Objectives

Conscious Sedation is now typically used in procedures such as endoscopy, vasectomy, RSI (Rapid Sequence Intubation), or minor surgery and in dentistry for reconstructive surgery, some cosmetic surgeries, removal of wisdom teeth, or for high-anxiety patients. Sedation methods in dentistry include inhalation sedation (using nitrous oxide), oral sedation, and intravenous (IV) sedation. Inhalation sedation is also sometimes referred to as Relative Analgesia. Sedation is also used extensively in the intensive care unit so that patients who are being ventilated tolerate having an endotracheal tube in their trachea. At the end of this module the nurse will be able to:

1. Define conscious sedation
2. Define and or differentiate between the different levels of sedation
3. List the different uses of conscious sedation
4. State the perioperative care done with conscious sedation
5. Explain some of the risk factors associated with conscious sedation
Overview

The administration of pharmacologic agents via IV or other routes for the purpose of achieving moderate sedation requires mastery of complex nursing knowledge, advanced skills, and the ability to make independent nursing judgments during an unstable and unpredictable period for the patient.

Definition

Sedation is the act of calming by administration of a sedative. A sedative is a medication that commonly induces the nervous system to calm.

The American College of Emergency Physicians (ACEP) defines procedural sedation as "a technique of administering sedatives or dissociative agents with or without analgesics to induce a state that allows the patient to tolerate unpleasant procedures while maintaining cardiorespiratory function. Procedural sedation and analgesia (PSA) is intended to result in a depressed level of consciousness that allows the patient to maintain oxygenation and airway control independently." The number of non-invasive and minimally invasive procedures performed outside of the operating room has grown exponentially over the last several decades. Sedation, analgesia, or both may be needed for many of these interventional or diagnostic procedures. Medications that elicit pharmacologic effects, such as anxiolysis, amnesia, or analgesia, provide patient comfort during various procedures. Understanding the efficacy and safe administration of these agents is essential to the practitioner performing interventional procedures.

Sedation and analgesia introduces an independent risk factor for morbidity and mortality in addition to the procedure itself. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) recognizes the risks involved with sedation and analgesia for procedures and mandates that sedation practices throughout an institution be monitored and evaluated by the department of anesthesia. The American Society of Anesthesiologists (ASA) has responded to this challenging responsibility by developing practice guidelines for nonanesthesiologists who provide sedation and analgesia.

The information described in this module does NOT apply to the following types of patients:
Patients receiving inhaled anesthetics
Patients receiving analgesia for pain control without sedation
Patients receiving sedation to manage behavioral emergencies
Patients who are intubated

Conscious sedation for surgical procedures

Conscious sedation is a combination of medicines to help relax the patient (a sedative) and to block pain (an anesthetic) during a medical or dental procedure. The patient will probably stay awake but may not be able to speak. Conscious sedation allows the patient to recover quickly and return to everyday activities soon after the procedure.

Purpose
The process of sedation has two primary intentions. First, sedation is recommended to allow patients the ability to tolerate unpleasant diagnostic or surgical procedures and to relieve anxiety and discomfort. Second, sedation for uncooperative patients may expedite and simplify special procedures that require little or no movement. Additionally, sedation is often desirable to diminish fear associated with operative procedures. Sedation is typically used for common diagnostic tests that require prolonged immobilization such as magnetic resonance imaging (MRI) and computed axial tomography (CAT) scanning. Some cases that require sedation may also necessitate the use of analgesics to decrease pain associated with a procedure or test.

Precautions
The original forms of diazepam (Valium, a very common sedative) caused irritation of veins and phlebitis. Newer forms of diazepam (Dizac) are chemically improved to lower the possibility of vein irritation. Age and physical health are important risk factors. Preexisting medical conditions such as high blood pressure and heart and lung disease may increase the chance of developing undesirable side effects.
Benzodiazepines (common sedative medication) have a cumulative effect. This means that if the patient has not had time to metabolize the previous dose and ingests more, then the effect of the sedative may increase. Additionally, because of these additive effects, these medications taken
with other sedatives or alcohol (also a sedative hypnotic drug) may increase chances for accidental death. In general, most of the medications that induce sedation may alter breathing and cardiac stability. In patients with preexisting lung and/or heart disease, these medications should be monitored closely or not prescribed.

**Description**

The procedure for sedation is usually explained to the patient by an attending clinician. An IV access line is set in place for fluid replacement and injection of medications. A history is usually taken to assess risk and choice of medication. The patient typically signs consent forms and the possible side effects are explained. The day before the test, the patient may be required to maintain specified dietary restriction. For outpatient surgery there are two types of sedation, conscious and unconscious sedation. Patients receiving conscious sedation are capable of rational responses, and they are able to maintain their airway for ventilation. The hallmark of conscious sedation is that it does not alter respiratory, cardiac, or reflex functions (nerve reflexes from the brain) to the level that requires external support for these vital functions. Patients receiving conscious sedation are cooperative, have stable vital signs (pulse, respiratory rate, and temperature), shorter recovery room convalescence, and lower risk of developing drug-induced complications. Unconscious sedation is a controlled state of anesthesia, characterized by partial or complete loss of protective nerve reflexes, including the ability to independently breathe and respond to commands. The patient is unable to cooperate, has labile (fluctuating) vital signs, prolonged recovery room convalescence, and higher risk of anesthetic complications. Understanding the various depths of sedation is essential to provide safe and effective procedural sedation and analgesia. The ASA has defined the various sedation depths. As defined below, minimal sedation or moderate sedation is used for PSA.

