse effects. Apnea and hypotension are the primary adverse effects of propofol. Caution should be used when prior analgesics have been administered since they may potentiate the effects of propofol. Local irritation may occur at the injection site.

Use in PSA. Propofol is only beginning to be studied in PSA in the ED. Some institutions report that its use is restricted. It has several features that make it ideal for some PSA indications. Undoubtedly, as experience with propofol increases its application in the ED also will increase.

INHALATION

Nitrous Oxide

Pharmacology and dose. Nitrous oxide (NO₂) is a colorless, sweet-smelling gas that is highly soluble in plasma but does not bind to hemoglobin. NO₂ is not metabolized and it is excreted unchanged by the lungs. Thus, it has no effect on either the cardiovascular or the...
The pulmonary system. NO₂ possesses amnestic as well as analgesic properties. Its onset of effect is within 2 minutes. ED NO₂/O₂ devices deliver a 50:50 concentration of NO₂ and O₂. Concentrations containing more than 50% NO₂ are used in anesthesia but are not recommended for ED use. Variation in patient response and analgesic effect has been described with NO₂. Patients self-deliver a concentration of 50% NO₂ and 50% O₂.

Adverse effects. Nitrous oxide has few adverse effects and is extremely safe when used properly. Diffusion hypoxia is described with concentrations of NO₂ greater than 50%. When NO₂ is discontinued, it rapidly diffuses into the alveoli, displacing O₂ and resulting in a relative hypoxia unless high concentrations of O₂ are delivered. With 50:50 NO₂ to O₂ concentrations, this is merely a theoretical concern. Because NO₂ is highly soluble and will diffuse rapidly into gas-filled spaces, its use is contraindicated in head trauma, facial trauma, pneumothorax, intestinal obstruction, or any condition that results in a potential gas-filled space. NO₂ is contraindicated in pregnancy. NO₂ should always be delivered by patient self-administration. It is contraindicated in patients who are unable to hold the mask to their face.

Use in PSA. Nitrous oxide is a very useful agent in PSA. It has a rapid onset and offset and provides significant analgesia to many patients. Patients do not receive the same degree of analgesia, so the clinician must be aware that NO₂ alone may not be sufficient. NO₂ is not effective for procedures that require profound or prolonged analgesia. Using NO₂ as part of a balanced approach may be effective as long as the patient can self-administer and self-titrate the gas.

POSTPROCEDURE

In the postprocedure period, the potential for complications still exists, as the noxious portion of the procedure may be completed but the sedative agent remains active. Therefore, patients should be closely monitored until the effects of the agent wear off. If the patient is still in a deep state of sedation after the procedure, placing the patient on his or her left side may be helpful to minimize the potential risk of aspiration. Patients should be monitored continuously until their airway is stable, they are awake enough to follow voice commands, and their vital signs are stable at presedation baseline.

Patients should be sent home with discharge instructions regarding the sedation. Instructions should discuss the need to continue observation at home and to limit any activity requiring full alertness (eg, driving, swimming). Parents of pediatric patients should be instructed that only small meals should follow the procedure and that the child should be closely observed for the next 24 hours. Standardized preprinted instructions for all patients undergoing PSA can be very helpful at discharge. Table 5 contains examples of content to be considered in discharge instructions.

CONCLUSION

PSA is a well-accepted component of emergency medical practice and when done effectively allows for better care of both pediatric and adult patients undergoing painful or unpleasant procedures. Emergency physicians possess the training and experience for choosing the appropriate drug(s) and delivering sophisticated and safe PSA.

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