Pediatric Moderate Sedation and Analgesia Self Study

Self-Study Packet & Test

*A Professional Education Training Program for **One** Contact Hour from*:

Baptist Health South Florida

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Objectives

1. Discuss the pre-,peri-, and post- monitoring of pediatric patients receiving moderate sedation.

2. Review the pharmacological implications for sedation and analgesia in the monitoring of pediatric patients receiving moderate sedation.

3. Describe proper airway management of the pediatric patient receiving moderate sedation.

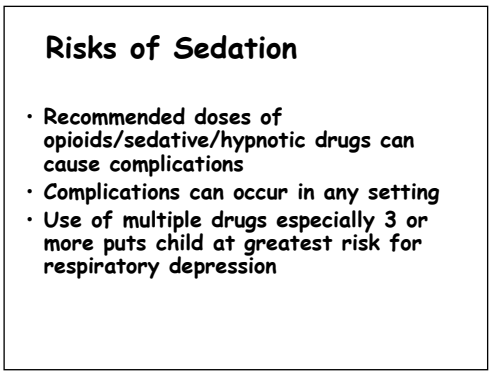
4. Identify complications and emergency measures associated with complications of moderate sedation in pediatric patients.

Introduction

The pediatric supplement to the moderate sedation and analgesia self study should be completed on a yearly basis for all practitioners intending to monitor pediatric patients whom are receiving moderate sedation and analgesia. The supplement should be used in conjunction with the moderate sedation and analgesia self study. It is not a stand alone product.

Section 1: Overview of Pediatric Sedation

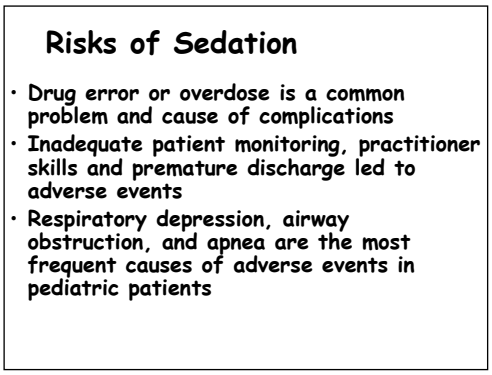
Children are not small adults, particularly when it comes to moderate sedation and analgesia. Practitioners intending to administer and monitor pediatric patients must be aware of the many factors that make pediatric sedation a special circumstance requiring a different skills set than that provided by adult moderate sedation training.



One study reviewed 95 adverse events related to moderate sedation procedures in children. Of those 95 events, 60 of those adverse events resulted in either death or disability.

After close examination of the adverse events they found the following causes:

- **Inadequate patient monitoring, practitioner skills and premature discharge led to adverse events.**
- Drug error or overdose is a common problem and cause of complications.
- Respiratory depression, airway obstruction, and apnea are the most frequent causes of adverse events in pediatric patients.



Therefore, it is important to note the differences between pediatric sedation and sedation provided to adults to ensure competent management and to avoid complications. Remember that in terms of moderate sedation, children are not small adults.

Unfortunately caring for children is not one size fits all. You must have appropriate sized equipment i.e. blood pressure cuffs, pulse ox probes, temp control, intubation equipment etc that will cover a wide variety of ages and sizes. Children should never be place in a dark room after being medicated because of inability for adequate assessment and monitoring. Ensure you have appropriate size positive pressure ventilation bags and suction catheters as well as some form of emergency resources information, i.e. Broselow tape or emergency drug card.

Section 2: Procedural Factors

Duration of the procedure

When choosing a sedation medication or technique, the provider should consider the time that the procedure will require to be accomplished. It would seem ill-advised to give sedative medication that lasts for several hours to a child who is having a procedure that only takes several minutes. Likewise the drug given should provide sedation for enough time to accomplish a procedure – or directions for further dosing should be included.

Pain as a side effect of a procedure

Another important aspect of moderate sedation procedures that must be considered is the presence or absence of pain with a given procedure. Many of the sedatives that are commonly used for sedation – such as chloral hydrate and the benzodiazepines - have absolutely **no** analgesic component. As a general rule of thumb, patients who are undergoing painful procedures should be given analgesic medications in addition to sedative agents. Assessing pain during procedures may be problematic, especially in the preverbal or nonverbal patient in whom

determining the cause of distress (pain versus irritation versus fear) may be difficult. Appropriate pain assessment tools based on developmental age should be used.

