PEDIATRIC EMERGENCY DEPARTMENT CLINICAL GUIDELINE: PROCEDURAL SEDATION & ANALGESIA

KEY CONCEPTS
- Sedative and analgesic agents minimize the pain and anxiety suffered by children during painful procedures and may also provide amnesia of the painful event.
- Parents and families benefit by having the comfort of knowing that although a procedure may be painful, their child is being made as comfortable as possible.
- Procedures are technically much easier to perform when the patient is sedated and not moving.
- Sedation decreases the length of time necessary to perform a procedure and reduces the potential risk of injury to patient or healthcare worker due to uncontrolled movements.
- Patients, families, and healthcare providers all benefit from the provision of adequate analgesia and sedation.
- When performing a procedure, clinicians must distinguish between the relative needs for pain control (analgesia), and those for behavioral control (sedation).
- In general, the need for pain control varies by procedure, and the need for behavioral control varies by the patient (age, developmental stage).
- Physicians should consider and address separately the individual needs of analgesia and sedation when planning a procedure.

DEFINITIONS
- **Pain** is a complex subjective experience defined as any unpleasant sensory or emotional experience that results from actual or potential injury.
- **Analgesia** refers to the lessening of pain.
- **Anesthesia** refers to the absence of sensation.
- **Sedation** refers to a reduced level of awareness. For our purposes, it generally refers to a reduced level of anxiety (anxiolysis) or a state of behavioral control which facilitates the performance of a procedure.

CONSIDERATIONS FOR DECIDING WHICH AGENT TO USE
- The ideal agent has potent analgesic and sedative properties that are rapid, titratable and reversible, with minimal side effects.
- There is no single agent, or combination of agents, which can be recommended for every child or every procedure.
- All have varying degrees of advantages and disadvantages, side effects and contraindications.
- Potential risks and benefits need to be weighed when deciding which set of medications to use, and vary depending on the combination of drugs used.

Patient characteristics
- **Age**: Children of different ages have varying abilities to understand and cooperate with procedures. Younger children in general tend to require more sedation than older children. Younger patients also have higher volumes of distribution that in general will necessitate relatively higher amounts of many of the commonly used sedative and analgesic agents.
- **Comorbid conditions**: Children with cardiac disease or craniofacial malformations are at particularly increased risk and in most all cases should be referred to a pediatric anesthesiologist.
NON-PHARMACOLOGIC METHODS

- **Education:** For older children with the cognitive capacity to understand, thorough explanation of the procedure may aid greatly in decreasing anxiety. Child life workers are particularly skillful at developmentally appropriate age-based explanations of procedures.
- **Distraction:** Purposely distracting the patient may decrease anxiety by focusing their attention on other things. Child life workers are particularly skillful at distraction techniques.
- **Hypnosis and guided imagery:** Hypnosis and guided imagery runs the spectrum from general relaxation via comforting speech and conversation to formal training on induction into altered states of consciousness. Guided imagery may be particularly helpful in patients undergoing ketamine sedation as they are extremely receptive to suggestion.
- **Physical Restraint:** Physical restraint may at times be necessary in order to provide safety for the patient and facilitate the performance of the procedure. Physical restraint is not a substitute for analgesia, however, and should always be instituted in as humane a manner as possible.

PHARMACOLOGIC METHODS

**Topical/Local Agents:** Less invasive modes of providing analgesia/anesthesia

- **EMLA** (Eutectic mixture local anesthetics): Applied topically under an occlusive dressing, best results occur after a minimum of 30 minutes and last approximately 2 hours. EMLA may be safely applied to non-intact skin.
- **Lidocaine, epinephrine, tetracaine (LET) and Tetracaine, adrenalin, cocaine (TAC):** LET and TAC are the two most common topical anesthetics used today. Both can be made using a gel or combined with cellulose to make the consistency more viscous and adherent to the wound. LET is favored by many because of its lack of side effects. TAC is used less often because of case reports describing cocaine toxicity and the difficulties related to procurement and storage. TAC is usually made by individual institutions and therefore comes in a variety of concentrations. The toxic dose of cocaine is considered to be 3 mg/kg. TAC should not be applied to mucous membranes as there is increased absorption and potential for toxicity. Both contain a vasoconstrictor and should not be used in areas of end-arteriolar supply (fingers, nose, penis, toes, ears).
- **Lidocaine/Bupivacaine infiltration:** Anesthetics such as lidocaine and bupivacaine may be infiltrated to provide local or regional anesthesia. Care should be taken with dosing as toxicity may occur.

