

# Current Concepts in Conscious Sedation

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## ABSTRACT

Conscious sedation (CS) is a rapidly changing field in emergency care. As new drugs breach the boundaries of anesthesia in the Emergency Department, physicians are finding new and more satisfactory methods of sedating patients. Short-acting and rapid-onset agents with minimal residual effects and better safety profiles are replacing the older drugs. This chapter discusses the warning signs and medical history that are particularly pertinent to conscious sedation and the drugs used. The needed equipment is also outlined to provide a basis for instituting safe sedation practices. It is important for practitioners to familiarize themselves with the most useful CS drugs, rather than the gamut of sedatives. Those agents most relevant to conscious sedation in the emergency department are presented here.

I have lanced many boils, but none pained like my own.

- Indian Proverb

The art of medicine consists in amusing the patient while nature cures the disease.

-Voltaire (1694-1778)

## INTRODUCTION

*Conscious sedation* (CS) is a controlled, drug-induced state that decreases the patient’s awareness to the environment and pain, allowing them to tolerate painful and anxiety-provoking procedures. *Analgesia* is a loss of sensation to painful stimuli and, by definition, has no effect on the sensorium. Most of the drugs used for analgesia, however, decrease a patient’s cognitive capabilities. *Anxiolysis* is a disruption of anxiety or apprehension without a decrease in the level of consciousness. *Dissociative anesthesia* refers to the changes in the electroencephalograph (EEG), which demonstrate disruption of the limbic and corticothalamic systems. This dissociative state results in amnesia, analgesia, and sedation with maintenance of muscle tone. *Sedation* encompasses a scope of different levels of consciousness ranging from light to deep sedation to general anesthesia. Table 1 outlines the varying levels of sedation.<sup>1</sup>

## INDICATIONS

Sedation has many uses in the ED setting. Pain associated with procedures, and anxiety associated with diagnostic imaging can effectively be managed with sedation and analgesia. Table 2 outlines common indications for CS in the ED. Though clinical judgment should always predominate, what may seem like a “minor” or relatively painless procedure can be quite traumatic

**Table 1: Definitions of levels of sedation**

- 1. Minimal sedation**  
Patient responds to verbal commands  
Cognitive function may be impaired  
Respiratory and cardiovascular systems unaffected
- 2. Moderate sedation and analgesia (Conscious sedation)**  
Patient responds to verbal commands, may not respond to light tactile stimulus  
Cognitive function is impaired  
Ventilation usually adequate, cardiovascular unaffected
- 3. Deep sedation and analgesia**  
Patient cannot be easily aroused without repeated or painful stimuli  
Ability to maintain airway may be impaired  
Spontaneous ventilation may be inadequate, cardiovascular function maintained
- 4. General anesthesia**  
Loss of consciousness, patient cannot be aroused even with painful stimuli  
Adequate airway usually cannot be maintained and ventilation is impaired  
Cardiovascular function may be impaired

**Table 2 : Examples of common indication for conscious sedation**

- Endoscopy
- Wound dressing changes
- Burn care
- Orthopedic manipulation
- Laceration repair
- Suture removal
- Lumbar puncture
- Chest tube
- Fecal impaction removal
- Eye injuries
- Central line placement
- Forensic exams in cases of childhood sexual assault cases
- Abscess incision and drainage

**Table 3 : American Society of Anesthesiologist's Physical Status Classification**

Class	Description
I	Normal, healthy
II	Mild systemic disease (asthma, controlled diabetes)
III	Moderate systemic disease, limits activity (stable angina, COPD, uncontrolled diabetes)
IV	Severe systemic disease, constant threat to life (unstable angina, diabetic ketoacidosis)
V	Moribund, not expected to survive >24 hours

for the patient. Sedation and analgesia should be offered to all patients undergoing a painful or unpleasant procedure. Satisfaction increases for both the patient and the physician.

