College of Medicine
Department of Radiology
Radiology Practice Committee

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Sedation Guidelines for Procedures

Minimal sedation (anxiolysis) is a drug-induced state during which patients respond normally to verbal commands. Although cognitive function and coordination may be impaired, ventilatory and cardiovascular functions are unaffected.

Moderate sedation/analgesia ("conscious sedation") is a drug-induced depression of consciousness during which patients respond purposefully to verbal commands, either alone or accompanied by light tactile stimulation. No interventions are required to maintain a patent airway, and spontaneous ventilation is adequate. Cardiovascular function is usually maintained.

Deep sedation/analgesia is a drug-induced depression of consciousness during which patients cannot be easily aroused but respond purposefully after repeated or painful stimulation. The ability to independently maintain ventilatory function may be impaired. Patients may require assistance in maintaining a patent airway, and spontaneous ventilation may be inadequate. Cardiovascular function is usually maintained.

General anesthesia is a drug-induced loss of consciousness during which patients are not arousable, even by painful stimulation. The ability to independently maintain ventilatory function is often impaired. Patients often require assistance in maintaining a 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.

It is common for patients to respond to a predetermined dose of a given medication in an unpredictable fashion. Therefore, patients may enter a deeper level of consciousness than originally planned, necessitating rescue measures to control the airway and provide ventilatory and cardiac support. It is also possible that a given dose of a drug fails to produce the desired effect and additional doses may become necessary. It is therefore important to recognize the boundaries between these categories.

Monitoring Requirements

The above continuum also underlines the importance of adequate monitoring of the patient. At a minimum, blood pressure monitoring, continuous electrocardiography, and pulse oximetry should be in place. Abnormal vital signs should be addressed immediately.

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Goals of Sedation

As stated earlier, the purpose of conscious sedation is to reduce patient discomfort and the risk of procedural complications by providing an optimum environment for the performance of the procedure. General goals of sedation fall in these categories:

1 ***Anxiolysis***: It is desirable to reduce the anxiety level during the procedure. This could lead to improved compliance of the patient and better procedural outcome.

2 ***Analgesia***: Refers to the relief of pain. This could in many cases be accomplished by using local anesthetics only, but it may require systemic analgesics in more complex and painful procedures.

3 ***Amnesia***: Patients prefer not to remember their procedure. Note that amnesia is different from sedation and anxiolysis. It is possible for patients to appear awake, but fail to recall the experience afterward.

4 ***Control of sympathetic reflexes***: Performing painful procedures in nonsedated patients could produce tachycardia, hypertension, and other sympathetic symptoms. This, at a minimum, is inconvenient and could be deleterious to the more fragile and unstable patients. Control of such reflexes, therefore, is an important goal of procedural sedation.

5 ***Reduced level of consciousness***: Refers to the quality of appearing asleep and unaware of one's surroundings.

The optimum sedation for interventional procedures should address all of the above and also allow for a timely recovery and discharge of the patient. It is important to remember the above elements when selecting a combination of agents for the procedure.

Agents

There are many agents that could be used for sedation. For the present article, we will limit the discussion to the ones used most commonly in the United States. These would fall into one of the three categories: **Benzodiazepines, opioids, and intravenous anesthetics**.

Benzodiazepines

This group of drugs exert their effect by acting as an agonist on the GABA receptors, producing an influx of chloride ions into the cell and causing hyperpolarization of the postsynaptic membrane. The most important resulting effects are: (1) amnesia, (2) anxiolysis, (3) anticonvulsant effects.

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These drugs are reasonably safe to use, as their cardiorespiratory suppressive effects are minimal. However, in the elderly, pediatric, and seriously ill patients, even commonly used doses of benzodiazepines can cause apnea. Therefore, it is important to adequately monitor patients receiving any medication, including benzodiazepines.