<table>
<thead>
<tr>
<th>Local Anesthetics and Maximum Recommended Dosages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anesthetic</td>
</tr>
<tr>
<td>--------------------</td>
</tr>
<tr>
<td>Bupivacaine</td>
</tr>
<tr>
<td>Lidocaine plain</td>
</tr>
<tr>
<td>Lidocaine w/Epinephrine</td>
</tr>
</tbody>
</table>

**ROUTES OF ADMINISTRATION & DOSSING CONSIDERATIONS**

- Nonparental routes (Oral/Nasal/Rectal) are less invasive, however absorption can be somewhat erratic, and do not allow for the ability to titrate dosing.
- Intramuscular injections allow for more precise absorption than mucous membranes, however do not allow for titration. IM dosing may be particularly useful in cases lasting longer periods of time in which analgesia is not as great a concern, such as complex laceration repair. IM dosing is not recommended in cases of shock, or potential shock (e.g., severe trauma or burns).
- Intravenous dosing of medications allows for precise titration of effects and ensures venous access is available in the event that an untoward reaction occurs.
- Appropriate dosing requires balancing the relative needs of analgesia and sedation with the specific patient and procedure.
When using IM dosing, shorter or less painful procedures may often be accomplished with doses on the lower end of the dosing range, however remember that titration is not possible and if necessary would require additional injections.

When using IV dosing, start low and titrate to effect. Also be certain to flush the medication entirely through the tubing and allow the medication enough time to take effect before redosing.

Younger children have higher volumes of distribution, higher rates of metabolism, and may require somewhat higher doses. Attention to the maximum recommended dose is required as older children may receive too much medication if the full mg/kg dose is given.

**SPECIFIC AGENTS (See Appendices)**

- **Chloral hydrate** is a sedative/hypnotic agent used commonly for nonpainful procedures. Chloral hydrate is available in an oral solution as well as in rectal suppositories. It has no analgesic properties. Care should be taken when combining it with other agents. Chloral hydrate requires the same monitoring as other sedative agents.

- **Codeine** may be given orally in an elixir with tylenol 1 hour prior to a procedure. It provides useful analgesia for regularly scheduled procedures such as burn or wound dressing changes that are only mildly to moderately painful.

- **Ketamine (Ketalar®)** is a dissociative anesthetic with potent sedative, analgesic, amnestic and anesthetic properties. Ketamine acts by causing a dissociation between the limbic and cortical areas of the brain and has an excellent safety record. Ketamine does not cause respiratory depression, and has minimal effect on protective airway reflexes. The only important caveat is that when given rapidly IV push, ketamine may cause apnea. Ketamine causes the release of endogenous catecholamines and is not associated with hypotension. Ketamine may be given by the rectal, intramuscular or intravenous routes and has gained increasing popularity for painful procedures in the pediatric emergency department. Ketamine is a secretory agent associated with increased production of saliva and bronchorrhea. Most therefore recommend using it in conjunction with either glycopyrrolate or atropine. **Glycopyrrolate is the preferred drying agent.** It does not cross the blood-brain barrier (atropine does) and is therefore less likely to cause untoward psychomimetic effects. It also causes much less tachycardia than atropine. Ketamine is chemically related to phencyclidine and can be associated with unpleasant hallucinations or behavioral reactions (so-called “emergence reactions”). The use of midazolam as an adjuvant agent remains somewhat controversial. There is some evidence that it may decrease the post-sedation incidence of vomiting. It may also ameliorate the ultrastructural pathophysiological changes associated with NMDA antagonists, however the evidence is limited to animals and the significance remains unknown. Limited studies to date have not supported the conclusion that use of midazolam reduces the occurrence of so-called “emergence reactions” or development of nightmares. If midazolam is used, and many still do, use lower doses (0.05mg/kg and maximum doses 2mg for example). Higher doses only cause respiratory depression and unnecessarily prolong the sedation and recovery time.

- **Midazolam (Versed®)** is widely used for its sedative and amnestic properties, but does not provide any analgesia. Midazolam may be given orally, nasally, or rectally, is relatively short acting, and reversible with flumazenil (Romazicon®). Significant respiration depression can occur, particularly when combined with an opioid. This agent should only be used with continuous pulse oximetry in place. When using an opioid and a benzodiazepine, the initial dose of each agent should be reduced by 25%.