### PATIENT PREPARATION

Choosing the appropriate patient to undergo sedation is just as important as choosing the agent itself. Sedation in the emergency room is not safe for all patients and it must be determined if the patient's procedure would be better handled in the operating room under the care of an anesthesiologist. Patients with severe systemic disease or life-threatening conditions are not always appropriate candidates for CS in the ED. Table 3 outlines the American Society of Anesthesiologists Patient Status Classification used for CS. Only Classes I and II are considered appropriate for CS and patients classified as a Class III may be candidates after consultation with an anesthesiologist.<sup>2</sup>

A thorough patient assessment is crucial before any procedure. Table 4 outlines key aspects of the medical history, which should be addressed prior to offering CS. Preparing the patient for the procedure and CS begins with a full detailed explanation of both the procedure and the drugs, including risks, benefits, and potential side effects can be expected. Patients need to be forewarned that they will be in no condition to drive themselves home after sedation. Furthermore, an informed consent for the procedure *and* the CS needs to be signed by the patient.

Vascular access should be obtained in most patients. Not only is intravenous (IV) administration the preferred route of CS but it allows for rapid delivery of resuscitative drugs, including reversal agents, and ease of titration. The oral route is used

**Table 4 : Key components of history to ask a patient prior to conscious sedation**

#### Past medical history:

Major illnesses—Asthma, COPD, psychiatric disorders, known cardiovascular disease, myocardial infarction, hepatic or renal impairment, diabetes, or porphyrias.

*Severe systemic disease may prohibit using PSA in certain patients.*

*Drugs with certain side effects are not suitable for some patients, such as ketamine in patients with psychiatric disorders.*

#### Allergies:

Opiates, benzodiazepines, barbiturates, local anesthetics, or others.

*An allergy to one class of opiates does not generally confer cross-allergy to other classes of opiates.*

#### Current medications:

Cardiovascular medications, CNS depressants

*May alter vital signs, volume status, or resuscitative measures. Careful in chronic benzodiazepine and opiate users—administration of reversal agents may induce withdrawal or seizures.*

#### Drug use:

Narcotics (including heroin), benzodiazepines, barbiturates, cocaine, and alcohol.

*May make the more experienced patient more tolerant of standard doses of sedatives and analgesics compared to the naive patient.*

#### Last oral intake:

For non-emergent cases, the guidelines recommend >6 hours for solid food and >2 hours for clear liquid.

#### Anesthetic history:

Any complications or adverse reactions

#### Volume status:

Vomiting, diarrhea, fluid restriction, urine output, making tears (pediatrics).

#### Events leading up to the presentation:

Chief complaint and history of present illness.

**Table 5 : Equipment for conscious sedation**

- High flow oxygen source and delivery device
- Suction and large bore catheters
- Vascular access materials
- Airway management supplies: endotracheal tubes, bag valve masks, and laryngoscopes.
- Pulse oximetry, blood pressure device, electrocardiography, capnography
- Resuscitation drugs, including intravenous fluids
- Reversal agents, including flumazenil and naloxone

occasionally for CS, but the potential risk of vomiting and aspiration may make this a less desirable choice. The criteria for patient discharge following CS are straightforward, and crucial to ensure patient safety. Patients should have stable vital signs, without any evidence of hypotension or hypoxia. They should be fully alert with a return to a level of orientation similar to their pre-procedural state.<sup>3,4</sup> Table 5 outlines essential equipment for CS.<sup>5,6</sup>