**Minimal sedation (anxiolysis) is as follows:**
- Response to verbal stimulation is normal.
- Cognitive function and coordination may be impaired.
- Ventilatory and cardiovascular functions are unaffected.
Moderate sedation/analgesia (formerly called conscious sedation) is as follows:
- Depression of consciousness is drug-induced.
- Patient responds purposefully to verbal commands.
- Airway is patent, and spontaneous ventilation is adequate.
- Cardiovascular function is usually unaffected.

Deep sedation/analgesia is as follows:
- Depression of consciousness is drug-induced.
- Patient is not easily aroused but responds purposefully following repeated or painful stimulation.
- Independent maintenance of ventilatory function may be impaired.
- Patient may require assistance in maintaining a patent airway.
- Spontaneous ventilation may be inadequate.
- Cardiovascular function is usually maintained.

General anesthesia is as follows:
- Loss of consciousness is drug-induced, where the patient is not able to be aroused, even by painful stimulation.
- Patient's ability to maintain ventilatory function independently is impaired.
- Patient requires assistance to maintain patent airway, and positive pressure ventilation may be required because of depressed spontaneous ventilation or drug-induced depression of neuromuscular function.
- Cardiovascular function may be impaired.

Additionally, clinicians must recognize procedures performed outside of the operating room that may require monitored anesthesia care (MAC). Various drugs are available to provide procedural sedation; their pharmacodynamic descriptions are described below. A short-acting benzodiazepine (eg, midazolam), either alone or in combination with an opioid analgesic (eg, fentanyl, morphine), is commonly selected for procedural sedation. Combining use of a benzodiazepine and an opiate may be preferable for longer procedures but increases the risk of
oxygen desaturation and cardiorespiratory complications. Specific reversal agents for opiates (naloxone [Narcan]) and benzodiazepines (flumazenil [Mazicon]) must be readily available during the procedure.

Evidence to support the use of other sedatives (eg, etomidate, propofol, nitrous oxide) for procedural sedation is also emerging in the literature. Etomidate is gaining popularity because it elicits minimal hemodynamic effects and has a very reliable onset of action. Ketamine results in a dissociative state, and patients may not be able to speak or respond purposefully to verbal commands. Ketamine is typically not used in adults because of frequent association with emergence delirium; however, ketamine is used frequently in the pediatric population, where this effect is not typically observed. Another, more recent addition has been dexmedetomidine. This agent provides a level of sedation similar to previously mentioned agents but lacks both respiratory depression and major cardiac depression. Comparative trials comparing a mixture of ketamine and propofol, referred to as ketofol, have also been reported.

A review by Aboumarzouk et al analyzed use of nitrous oxide (NO) for analgesia and sedation during colonoscopy. The short half-life of NO allows a quicker recovery than most sedative/analgesics. The analysis included 7 studies (n=547). The authors concluded that NO was as effective as other sedatives with little pulmonary or cardiovascular risk compared with other sedative/analgesics, although further trials are necessary.

**Benzodiazepines**

Benzodiazepines elicit beneficial effects for PSA that include amnesia, anticonvulsant, anxiolysis, and sedation. Benzodiazepines potentiate gamma-aminobutyric acid (GABA) inhibitory action in the CNS by binding to benzodiazepine-specific receptors on the GABA_A-benzodiazepine receptor complex. Binding of this complex potentiates GABA-mediated chloride influx that results in sedation, amnesia, anxiolysis, and anticonvulsant effects and respiratory depression.

Midazolam (Versed) is the benzodiazepine most commonly used for PSA, since it produces a faster onset of sedation, more complete amnesia, less pain on injection, and improved awakening when compared with diazepam. Midazolam possesses a relatively high volume of distribution (V_d) compared with other benzodiazepines because of its lipophilicity. The V_d is greatly
amplified in obese patients, resulting in an increased half-life from 2.7 hours to 8.4 hours. Midazolam is cleared by hepatic hydroxylation to 1-hydroxymidazolam (elicits about 10% of the pharmacologic activity as parent compound). In comparison, diazepam has an extremely long half-life (0.8-2.25 d) that is markedly increased in obese or elderly patients (3.9 d and 3.29 d, respectively). Additionally, its active metabolites have long half-lives (i.e., N desmethyldiazepam [1.6-4.2 d]; nordiazepam [about 8 d]).