Position required for the procedure:

In planning the depth of sedation, each provider must consider the position that the patient will be in during the procedure. The average child will maintain an open airway in the supine position even when deeply sedated as long as the head is placed in the sniffing position (neck slightly extended). If the head must be flexed during a procedure or a scan, obstruction of the airway will be much more likely and care should be taken to avoid deep sedation unless the provider is ready to place an oral airway or endotracheal tube. Placing a patient in the prone position can be especially dangerous. If the airway becomes compromised it will be difficult to assess. In addition chest wall expansion may be limited or impossible making it difficult for the child to spontaneously breathe. Finally if the airway is going to be remote from the sedation provider (i.e. MRI scan) the sedation provider should consider remaining with the patient during the procedures and take into account that adjustment of the airway will not be possible and assisting ventilation will require ceasing the procedure itself.

Anxiety/Stress/inability to cooperate as a side effect of the procedure

Children undergoing diagnostic and therapeutic procedures are often frightened and uncooperative. This fear may be exacerbated by parental anxiety and separation from parents. As a result sedation may be required for procedures that are not painful and do not require a great deal of movement control.

Section 3: Factors Relating to the Patient

Past Experience

When planning to sedate a child, the previous experiences of the patient to be sedated should be elicited. Both good and bad experiences should be reviewed along with the medications that were previously administered. Obviously patients who became combative with a given dose of oral Versed would not be well served by repeating that drug and dose for another procedure. Similarly the provider should elicit some indication of the anxiety that the patient and family have regarding the upcoming procedure and sedation. The severely anxious patient will often time need significant sedation where a relaxed patient may only need support or distraction. While these facts may seem self evident, a sedation history is often completely neglected by many providers. The response and satisfaction that a patient and family have with a particular sedation will be heavily influenced by their previous experience.

Allergies

It is imperative that a good drug allergy and adverse reaction history be elicited prior to providing sedation. If a patient states an “allergy” is present to a given medication, a history of what type of reaction occurred should be obtained. Often patients will interpret nausea after sedation as an allergy to whatever medication was given when this is clearly not the case. Drugs which were associated with urticaria or shortness of breath should obviously be avoided.

Adverse Reactions

Children may have paradoxical reactions to medications. Agitation and dysphoria may occur instead of sedation and relaxation. Case studies involving incoherent shouting and agitation have been reported in children and adults immediately after the administration of Benzodiazepines. Versed is one of the medications that are known for paradoxical reactions.

Before the patient's paradoxical reaction is assumed to be a response to a certain medication, other potential causes must be ruled out. Inadequate pain medication may be the cause for the agitation and restlessness. This may not be recognized in patients unable to verbalize their pain.

Aspiration Risk

A history of last oral intake is required before providing sedation. Although the data on aspiration injury associated with pediatric sedation cases is not definitive, most experts advise fasting guidelines (NPO) that mimic those require for anesthesia. The reasoning behind these recommendations follows the thought that is often very difficult to predict the exact depth of sedation that will result from a dose of a sedative in a small child – therefore it should be assumed that airway reflexes may be lost and steps to minimize risk should be taken.

There are no national standard guidelines for fasting prior to sedation. Generally accepted guidelines differentiate between clear liquid intake and heavy meals in a graded fashion as outlined below: **Pediatric Fasting Guidelines for Sedation or Anesthesia.**

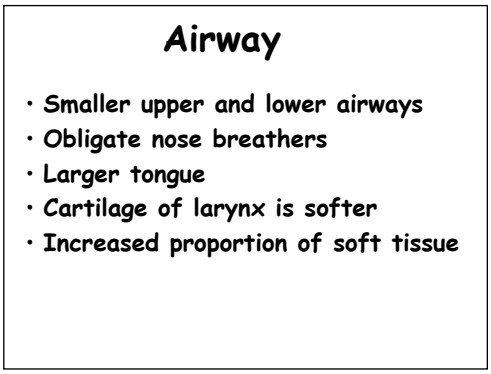
Food	Hours of Fasting Required
Clear Liquids	2
Breast Milk	2 or 4 depending of mother's diet
Formula or Light Meal (no fat)	6
Full Meal	8

In addition to the history of intake, prior to sedation the provider should elicit a history of gastroesophageal reflux disease. Patients who have a history of severe reflux disease (with associated growth failure or daily vomiting) may not be completed safe under significant sedation unless their airway is protected. At the very least, these patients should have an assured fasting interval, and some experts will insist on securing their airway with an endotracheal tube prior to providing deep sedation.