- **Morphine and Fentanyl (Sublimaze®)** are two opioids commonly used for analgesia. Respiratory depression can occur, particularly when combined with benzodiazepines (midazolam). When using an opioid and a benzodiazepine, the initial dose of each should be reduced by 25%. Sedation may also become more pronounced when the painful procedure is completed and the child is no longer being stimulated. Opioids are reversible with naloxone (Narcan®) or nalmefene (Revex®). Chest wall rigidity may occasionally occur following opioid administration. It results in the mass contraction of the thoracic musculature making ventilation nearly impossible. It may be remedied either by directly reversing the opioid with naloxone (Narcan®) or using pharmacologic muscle relaxation (succinylcholine).
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- **Pentobarbital (Nembutal®)** is a rapid-acting sedative hypnotic barbiturate without any analgesic properties. It has an excellent safety profile and may be used IV in doses of 1-3 mg/kg titrated to effect for nonpainful procedures. It is particularly useful for imaging studies such as CT scans. A commonly used protocol is to administer 2mg/kg IV over 30 seconds, flush the medicine to insure that it is in, and wait 1-3 minutes for effect. If the child is not sleeping, administer 1mg/kg IV over 30 seconds, flush, and wait another 1-3 minutes for effect. If the child is not sleeping, consider another 1mg/kg, or consider other options. Contraindicated in liver failure, and should be used with caution in neonates. There are no reversal agents.

**PREPARATION FOR SEDATION**
- Preparation is the most important, and most often neglected, portion of a sedation.
- Adequate preparation requires a history, including determination of NPO status, physical examination, including determination of ASA classification, basic airway screening examination, and ensuring that all monitoring and emergency equipment are ready and in working order prior to the sedation starting and any medications being given.
- Informed consent should be obtained from the parent or guardian that includes a discussion of the risks, benefits and alternatives to the planned sedation; it should also specifically be documented in the chart.

**HISTORY**
- In addition to usual recent HPI, important historical features include obtaining information regarding any of the following:
  - History (or family history) of any previous problems with anesthesia
  - History of stridor, snoring, obstructive sleep apnea
  - Heart or lung disease
  - Chromosomal abnormality or syndrome
  - Craniofacial abnormality

**NPO STATUS**
- Sedations always carry the risk of vomiting and aspiration.
- Specific factors to document related to NPO status include:
  - Time last drank (and what)
  - Time last ate (and what)
  - Time of injury
- The University of Chicago Hospital’s official policy on sedation states that, “patients should have oral intake limited to clear liquids for six (6) hours before the sedation, and be NPO for at least two (2) hours immediately prior to the sedation, as recommended by the Department of Anesthesia. If NPO has not been maintained, the physician must be notified and the response of the physician must be documented in the patient’s medical record.”
- Depending on age, the American Academy of Pediatrics recommends between 4 to 8 hours of fasting prior to sedation. For children under 36 months, no milk or solids is recommended for 4 to 6 hrs, and for those over 36 months, no milk or solids for 8 hrs prior to procedure (Pediatrics 1992;89:1110-1115).
- The American College of Emergency Physicians official policy on procedural sedation states that recent food intake is not a contraindication for administering analgesia and sedation, but should be considered when choosing the depth and target level of sedation (Ann Emerg Med 1998;31(5):663-77).
- Although it would be more desirable to perform sedations only on patients with a completely empty stomach, there are many variables associated with determining the rate of gastric emptying, and little data is available to support any of the previously recommended time limits.
- Most of the recently published studies related to NPO status and PSA occurring in the emergency department have failed to show any significant correlation between the length of NPO status and adverse events. These results are preliminary, however, and will require further investigation before any firm conclusions can be drawn.
PHYSICAL EXAMINATION

- Baseline vital signs
- Attention to body habitus – is there significant obesity? (BMI > 30?)
- Cardiopulmonary examination
- Airway assessment – is there a potential for a difficult airway?
  1) Mallampati airway classification
  2) Short or limited movement of neck
  3) Estimation of the thyromental/hyoid-mental distance
  4) Viewing of the patient’s head and neck frontally and in profile

MALLAMPATI AIRWAY CLASSIFICATION

PHYSICAL STATUS CLASSIFICATION OF THE AMERICAN SOCIETY OF ANESTHESIOLOGISTS (ASA)

<table>
<thead>
<tr>
<th>Status</th>
<th>Disease State</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>No organic, physiologic, biochemical, or psychiatric disturbance</td>
</tr>
<tr>
<td>II</td>
<td>Mild to moderate systemic disturbance that may or may not be related to the reason for surgery. (Examples include Mild asthma, well-controlled diabetes)</td>
</tr>
<tr>
<td>III*</td>
<td>Severe systemic disturbance that may or may not be related to the reason for surgery. (Examples include heart disease that limits activity, poorly controlled essential hypertension, diabetes mellitus with complications, chronic pulmonary disease that limits activity)</td>
</tr>
<tr>
<td>IV*</td>
<td>Severe systemic disturbance that is life-threatening with or without surgery. (Examples include congestive heart failure, advanced pulmonary, renal or hepatic dysfunction)</td>
</tr>
<tr>
<td>V*</td>
<td>Moribund patient who has little chance of survival but is submitted to surgery as a last resort (resuscitative effort). (Examples include cerebral trauma, pulmonary embolus)</td>
</tr>
</tbody>
</table>