Lorazepam (Ativan) is another benzodiazepine that may be used for mild-to-moderate sedation; however, unlike midazolam, its onset of action does not peak until 15-20 minutes after administration. The duration of action of lorazepam is longer (i.e., 6-8 h) than that of midazolam (30-60 min). In addition, lorazepam has roughly double the potency of midazolam and lack of metabolite activity. Because of this, lorazepam is typically used for long-term sedation, such as in an ICU setting.

When combined with alcohol or opioids, the sedative and respiratory-depressant effects of benzodiazepines are greatly increased, as is the risk for cardiovascular depression.

**Opiates**

Opiates provide analgesia and sedation during painful procedures. Fentanyl is favored because of its prompt onset and short duration of action. Unlike morphine, fentanyl has minimal cardiovascular depressive effects and hypotension rarely occurs. Fentanyl binds with stereospecific receptors at many sites within the CNS and increases pain threshold, alters pain reception, and inhibits ascending pain pathways. In addition to analgesia, opioid agonists suppress the cough reflex and cause respiratory depression, drowsiness, and sedation. The half-life is 2-4 hours. Meperidine is typically not a first line agent for PSA due to active metabolites that can have neuro-excitatory effects and accumulate in those with poor renal clearance.

**Ketamine**

Ketamine (Ketalar) elicits profound dissociative and amnestic actions. In doses typically used for PSA it does not affect pharyngeal-laryngeal reflexes and, thus, allows a patent airway as well as spontaneous respiration to maintain intact. This characteristic of the medication is particularly useful for emergency procedures when fasting is not assured. It should be mentioned, though,
that reflexes may remain intact but cannot be assumed to be protective. Cardiovascular and respiratory stimulation and normal or slightly enhanced skeletal muscle tone are observed following administration, although transient respiratory depression may occur if administered too rapidly or in high doses. The unique dissociative action and partial agonism at opiate mu-receptors permits painful procedures to be performed in a consistent state of sedation and patient comfort. Ketamine is contraindicated in patients who have underlying conditions in which increased blood pressure would pose risk of complications. An increase in oropharyngeal secretions is often triggered and diligent patient monitoring for laryngospasms needs be employed.

Onset of action for intravenous (IV) administration of ketamine is within 1 minute, and duration of action lasts about 10-15 minutes. The context sensitive half-life after administration is roughly 45 minutes and it does have an active metabolite with approximately 1/3 the activity of the parent compound. If administered intramuscularly (IM), the onset of action is observed in 3-5 minutes, and duration of procedural conditions lasts about 20-30 minutes.

Ketamine results in a dissociative state, and patients may not be able to speak or respond purposefully to verbal commands. Ketamine is usually not recommended for use in adults because it frequently causes emergence delirium (i.e., vivid imagery, hallucinations, confusion, excitement, irrational behavior). Emergence reactions are estimated to occur in approximately 12% of patients. Strayer and Nelson have estimated emergence phenomena to occur in between 10% and 20% of adults who have received ketamine. Symptoms can be expected to last from 1-3 hours.

The incidence of emergence delirium may be reduced by decreasing the recommended dose of ketamine and using it in conjunction with a benzodiazepine. A small hypnotic dose of a short-acting barbiturate or benzodiazepine is recommended to terminate severe emergence reactions. Emergence delirium is not typical in children younger than 15 years or in elderly patients (i.e., >65 y). In a randomized controlled study of adult ED patients, Sener et al found that the incidence of recovery agitation was significantly reduced when midazolam was coadministered with ketamine for procedural sedation.
Krauss and Green have discussed ketamine's lack of a characteristic dose-response continuum by progressive titration, which is typical with other sedatives. At doses below a certain threshold, ketamine produces analgesia and sedation. However, once the critical dosage threshold of roughly 1–1.5 mg/kg IV (or 3–4 mg/kg IM) is reached, the characteristic dissociative state abruptly appears. Because of this, the dissociative state is not consistent with the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) definitions of moderate sedation, deep sedation, or general anesthesia; therefore, ketamine must be considered from a different perspective than drugs with the classical sedation continuum.

Data are emerging that a 1:1 mixture of ketamine with propofol can be used in adults for procedural sedation and analgesia. This mixture has been associated with a reduced incidence of emergence delirium and may negate the need for concomitant benzodiazepine use. In a prospective case series study of 728 adults presenting to a trauma center for orthopedic procedures, the median dose of ketamine and propofol was 0.7 mg/kg. Bag-mask ventilation occurred in 21%, and recovery agitation occurred in 3.6% (50% of these patients required treatment for agitation).

A double-blind, randomized trial compared ketamine (0.5 mg/kg) plus propofol with placebo plus propofol in 193 adults and children. Respiratory depression was similar between the groups. Treating physicians and nurses found less propofol was used when ketamine was administered, and there was trend toward better sedation quality.