**Table 6 : Drugs used in conscious sedation**

<b>Analgesics</b>	<b>Dose*</b>		<b>Peak</b>	<b>Duration</b>
<i>Opiates</i>				
Morphine	Pediatric	0.1-0.2 mg/kg IV	15 min	2-4 hours
	Adult	0.1-0.15 mg/kg IV	15min	4-6 hours
Fentanyl	Pediatric	1-2 mcg/kg IV	10 min	30-60 min
	Adult	1-2 mcg/kg IV	10 min	60 min
<b>Sedatives</b>				
<i>Benzodiazepines</i>				
Midazolam	Pediatric	0.02-0.1mg/kg IV	5 min	1-2 hours
	Adult	2.5-5 mg total IV	5 min	1-2 hours
<i>Barbiturates</i>				
Pentobarbital	Pediatric	2-5 mg/kg PR (max 150 mg)	15-60 min	1-3 hours
		1-3 mg/kg IV (max 150 mg)	1 min	15 min
<i>Hypnotics</i>				
Propofol	Pediatric	0.5-3 mg/kg IV, then 25-150 mcg/kg/min IV	6-7 min	5-10 min
	Adult	0.5-1.5 mg/kg IV, then 25-100 mcg/kg/min IV	6-7 min	5-10 min
Etomidate	Pediatric	0.1-0.2 mg/kg IV	30 sec	5-10 min
	Adult	0.1-0.2 mg/kg IV	30 sec	5-10 min
<b>Dissociative</b>				
Ketamine	Pediatric	1-2 mg/kg IV	5 min	30-60 min
		3-5 mg/kg IM	10 min	1-2 hours
	Adult	1-2 mg/kg IV	5 min	30-60 min
<i>Adjuvants for ketamine</i>				
Atropine	Pediatric	0.01 mg/kg IM/IV, max 0.4 mg		
	Adult	0.5 mg dose		
Midazolam		0.05 mg/kg IV		
<b>Inhaled</b>				
Nitrous Oxide	Pediatric	30-50% N <sub>2</sub> O, mixed with O <sub>2</sub>	3-5 min	5-10 min
	Adult	50% N <sub>2</sub> O and 50% O <sub>2</sub>	1-2 min	5-10 min

\*Titrate dose to effect

## PHARMACOLOGY OF CS

### Conscious sedation

There is a great concern for the use of appropriate, and effective agents used in the ED. This article reviews the literature for up-to-date developments in CS, discussing those agents with a proven track record in clinical practice. CS must be carefully tailored for each patient. Overzealous administration may result in deep sedation or general anesthesia with depression of ventilation and hypoxia. Sedating agents should be given in small initial doses with subsequent titration to effect. Patient responsiveness and vital signs to include pulse oximetry should be assessed during CS induction and throughout the course of the sedation.<sup>7</sup> Table 6 outlines the drugs and dosages for pediatric and adult patients.

### Local anesthetics

Although a thorough explanation of local anesthetic drugs and techniques is beyond the scope of this publication, a quick note about their usefulness with CS is warranted. The benefits of local infiltration are numerous and they can be a powerful adjuvant.

Local anesthetics can make the patient completely unaware of pain and decrease the need for systemic analgesia, increasing the safety potential. Long-acting anesthetics, such as bupivacaine, afford the patient prolonged pain relief after the procedure.

### Opioids

The most widely used analgesics for CS are the opioids- see centrally acting analgesics. Their significant effect on pain and concomitant sedative properties lead to a higher rate of utilization for most painful procedures. Morphine is a naturally occurring opioid and is considered the prototypical opioid. Morphine is a good choice for CS due to its analgesia and associated sense of euphoria, and sedation. Morphine has a relatively long half-life making it more helpful if pain is anticipated after the procedure. Side effects associated with opioids include nausea, feeling of warmth, heaviness of extremities, dry mouth, and pruritus, especially of the face and nose. Exaggerated effects can also be seen in patients taking monoamine oxidase inhibitors. The most profound effects on hemodynamics come from the release of histamine. The resultant hypotension may be blunted

with administration of fluids in patients who may be slightly hypovolemic, with special consideration in the elderly. Hypoxia is the side effect of most concern; as with all opioids, morphine causes a dose-dependent depression of ventilation.<sup>8</sup>