*Anesthesia consultation required

MONITORING

- Please refer to The University of Chicago Hospital’s Patient Care Policy and Procedure for complete details related to Monitoring.
- Appropriate equipment for care and resuscitation must be available for monitoring of vital signs, including heart rate and respiratory rate and oxygenation using pulse oximetry equipment.
- Heart rate and oxygenation are continuously monitored.
- Blood pressure is measured at regular intervals (every 5 minutes for deep sedation).
• A cardiac monitor capable of displaying ECG wave forms with appropriate alarms should be used on all patients with an ASA classification equal to or greater than III or on those with a history of cardiopulmonary disease or when dysrhythmias are anticipated or detected.
• A self-inflating BVM device should be immediately available at the bedside.
• Suction and supplemental oxygen delivery devices should be set-up and immediately ready to use.
• A crash cart and reversal agents should be immediately available.
• All patients receiving moderate or deep sedation should have functioning IV access.

**MONITORING DURING SEDATION**

• Patient’s responses to care should be documented on the Sedation Flowsheet.
• VS are recorded every 5 minutes for moderate to deep sedation.
• If a deeper level of sedation is achieved than initially planned, the procedure should be temporarily aborted and full attention given toward additional ventilatory or circulatory support as needed.

**POST-SEDATION MONITORING**

### MODIFIED ALDRETE SCORING SYSTEM

<table>
<thead>
<tr>
<th>Activity</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Able to move 4 extremities voluntarily or on command w/normal strength or at baseline for patient</td>
<td>2</td>
</tr>
<tr>
<td>Able to move 2 extremities voluntarily or on command</td>
<td>1</td>
</tr>
<tr>
<td>Able to move 0 extremities voluntarily or on command</td>
<td>0</td>
</tr>
<tr>
<td>Able to deep breathe and cough freely</td>
<td>2</td>
</tr>
<tr>
<td>Dyspnea or limited breathing</td>
<td>1</td>
</tr>
<tr>
<td>Apnea</td>
<td>0</td>
</tr>
<tr>
<td>BP = 20% of preanesthetic level</td>
<td>2</td>
</tr>
<tr>
<td>BP = 20-50% of preanesthetic level</td>
<td>1</td>
</tr>
<tr>
<td>BP &lt; 50% of preanesthetic level</td>
<td>0</td>
</tr>
<tr>
<td>Fully awake, or at baseline for patient</td>
<td>2</td>
</tr>
<tr>
<td>Arousable with verbal stimulation</td>
<td>1</td>
</tr>
<tr>
<td>Not responding or arousable to painful stimuli</td>
<td>0</td>
</tr>
<tr>
<td>Pink</td>
<td>2</td>
</tr>
<tr>
<td>Pale, dusky, blotchy, jaundiced, other</td>
<td>1</td>
</tr>
<tr>
<td>Cyanotic</td>
<td>0</td>
</tr>
</tbody>
</table>

* At the UofC, patients are required to have a Modified Aldrete Score of 9 or greater for discharge

### RECOMMENDED DISCHARGE CRITERIA

1. Cardiovascular function and airway patency are satisfactory and stable.
2. The patient is easily arousable, and protective reflexes are intact.
3. The patient can talk (if age appropriate).
4. The patient can sit up unaided (if age appropriate).
5. For a very young or handicapped child, incapable of the usually expected responses, the presedation level of responsiveness or a level as close as possible.
6. The state of hydration is adequate.
DISCHARGE CRITERIA

- Patients must have an Aldrete score of 9 or greater
- Patients should also meet the recommended discharge criteria as listed above
- Patients should also have their pain needs addressed and have an appropriate discharge plan in place.
## Appendix A. Procedural Sedation and Analgesia Agents available at The University of Chicago Pediatric ER.