A prospective trial comparing ketamine plus propofol (ketofol) to midazolam plus fentanyl (MF) was conducted in the emergency setting by Nejati et al. Patients (n=62) requiring procedural sedation and analgesia for deep traumatic lacerations and reduction of bone fractures were included. No significant differences were observed for sedation time or physician satisfaction between the groups. Pain was significantly lower in the ketofol group compared with the MF group (p < 0.001).

The use of ketamine and propofol is a potential alternative in adults requiring procedural sedation.
**Propofol**

Propofol (Diprivan) provides potent, ultra–short-acting sedation and anesthesia. It is a phenolic compound, and its mechanism of action is unknown, but it is thought to mediate GABA activity. Propofol has no analgesic properties. It is associated with rapid deepening of a sedation level to that of general anesthesia. Because of this, an anesthesiologist or sedation team often administers it and monitors its use outside the operating room.

Propofol is rapidly metabolized by the liver; though duration of action when continuous infusion is not used is related to redistribution away from its site of action - therefore renal and hepatic dysfunction typically do not affect its duration of action. Onset of action is very rapid with peak affect seen at 90 - 100 seconds. Duration of action is dose dependant and ranges from 5-10min after bolus administration. Propofol leads to a dose dependant decrease in arterial blood pressure and cardiac output. Therefore, it must be used with caution in those that may be hemodynamically unstable or reliant on sympathetic tone.

Increasing use of propofol for emergency department procedural sedation has been described. Hohl et al described propofol as slightly more cost-effective than midazolam because of shorter recovery times with propofol. A prospective study using propofol in a standard protocol in 113 patients in an emergency department concluded propofol as safe and effective for procedural sedation with high patient and physician satisfaction. Other studies have confirmed the safety of propofol in the emergency department setting. One randomized clinical trial indicated that, while ketamine and propofol are both safe and effective agents for procedural sedation in the ED, patients who received ketamine had higher rates of subclinical respiratory depression, higher rates of recovery agitation, and longer times to regain baseline mental status than patients who received propofol.

A consideration for the use of propofol is the relatively high rate of discomfort, including severe or excruciating pain, with injection. Propofol is known to cause injection site burning, stinging, and pain. Up to 28-90% of adults and 28-85% of children may experience this. There are many publications that have examined methods to reduce this and none of them are completely effective except the tourniquet method. The prescribing information describes that when a small vein in the hand is used in children to administer propofol, pain was frequently reported (45%).
Transient local pain can be minimized if the larger veins of the forearm or antecubital fossa are used.

A systematic review and meta-analysis in 2011 concluded that the incidence of discomfort could be significantly reduced by simple interventions such as selection of an antecubital vein for injection instead of a hand vein (relative risk [RR], 0.14; 95% confidence interval [CI], 0.07-0.30), pre-treatment with lidocaine in conjunction with venous occlusion (RR, 0.29; CI, 0.22-0.38), or the use of admixtures containing lidocaine (RR, 0.40; CI, 0.33-0.48) or ketamine (RR, 0.52; CI, 0.46-0.57).

**Etomidate**

Etomidate (Amidate) is an ultra–short-acting nonbarbiturate hypnotic used for anesthesia. It produces rapid induction without histamine release and with minimal cardiovascular and respiratory effects. As with ketamine or barbiturates, etomidate transiently lowers cerebral blood flow by 20-30% and slightly reduces intracranial and intraocular pressure. It has no analgesic properties. Onset of action is 5-30 seconds with peak action at 1 minute. Etomidate has a duration of 2-10 minutes depending on the dose. The major adverse effect is transient adrenal suppression secondary to inhibition of 11-ß-hydroxylase and 17-alpha-hydroxylase enzymes which are important in cortisol synthesis. There is also a high incidence of pain on injection and nausea and vomiting associated with bolus administration.

**Dexmedetomidine**

Dexmedetomidine (Precedex) is utilized for procedural sedation in paediatric and adult patients. It is an alpha2-adrenergic agonist that provides sedation, anxiolysis, hypnosis, analgesia, and sympatholysis. Clonidine, another alpha2 agonist, has been shown to decrease anesthetic requirements and thus prompted the study and creation of this drug. Thus far the FDA has only approved its use for short-term mechanically ventilated adults in the ICU, but it is currently being used off-label in many settings outside the ICU.

Dexmedetomidine has several characteristics that make its use for procedural sedation very appealing. First, it provides little to no respiratory depression. Also, patients are able to follow commands and respond to verbal and tactile stimulus but fall quickly asleep when not stimulated.
It does provide some pain relief, like ketamine, but not to the same degree. This makes the use of other analgesics necessary for the more painful procedures. Minimal cardiovascular effects are seen and include mild bradycardia and a decrease in systemic vascular resistance.

Onset of action is relatively rapid and the context-sensitive half-time is approximately 4 minutes after a 10-minute infusion. Dexmedetomidine is 1600 times more selective for alpha2 than alpha1 receptors and therefore has very few side effects and provides predictable results.