Fentanyl is a synthetic opioid agonist with a rapid onset and short duration of action, making it an excellent choice for CS. Fentanyl is 100 times as potent as morphine and has a wide therapeutic window. Other desirable attributes include a lack of direct myocardial depressant effects and absence of histamine release. Like morphine, the major concern with fentanyl is the ventilatory depression. Caution must be exercised when administering fentanyl because of its association with rigidity of the chest wall following rapid, large boluses (>15 mcg/kg). Treatment of the rigid chest wall phenomena requires pharmacological paralysis and mechanical ventilation. Fentanyl should be titrated in 0.5 mcg/kg increments until the desired level of sedation is achieved.<sup>9</sup>

Meperidine has grown out of favor in the past years. It has a shorter half-life than morphine, but fentanyl is preferred for a short-acting opioid. Meperidine has less predictable sedative properties compared to morphine and fentanyl. The metabolites of meperidine are toxic to the central nervous system at high doses and in patients with renal impairment. Side effects of meperidine include a greater histamine release than seen with morphine, hypotension, and seizures.<sup>8</sup> The CNS excitation associated with meperidine is not reversed by naloxone. Fatal reactions have also occurred in patients taking monoamine oxidase (MAO) inhibitors. Meperidine is not recommended for CS.

### Barbiturates

The class of barbiturates is becoming less popular for CS as new sedatives and hypnotics make their way into the ED. Barbiturates primarily work on the CNS by depressing the reticular activating system. As there is no analgesic activity they are best used in combination with narcotics. Pentobarbital is an ultra-short acting barbiturate, which has utility for sedation prior to diagnostic imaging procedures in children. It can be given intravenously or rectally, but the rectal route has proven to be safe and well tolerated and is therefore preferred for this purpose. Continuous monitoring is still needed, however, especially if the patient leaves the ED for the procedure. Side effects can include ventilatory depression, decreased blood pressure, and increased heart rate.<sup>10,11</sup>

### Benzodiazepines

Benzodiazepines are preferred agents because of their desirable profiles. The anterograde amnesia they induce impairs the patient's ability to acquire and encode new information, such as that of a traumatic procedure. Rapid, large boluses, especially in the presence of opioids can cause transient apnea. Midazolam has become the benzodiazepine of choice for CS. It has a rapid onset and short duration of action and limited side effects. Anterograde amnesia can be a desired side effect, but care must be taken when discharging patients. Discharge instructions to the patient may not be remembered when they get home; be sure to write them down or tell their companion. Midazolam is approved for many routes, including oral and nasal. In inadequate doses, midazolam can cause agitation rather than sedation, making the patient less

cooperative. In chronic alcohol users without cirrhosis, larger doses of midazolam may be required to achieve the desired effect.<sup>12,13</sup>

### Ketamine

Ketamine is a phencyclidine ("PCP") derivative and is classified as a *dissociative anesthetic* due to the disruption of cerebral association pathways it causes. Ketamine is ideal because it has analgesic, amnesic, and sedative properties without a loss of protective reflexes. Patients given ketamine often look as if they are in a cataleptic state—their eyes remain open and there is a slow nystagmic gaze. Ketamine also induces salivary secretions, which can induce cough and laryngospasm. Because of these effects, Atropine is commonly given with Ketamine in children less than 5 years of age. Ketamine does not, however, produce any appreciable depression of ventilation, though this is not with certainty. If given as a rapid bolus or concomitantly with opioids, however apnea can occur. One adverse reaction associated with ketamine is the emergence phenomenon, which can manifest as disturbing dreams or frightening hallucinations. It is most common in females, patients >16 years old, doses >2 mg/kg IV and patients with a history of psychiatric disorders. Midazolam 0.2 mg/kg given 5 minutes before the ketamine has been shown to prevent the emergence phenomena. If using the intramuscular route, ketamine, atropine, and midazolam can all be mixed in one syringe. Ketamine is contraindicated in increased intracranial or intraocular pressure, pregnancy, hyperthyroidism, or uncontrolled hypertension. As with all agents used for CS, ketamine must be slowly administered as rapid boluses have been associated with malignant arrhythmias.<sup>8,14-16</sup>