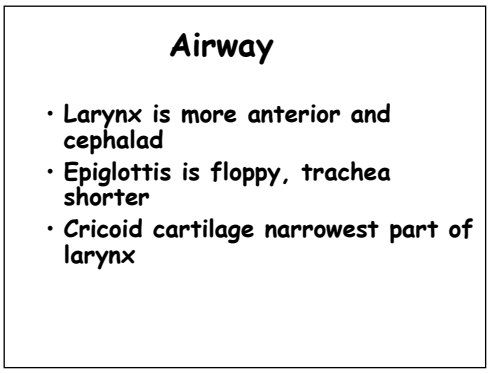
With the recommendations outlined above in mind, each provider will need to weigh the urgency of the procedure against the relative risk of the "full stomach". Emergency departments routinely do not abide by these fasting guidelines and there is little indication that aspiration is a significant problem in this setting. In spite of this it seems prudent to strive for a reasonable fasting interval when sedating pediatric patients – <u>in particular those having elective procedures.</u>

Section 4: Anatomical Differences between Children and Adults

Airway



With the pediatric population, the airways are smaller so a small amount of edema or secretions can cause increased distress whereas an adult would be able to tolerate. Infants up to 2-3 months of age breath through their nose so anything causing an obstruction such as a tube or secretions will increase the work load of breathing.



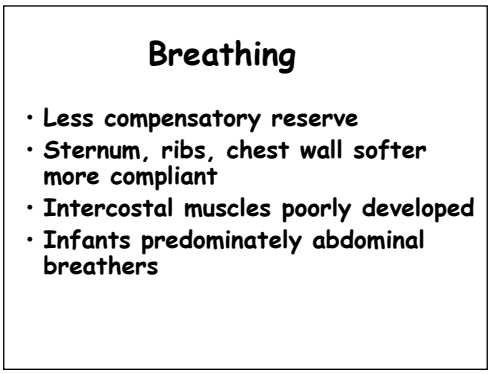
The child's tongue is larger when compared to adults and is the primary cause of airway obstruction in the pediatric patient. Because of the soft cartilage of the larynx, the pediatric airway should be open to a sniffing

position. If the infants head is hyper-extended the airway will collapse causing an obstruction. The structure of the airway is important for intubation purposes. An experienced provider in the pediatric airway must be available to intubate if the situation arises. Pediatric patients up until the age of 8 typically will utilize an uncuffed endotracheal tube because of the cricoid cartilage.

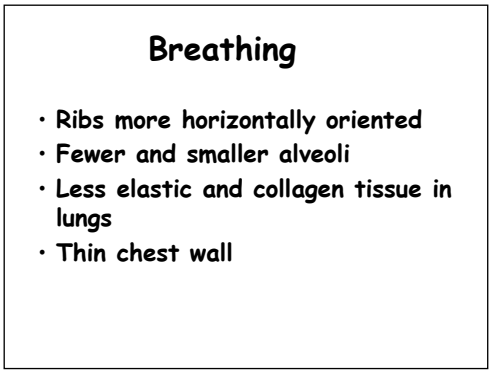
And finally, compared to adults, respiratory failure and respiratory arrest are most common cause of cardiac arrest in infants and children.

Breathing

Children have a limited oxygen reserve and hypoxia and respiratory arrest may cause or contribute to acute deterioration and eventual cardiopulmonary arrest. Also with pediatric patients, compliant ribs and sternum fail to maintain tidal volume and gastric distention can impede respirations in the abdominal breather.



Particularly with infants, the thin chest wall allows for breath sounds to be transmitted throughout the chest. The practitioner must listen to changes in pitch to detect a pneumothorax.



Circulation

Circulation

- **Infants and children have less oxygen reserve**
- **Myocardium less compliant**
- **Stroke volume small in children & is dependent on heart rate**
- **Bradycardia most common terminal rhythm**

Cardiac out put and oxygen delivery in children are higher per kilogram of body weight than in adults but oxygen consumption is also higher.

Also, unlike adults, pediatric cardiac output is primarily affected and maintained by heart rate. Because the myocardium is less compliant and stroke volume is small, changes in the pediatric heart rate can drastically alter the cardiac output.