The most commonly used benzodiazepines include **midazolam** and **lorazepam**. Midazolam has a quicker onset and shorter duration of action, which makes it an ideal drug for most procedures. Furthermore, the longer elimination time of lorazepam could be particularly troublesome in the elderly, where postsedation cognitive dysfunction could be a serious issue.

It is important to know that benzodiazepines confer no analgesia and are weak blockers of the sympathetic response to pain. Therefore, in most cases, more than just a benzodiazepine is necessary to successfully provide sedation

	Onset of Action	Elimination Half Life (h)	Usual Adult Dosing	Pediatric Dosing
Midazolam (Versed)	1-3 minutes	1.5-2.5	1-2 mg increments	0.1-0.15 mg/kg
Lorazepam (Ativan)	5-10 minutes	10-20	1 mg increments	0.05 mg/kg

Overdose

Benzodiazepine overdose is characterized by deep sedation, inability to be aroused, or prolonged emergence from sedation. Hypotension could also be associated with overdose of this class of drugs. In case of a benzodiazepine overdose, **flumazenil** (0.2 mg IV every 60 seconds, usually up to 1 mg) should be administered. One should know that the duration of action of flumazenil is very short (10-20 minutes) and re-sedation may occur, requiring continuous infusions and airway support.

Opioids

Opioids exert their effects by acting on the opioids receptors Mu, Delta, Kappa, and Sigma. The most commonly used opioids include **morphine, meperidine, *fentanyl***, and **alfentanil**.

Clinical Effects of Opiods

Central Nervous System	Cardiovascular	Gastrointestinal	Other

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Central Nervous System	Cardiovascular	Gastrointestinal	Other
Analgesia	Bradycardia	Nausea/vomiting	Pruritus
Respiratory depression	Possible hypotension	Spasm of sphincter of Oddi	Urinary retention
Sedation		Constipation	
Miosis			
Euphoria			

Tachycardia is possible with meperidine.

Comparison of Opiods

	Onset (min)	Duration of Action	Usual Adult Dosing Increments	Notes
Morphine	5-20	4-8 hr	2-10 mg	Active metabolite, morphine-6-glucoronide, accumulates in renal-impaired patients, causing prolonged sedation/respiratory depression
Meperidine (Demerol)	5-15	4-6 hr	10-25 mg	Active metabolite, nor-meperidine, accumulates in renal-impaired patients, causing seizures
Fentanyl	**2-5**	**45-90 min**	**25-50 mcg**	**Duration becomes longer with higher doses/infusions**
Alfentanil	1-3	10-20 min	100-200 mcg	Very short acting, ideal for short procedures but little postprocedural analgesia

Overdose

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In case of opioid overdose, **naloxone** (0.1-0.3 mg IV every 30-60 seconds, with no specific maximum dose) should be administered. Such intermittent, low dose naloxone administration is preferred because it is likely to reverse the respiratory depression and apnea without complete reversal of the analgesic effect. As with the benzodiazepines, the duration of action of the antagonist naloxone (20-30 minutes) is shorter than most opioids and re-narcotization and apnea may re-appear, requiring continuous infusions (2-5 μg/kg/hr) and/or airway support

Control of Nausea and Vomiting

Use of opioids can be associated with nausea and vomiting. A number of different agents can be used to reverse this effect. These include (1) 5-HT3 antagonists ondansetron, dolasetron, and granisetron; (2) dopamine antagonists such as metoclopromide and butyrophenones like droperidol; and (3) histamine H1 blockers such as diphenhydramine.

The first line of therapy is dependant on institutional preferences. The most frequently used 5-HT3 blockers include **Ondansetron (Zofran) 0.1 mg/kg up to 4 mg**, and Dolasetron (Anzemet) 0.35 mg/kg, usual adult dose is 12.5 to 25 mg. Recent black-box warnings have been issued linking droperidol with polymorphic ventricular tachycardias in certain patient groups, leading to more caution in its use. Furthermore, this drug can cause delayed awakening in high doses. When used, the usual adult dose of droperidol is 0.625 mg.

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