### Hypnotics

Etomidate is a rapid onset sedative that has a fast offset resulting in rapid awakening. As per the authors experience in order to be used for effectively for CS, etomidate is usually administered as a single bolus. Etomidate's most appealing attribute is its cardiovascular stability with minimal effects on ventilation. It can also lower intracranial pressure. Etomidate is associated with myoclonus and may induce seizures in epileptic patients. Propofol is newer hypnotic with a significant role in the ED. Both etomidate and propofol are painful when injected. Propofol has received high satisfaction scores from both patient and physician and has been shown to be a safer choice for CS. Special care must be taken with the vials of propofol. No antibacterial agents are added to the propofol solution, so contamination and bacterial growth can occur relatively easily in the vial. Vials should only be for single patient use. Propofol can profoundly depress ventilation and even cause transient apnea following rapid infusion. As with all CS agents close patient monitoring is required. Chloral hydrate is a hypnotic that has been a popular choice for diagnostic imaging, but experience shows that due to its high failure rate and side effects alternative agents may be used in this scenario.<sup>17-23</sup>

### Nitrous oxide

Nitrous oxide (N<sub>2</sub>O) is a colorless, sweet-smelling, non-flammable gas that has both analgesic and sedative properties. The gas is self-administered by the patient so that when the patient loses

consciousness, the mask falls off. A cooperative child is needed for this type of sedation. The dose used for CS is a mixture of 30-50% of nitrous oxide with the remaining percentage being pure oxygen. The onset of action is usually in two minutes. Adverse reactions with nitrous oxide are minimal, but diffusion hypoxia can be serious. Normally only seen with nitrous oxide concentrations above 50%, diffusion hypoxia occurs as a result of the dissolved gas in the blood exiting through the alveoli, displacing the oxygen after rapid discontinuation of the oxygen. Nitrous oxide is contraindicated in patients that have a pneumothorax, eye injury, obstructed viscous, or an altered level of consciousness.<sup>24</sup>

### Combination formulas

Fentanyl/midazolam, morphine/midazolam, and ketamine/midazolam are three common combinations used for CS. When using an opioid and benzodiazepine, the opioid should be titrated to effect first, followed by the benzodiazepine for further sedation. Kennedy et al showed in one study that the combination of ketamine and midazolam was more effective on pain and anxiety relief and had less respiratory depression when compared to fentanyl and midazolam. However, the ketamine and midazolam combination group had a higher incidence of vomiting and recovery from sedation was longer. The combination "DPT" or Demerol (meperidine), Phenergan (promethazine), and Thorazine (chlorpromazine) is no longer recommended due to the high frequency of side effects and an unpredictable onset and depth of sedation.<sup>25-27</sup>

### Reversal agents

Naloxone is an antagonist of opioids at mu receptors. It can reverse the unwanted respiratory depression induced by opioids, like morphine and fentanyl. It does not, however, reverse the rigid chest wall phenomenon associated with fentanyl. If given to opioid-dependant patients, naloxone may induce withdrawal symptoms or pain. Flumazenil is a benzodiazepine antagonist and can safely reverse the sedative and respiratory effects caused by benzodiazepines. Even though flumazenil has been shown to bring patients safely out of midazolam-induced sedation, it is not recommended for routine use. The half-life of both naloxone and flumazenil is shorter than that of opioids and benzodiazepines and therefore require repeated administration of the antagonist until the sedatives have worn off.<sup>8</sup>

### CONCLUSION

No matter what agent is used, always remember to administer it slowly and allow time for the drug to take full effect. The drugs discussed here have an excellent safety profile, especially when used appropriately and with finesse. Intravenous titration of CS agents is the safest and most appropriate route of delivery because it allows for tighter control on the level of sedation and rapid administration of reversal drugs if need be.

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