The acceptance and use of this agent in many settings is growing rapidly and its role in PSA is expected to expand as more studies review its reliability and safety.

**History and physical examination**

**Question the patient or caregiver regarding the following:**

- Abnormalities of major organ systems
- History of adverse events with sedation or analgesia, or regional or general anesthesia
- Drug allergies
- Current medications or herbal products
- Description and time of last oral intake (for elective procedures, should be fasting)
- Tobacco, alcohol, or substance abuse
- Vital signs
- Heart and lung assessment
- Airway

**Equipment and supplies**

- Note the following equipment and supplies:
  - Oxygen
  - Suction
  - Airway management equipment
  - Reversal agents for opioids or benzodiazepines (eg, naloxone, flumazenil)
  - Resuscitation medications and equipment
Intravenous access (when intravenous sedation is administered and anytime more than very light sedation is planned)

**Monitoring**

Practitioners must be skilled in providing procedural sedation, must be proficient in airway management and cardiovascular support, and must possess the skills required to rescue a patient from sedation deeper than intended. Continually evaluating and monitoring respiratory and circulatory requirements prior to, during, and following the procedure is essential. One analysis describes emergency department physicians' knowledge of procedural sedation. Additionally, the JCAHO requires practitioners to be competent in managing reversal of sedation from one level deeper than anticipated. Note the following:

- Monitor vital signs before, during, and after the procedure.
- ECG monitoring should be continuous for high-risk patients, during prolonged procedures, or during deep sedation.
- Consider continuous pulse oximetry for patients with comorbidities (eg, chronic obstructive pulmonary disease [COPD], asthma, congestive heart failure) or when high doses of sedatives or multiple drugs that may depress respirations are used.
- Observe the patient's appearance.
- Monitor airway patency.
- Monitor response to physical stimuli and verbal command.
- Measurement of blood gas level may be required.
- Consider capnography for high-risk patients. According to a 2010 randomized controlled trial of 132 adult patients receiving propofol sedation in the ED, adding capnography to standard monitoring resulted in a decrease in hypoxia and identified all hypoxic events before onset.

**Monitored Anesthesia Care (MAC)**

Following is the ASA position on monitored anesthesia care (approved by the House of Delegates October 21, 1986, and last amended October 25, 2005; 2). ASA Guidelines for sedation and analgesia by non-anesthesiologists recommend monitoring of

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patient’s oxygenation, ventilation and circulation. Electrocardiograph monitoring should be used during moderate sedation in patients with significant cardiovascular disease or for patients undergoing procedures where dysrhythmias are anticipated. Electrocardiograph monitoring is also recommended for all patients undergoing deep sedation. For all patients receiving deep sedation and those whose ventilation cannot be observed directly during moderate sedation, exhaled carbon dioxide capnography should be monitored. Other monitors recommended for both moderate and deep sedation include continuous pulse oximetry, observation and/or auscultation of ventilation at regular intervals, and blood pressure measurements every 5 minutes. Level of consciousness should be assessed at regular intervals throughout the sedation process. Verbal stimuli should be used for moderate sedation, with more profound stimuli used for deep sedation.

Moderate sedation/analgesia is the most common target level of sedation used in the outpatient/ambulatory setting. *Pain: Clinical Manual* states that optimal moderate sedation is achieved when the patient:

- Maintains consciousness
- Independently maintains airway
- Retains protective reflexes (swallow and gag)
- Responds to verbal and physical commands
- Is not anxious or afraid
- Experiences acceptable pain control
- Has a minimal change in vital signs
- Remains cooperative during the procedure
- Has mild amnesia for the procedure
- Recovers to baseline (pre-procedure) status safely and promptly.

Several sedation scales and scoring systems have been developed to describe the level of consciousness. The Modified Observer’s Assessment of Alertness and Sedation, and to a lesser degree, the Ramsey Scale, is currently used most often in clinical research. However, these are not interchangeable with the ASA Definitions of Levels of Sedation, as they do not take into account cardiorespiratory status and there is some subjectivity as to what MOAA/S levels
constitute moderate or deep sedation. It is important that there is a uniform assessment and subsequent assignment of a sedation scale score.

ASA Definitions of General Anesthesia and Levels of Sedation/Analgesia (1)

<table>
<thead>
<tr>
<th></th>
<th>Minimal Sedation (Anxiolysis)</th>
<th>Moderate Sedation/Analgesia (Conscious Sedation)</th>
<th>Deep Sedation/Analgesia</th>
<th>General Anesthesia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Responsiveness</strong></td>
<td>Normal Response to Verbal Stimulation</td>
<td>Purposeful* response to verbal or tactile stimulation</td>
<td>Purposeful response after repeated or painful stimulation</td>
<td>Unarousable, even w/painful stimulus</td>
</tr>
<tr>
<td><strong>Airway</strong></td>
<td>Unaffected</td>
<td>No intervention required</td>
<td>Intervention may be required</td>
<td>Intervention often required</td>
</tr>
<tr>
<td><strong>Spontaneous Ventilation</strong></td>
<td>Unaffected</td>
<td>Adequate</td>
<td>May be inadequate</td>
<td>Frequently inadequate</td>
</tr>
<tr>
<td><strong>Cardiovascular Function</strong></td>
<td>Unaffected</td>
<td>Usually maintained</td>
<td>Usually maintained</td>
<td>May be impaired</td>
</tr>
</tbody>
</table>

* Reflex withdrawal from a painful stimulus is NOT considered a purposeful response.