<table>
<thead>
<tr>
<th>Agent</th>
<th>Route</th>
<th>Dose</th>
<th>Duration</th>
<th>Comments</th>
<th>Reversal Agent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloral hydrate</td>
<td>PO, PR</td>
<td>50-100 mg/kg (2g max)</td>
<td>3-5 hrs</td>
<td>Sedative agent without analgesic properties. Requires same monitoring as other sedative agents.</td>
<td>None available</td>
</tr>
<tr>
<td>Fentanyl (Sublimaze®)</td>
<td>IV</td>
<td>1-2 mcg/kg titrated</td>
<td>15-30 min</td>
<td>May cause respiratory depression, particularly if combined with a benzodiazepine. Sedation may become more pronounced when the painful procedure has been completed and the child is no longer being stimulated.</td>
<td>Naloxone (Narcan®), Nalmefene (Revex®)</td>
</tr>
<tr>
<td>Ketamine (Ketalar®)</td>
<td>PR, IM, IV</td>
<td>4-6 mg/kg 2-4 mg/kg 1-2 mg/kg titrated</td>
<td>30 min – 1 hr</td>
<td>Give antisecretory agent (glycopyrrolate preferred) Consider benzodiazepine (midazolam) IV Ketamine given too rapidly may cause apnea. Bronchodilator without respiratory depression. Minimal cardiovascular effects.</td>
<td>None available</td>
</tr>
<tr>
<td>Midazolam (Versed®)</td>
<td>PO, IN, PR</td>
<td>0.4-0.8 mg/kg 0.1 mg/kg (2mg max)</td>
<td>30 min – 1 hr</td>
<td>Intransal administration is not always well tolerated, and has been associated with paradoxical hyperactivity. Midazolam administered by any route can cause respiratory depression, particularly when combined with opioids. Sedation may become more pronounced when the painful procedure has been completed and the child is no longer being stimulated.</td>
<td>Flumazenil (Romazecon®)</td>
</tr>
<tr>
<td>Morphine</td>
<td>IM, SQ, IV</td>
<td>0.1 mg/kg (2mg max/dose)</td>
<td>1-2 hrs</td>
<td>May cause respiratory depression, particularly when combined with benzodiazepines. Sedation may become more pronounced when the painful procedure has been completed and the child is no longer being stimulated.</td>
<td>Naloxone (Narcan®), Nalmefene (Revex®)</td>
</tr>
<tr>
<td>Pentobarbital (Nembutal®)</td>
<td>IV, IM, PO, PR</td>
<td>1-3 mg/kg 2-6 mg/kg (150mg max)</td>
<td>1-4 hrs</td>
<td>Onset of action 1 min after IV dosing. May cause respiration depression or hypotension, but unusual at therapeutic doses. Contraindicated in liver failure. Use with caution in neonates.</td>
<td>None available</td>
</tr>
</tbody>
</table>
**Appendix B. Adjuvant and Reversal Agents available at The University of Chicago Pediatric ER.**

<table>
<thead>
<tr>
<th>Agent</th>
<th>Dose</th>
<th>Action</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atropine</td>
<td>0.01 mg/kg (0.3 mg max)</td>
<td>Antisecretory</td>
<td>May be used with Ketamine (glycopyrrolate preferred)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(anticholinergic)</td>
<td>May produce tachycardia. Crosses blood-brain barrier – may be associated with untoward psychomimetic effects.</td>
</tr>
<tr>
<td>Flumazenil</td>
<td>0.1 mg aliquots every 60 sec</td>
<td>Reversal Agent</td>
<td>Onset of action is 1-3 min. Duration of action may be shorter than benzodiazepine and therefore require multiple doses.</td>
</tr>
<tr>
<td>(Romazecon®)</td>
<td>(Max initial dose 1 mg)</td>
<td>for Benzodiazepines</td>
<td>May precipitate seizures in those habituated.</td>
</tr>
<tr>
<td>Glycopyrrolate</td>
<td>0.01 mg/kg (0.2 mg max)</td>
<td>Antisecretory</td>
<td>Commonly used with Ketamine (preferred drying agent)</td>
</tr>
<tr>
<td>(Robinal®)</td>
<td></td>
<td>(anticholinergic)</td>
<td>Produces less tachycardia than atropine.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Does not cross the blood-brain barrier – may therefore cause fewer untoward psychomimetic effects.</td>
</tr>
<tr>
<td>Naloxone</td>
<td>0.1 mg/kg (2.0 mg max)</td>
<td>Reversal Agent</td>
<td>Onset of action is almost immediate. Duration of action may be shorter than opioid and therefore require multiple doses.</td>
</tr>
<tr>
<td>(Narcan®)</td>
<td></td>
<td>for Opiods</td>
<td>May precipitate withdrawl in those habituated.</td>
</tr>
</tbody>
</table>
REFERENCES:


DISCLAIMER:
This clinical guideline has been developed for the purpose of unifying the general emergency care of children requiring procedural sedation or analgesia in the emergency department. It is intended to aid, rather than substitute for, professional judgment. It is not intended to serve as a rigid protocol or a written proxy for the standard of care. Failure to comply with this guideline does not represent a breach of the standard of care.