Modified Observer’s Assessment of Alertness/Sedation Scale (2)

<table>
<thead>
<tr>
<th>Responsiveness</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agitated</td>
<td>6</td>
</tr>
<tr>
<td>Responds readily to name spoken in normal tone (alert)</td>
<td>5</td>
</tr>
<tr>
<td>Lethargic response to name spoken in normal tone</td>
<td>4</td>
</tr>
<tr>
<td>Responds only after name is called loudly and/or repeatedly</td>
<td>3</td>
</tr>
<tr>
<td>Responds only after mild prodding or shaking</td>
<td>2</td>
</tr>
<tr>
<td>Does not respond to mild prodding or shaking</td>
<td>1</td>
</tr>
<tr>
<td>Ramsey Sedation Scale (4)</td>
<td>Score</td>
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<tr>
<td></td>
<td>1</td>
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<td>4</td>
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<td></td>
<td>5</td>
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<td>6</td>
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</tbody>
</table>

**Table 1 Commonly Used Drugs for Procedural Sedation and Analgesia in Adults**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Adult Dose</th>
<th>Onset of Action</th>
<th>Duration of Action*</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midazolam (Versed)</td>
<td>0.02-0.1 mg/kg IV initially; if further sedation is required, may repeat with 25% of initial dose after 3-5 min; not to exceed 2.5 mg/dose (1.5 mg for elderly persons) and 5 mg cumulative dose (3.5 mg for elderly persons)</td>
<td>1-2 min</td>
<td>30-60 min</td>
<td>Respiratory depression or hypotension may occur, particularly when rapidly administered or combined with fentanyl (may need to decrease midazolam dose); does not provide analgesia; action reversed by flumazenil</td>
</tr>
<tr>
<td>Sedative/Analgesic</td>
<td>Dose</td>
<td>Onset</td>
<td>Duration</td>
<td>Adverse Effects</td>
</tr>
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<td>--------------------</td>
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</tr>
<tr>
<td>Fentanyl</td>
<td>1-2 mcg/kg slow IV push (over 1-2 min); may repeat dose after 30 min</td>
<td>1-2 min</td>
<td>30-60 min</td>
<td>May cause chest wall rigidity, apnea, respiratory depression, or hypotension; elicits minimal cardiovascular depression; may cause dysphoria, nausea, vomiting, or EEG changes; action reversed by naloxone</td>
</tr>
<tr>
<td>Etomidate (Amidate)</td>
<td>0.1-0.2 mg/kg slow IV push over 30-60 sec</td>
<td>&lt; 1 min</td>
<td>3-5 min</td>
<td>Commonly causes myoclonus, pain upon injection, adrenal suppression (typically no clinical significance unless repeated doses are used within a limited time span); may cause nausea, vomiting, and lower seizure threshold; does not alter hemodynamics; causes a slight to moderate decrease in intracranial pressure that only lasts for several minutes; does not cause histamine release; useful for patients with trauma and hypotension</td>
</tr>
<tr>
<td>Propofol (Diprivan)</td>
<td>0.5-1 mg/kg IV loading dose; may repeat by 0.5-mg increments q3-5min</td>
<td>&lt; 1 min</td>
<td>3-10 min</td>
<td>Provides rapid onset and recovery phase, and brief duration of action; has anticonvulsant properties; can rapidly cause deepening sedation; causes cardiovascular depression and hypotension</td>
</tr>
</tbody>
</table>

*Duration of action based on normal drug elimination (i.e., nonelderly adult with normal renal and hepatic function)*

The selection of sedative and analgesic agents differs slightly when these agents are used in children. Benzodiazepines, chloral hydrate, and barbiturates have been used for decades to provide sedation for pediatric procedures. Propofol is also beginning to be used outside the operating room to induce anesthesia for pediatric procedures (mostly by pediatric
anesthesiologists or a sedation team). Data suggest greater variability in children younger than 1 year for the loading dose, whereas more variability is seen with the maintenance dose in children older than 7 years.

Data are limited for the use of etomidate for procedural sedation in children. A review by den Brinker et al summarizes the information currently available. The potential for etomidate to inhibit cortisol production may make its use in children limited.

None of the aforementioned sedative agents provide analgesia. For painful procedures, an opioid analgesic (eg, fentanyl) is required; ketamine, which provides sedation and analgesia, may be considered instead.

Midazolam is the most commonly prescribed benzodiazepine for pediatrics and can be administered via various routes (eg, oral, intranasal, rectal, intramuscular, intravenous). It provides excellent amnesia and anxiolytic effect. Chloral hydrate has been used for routine sedation for many years; however, the development of safer and more effective agents have largely replaced it. Barbiturates may be considered for procedures requiring immobilization.

A prospective, nonblinded, interventional trial by Saunders et al investigated the use of intranasal fentanyl as analgesia for painful orthopedic injuries among children aged 3-18 years. The trial determined that intranasal fentanyl at 2 μg/kg was effective in alleviating pain caused by orthopedic trauma in pediatric patients within 10 minutes of administration.

Leroy et al state that procedural sedation for children should only be provided by well-trained and credentialed professionals and that professionals with the needed expertise are available at all times. Ideally, procedural sedation should be performed in the fasted state, but this is not always possible in an emergency setting. A survey of Canadian pediatric emergency physicians by Bhatt et al suggest that fasting guidelines are not strictly adhered to in Canadian pediatric emergency departments. Additionally, the survey found some willingness of physicians to change their sedation practice in light of evidence from hypothetical surveillance data about risks. Years in practice affected the decision, with those in practice for 6-10 years more likely to perform immediate procedural sedation and analgesia than those in practice for shorter or longer.

The Consensus Panel on Sedation Research of Pediatric Emergency Research Canada (PERC) and the Pediatric Emergency Care Applied Research Network (PECARN) have published
recommendations for standardizing terminology and reporting adverse events involving procedural sedation and analgesia in children. These recommendations will also help guide monitoring and quality assurance of pediatric procedural sedation in emergency departments.

Table 2 Commonly Used Drugs for Procedural Sedation and Analgesia in Pediatric Patients

<table>
<thead>
<tr>
<th>Drug</th>
<th>Pediatric Dose</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midazolam</td>
<td>Intravenous: 0.05-0.1 mg/kg IV 3 min before procedure; not to exceed a total cumulative dose of 0.4 mg/kg or 6 mg</td>
<td>Reduce dose by 30-50% if combined with opioid analgesic (eg, fentanyl); younger children (i.e., &lt; 5 y) may require higher doses up to 0.6 mg/kg/dose</td>
</tr>
<tr>
<td></td>
<td>Intramuscular: 0.1-0.2 mg/kg IM 30-45 min before procedure</td>
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</tr>
<tr>
<td></td>
<td>Oral: 0.25-0.5 mg/kg PO 30-45 min before procedure</td>
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<tr>
<td></td>
<td>Intranasal: 0.2-0.6 mg/kg/dose inhaled intranasally 10 min before procedure</td>
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<tr>
<td></td>
<td>Rectal: 0.3-0.5 mg/kg/dose PR 30-45 min before procedure</td>
<td></td>
</tr>
<tr>
<td>Pentobarbital</td>
<td>Intravenous: 1-2 mg/kg/dose IV; if needed</td>
<td>Short-acting barbiturate that provides excellent hypnosis and is particularly useful for procedures</td>
</tr>
<tr>
<td>Drug</td>
<td>Administration</td>
<td>Dosage</td>
</tr>
<tr>
<td>------</td>
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<td>--------</td>
</tr>
<tr>
<td>Methohexital</td>
<td>Intramuscular: 1-6 mg/kg IM; not to exceed 100 mg/dose</td>
<td>Oral: 4-6 mg/kg PO; not to exceed 100 mg/dose</td>
</tr>
<tr>
<td></td>
<td>25 mg/kg/dose PR 15 min before procedure; not to exceed 500 mg/dose</td>
<td></td>
</tr>
<tr>
<td>Fentanyl</td>
<td>Intravenous: 1-2 mg/kg loading dose IV; 0.25-1 mg/kg IV q10-15min; administer slowly, not to exceed 0.5 mg/kg/min</td>
<td>Intramuscular: 2-5 mg/kg/dose IM</td>
</tr>
<tr>
<td></td>
<td>Oral: 6-10 mg/kg/dose PO mixed in cola or other beverage 30 min before procedure</td>
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</tr>
<tr>
<td>Ketamine</td>
<td></td>
<td></td>
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</tbody>
</table>
Propofol

| Data limited: 1-1.5 mg/kg IV loading dose; 0.25-0.5 mg/kg IV q3-5min or 50-150 mcg/kg/min continuous IV infusion |
| Provides rapid anesthesia; apnea occurs upon induction and unpredictably causes loss of airway reflexes (even at sedative doses); irritation and burning with IV administration; effect NOT reversible |

Chloral hydrate

| 25-75 mg/kg/dose PO/PR; not to exceed 1 g/dose (infants) or 2 g/dose (children); administer 30 min before procedure |
| No longer recommended, see comments |
| No longer recommended since much safer and more effective alternatives exist; unpredictable effect; paradoxical hyperactivity may occur; may cause nausea and vomiting; decrease dose if combined with opioid analgesic (eg, fentanyl); deaths and permanent neurologic injury from respiratory compromise have been reported, particularly in those with risk factors (eg, ASA class III, Leigh encephalopathy, tonsillar and adenoidal hypertrophy, obstructive sleep apnea); active metabolite has prolonged half-life |

### Reversal agents

Drug dosages for sedation and analgesia are highly variable, and other factors such as concurrent medications, medical conditions, and age contribute to this variability. Drugs for mild-to-moderate sedation should only be used in settings that provide for continuous monitoring of respiratory and cardiac function. Availability of resuscitative drugs, equipment, and health care personnel experienced with the use of these drugs must be guaranteed. Reversal agents for opioids (i.e., naloxone) and benzodiazepines (i.e., flumazenil) must also be available.

### Table 3 Commonly Used Reversal Agents

<table>
<thead>
<tr>
<th>Reversal Agent</th>
<th>Indication</th>
<th>Adult Dose</th>
<th>Pediatric Dose</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naloxone (Narcan)</td>
<td>Reverses opioid agonists</td>
<td>Postanesthetic or opioid dependent: 0.1-0.2 mg/kg IV; 0.005-0.01 mg/kg IV/IM;</td>
<td>Onset of action for IV is 1-3 min vs 10-15 min for IM;</td>
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<td></td>
<td>Opioid overdose: 0.4-2 mg IV; may repeat q2-3min prn</td>
<td>may repeat q2-3min prn</td>
<td>rebound sedation may occur; if used in patient with chronic opioid use, will precipitate acute withdrawal and abrupt sympathetic discharge possibly leading to acute pulmonary edema</td>
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<tr>
<td>Flumazenil</td>
<td>Partial antagonism (for sedation reversal): 0.1-0.2 mg IV infused over 15 sec; may repeat after 45 sec and then every min; not to exceed total cumulative dose of 1 mg</td>
<td>0.01 mg/kg/dose IV infused over 15 sec; not to exceed 0.2 mg/dose; may repeat every min; not to exceed total cumulative dose of 0.05 mg/kg or 1 mg (whichever is lower)</td>
<td>Rebound sedation may occur; if used in patient with chronic BZP use, will precipitate acute withdrawal; may precipitate seizures unresponsive to BZPs</td>
<td></td>
</tr>
<tr>
<td>(Mazicon)</td>
<td>Complete antagonism (for overdose): 0.2 mg IV infused over 30 sec; may repeat with additional doses of 0.5 mg over 30 sec at 1-min intervals; not to exceed a total cumulative dose of 3 mg</td>
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</tbody>
</table>

Flumazenil (Mazicon) Reverses benzodiazepines

Partial antagonism (for sedation reversal): 0.1-0.2 mg IV infused over 15 sec; may repeat after 45 sec and then every min; not to exceed total cumulative dose of 1 mg

Complete antagonism (for overdose): 0.2 mg IV infused over 30 sec; may repeat with additional doses of 0.5 mg over 30 sec at 1-min intervals; not to exceed a total cumulative dose of 3 mg

Opiate intoxication: 0.01-0.1 mg/kg dose IV/IM; may repeat every min; not to exceed 2 mg/dose

Rebound sedation may occur; if used in patient with chronic opioid use, will precipitate acute withdrawal and abrupt sympathetic discharge possibly leading to acute pulmonary edema
Conclusion

The future of anesthetic care involves the simultaneous administration of several drugs including IV medications and inhaled anesthetics. An extensive survey of death in 100,000 cases published in 1988 revealed that death within seven days was 2.9 times greater when one or two anesthetic drugs were used than when using three or more medications. As of 2000 this study is accepted as standard practice and multiple IV anesthetics are the preferable recommendation for optimal patient care. The American College of Emergency Physicians (ACEP) defines procedural sedation as "a technique of administering sedatives or dissociative agents with or without analgesics to induce a state that allows the patient to tolerate unpleasant procedures while maintaining cardiorespiratory function. Procedural sedation and analgesia (PSA) is intended to result in a depressed level of consciousness that allows the patient to maintain oxygenation and airway control independently." The number of non-invasive and minimally invasive procedures performed outside of the operating room has grown exponentially over the last several decades. Sedation, analgesia, or both may be needed for many of these interventional or diagnostic procedures. Medications that elicit pharmacologic effects, such as anxiolysis, amnesia, or analgesia, provide patient comfort during various procedures. Understanding the efficacy and safe administration of these agents is essential to the practitioner performing interventional procedures.

Sedation and analgesia introduces an independent risk factor for morbidity and mortality in addition to the procedure itself. The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) recognizes the risks involved with sedation and analgesia for procedures and mandates that sedation practices throughout an institution be monitored and evaluated by the department of anesthesia. The American Society of Anaesthesiologists (ASA) has responded to this challenging responsibility by developing practice guidelines for nonanesthesiologists that provide sedation and analgesia.
References


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