The most important point to remember is prevention of bradycardia. This is done through careful monitoring and oxygen administration. **Children with a heart rate of less than 60 who are receiving high flow oxygen and have poor perfusion will require chest compressions.**

Exposure

Exposure

- **Infants and young children have higher body surface area to weight ratios**
- **Proportionally large head**
- **Infants < 3 months are unable to produce heat through shivering**

Because infants and young children have higher body surface areas to weight rations when compared with adults, it is much easier for the exposed infant or child to lose body heat. Cold stress can lead to acidosis and hypoglycemia. Therefore it is important to provide a warm environment for pediatric patients paying particular attention to the neonate and infant.

Other Differences

Other Differences

- **Significant changes in body weight**
- **Children metabolize drugs at different rates**
- **Paradoxical Reactions to medications**

Medications for pediatric patients are based upon weight (mg/kg). Because children tend to change body weight more quickly than adults, it is important that all pediatric patients have a current measured weight.

Dosages of various medications will vary according to their weight and age. An updated pediatric specific drug reference book should be utilized (Neofax, Harriet Lane, or Pediatric Dosage Handbook for example) when checking doses.

Section 5: Pediatric Medications, Dosages and Special Considerations

Chloral Hydrate

Moderate Sedation Agents: *Pediatric Dosages*

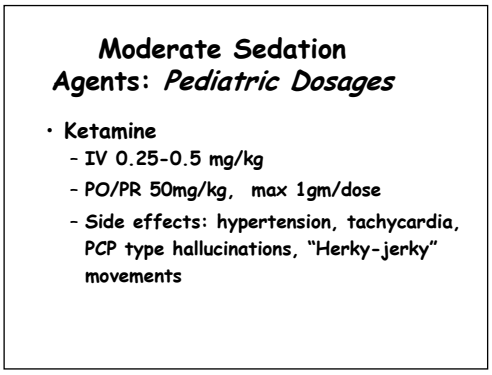
- **Chloral Hydrate**
  - **PO/PR 50mg/kg, max 1gm/dose**
  - **Side effects: N/V, diarrhea, residual sedation, nightmares. No reversal agent.**

Chloral hydrate is a sedative-hypnotic which is used to produce immobility for non painful procedures in radiology and EEG and is most effective in children less than 3 years-of-age. Overall it is less effective than pentobarbital and fails to provide adequate immobility in about 30-40% of the cases. Chloral hydrate can cause airway obstruction more so than respiratory depression. It is not uncommon for patients to experience nightmares. Interventions would include providing a quite environment and patient family education. Onset is 30-60 minutes with duration of 2-8 hours. There is **NO** reversal agent for this medication.

Chloral hydrate should be used cautiously in neonates because of its long half life: 40 hours for premature infants, 18 hours for full term infants, and 10 hours for toddlers. Because of the long half life, residual drug effect may occur once the patient is discharged home after the procedure. Chloral hydrate must **NEVER** be given at home before procedure. Deaths have been

reported from infants who have slumped forward in their car seats on the way to the hospital and as a result have obstructed their airways.

Ketamine



Ketamine is a non-barbiturate phencyclidine derivative that produces "Dissociative anesthesia" a cataleptic state in which the eyes remain open with a slow nystagmic gaze. The patient is non-communicative although wakefulness may appear to be present. Varying degrees of hypertonus and purposeful movement may occur independent of the procedure. Ketamine has analgesic, amnesic and altered consciousness properties making this an ideal agent for painful procedures.

Ketamine is a potent cerebral vasodilator; its use is controversial in head trauma as it may increase intracranial pressure. Ketamine is also a potent hallucinogen. Emergence from Ketamine sedation is associated with visual, auditory illusions. The incidence of illusions is greatest in patients over 16 years-of-age and those patients with a history of psychosis. Providing education, a quite environment as well as co-administration of a benzodiazepine (midazolam) will prevent or minimize these reactions. When given slowly, ketamine does not produce significant respiratory depression. However, it will produce apnea following rapid intravenous (1-2 mg/kg) administration. Salivary and tracheobronchial mucous gland secretions are significantly increased in patients receiving ketamine. Simultaneous use of an anti-sialogogue (atropine or glycopyrrolate) minimizes this effect.

Pentobarbital

Pentobarbital is a barbiturate given to immobilize pediatric patients, particularly during radiology procedures. It is very strong sedative properties (can lead to deep sedation) but provides no analgesia. There is **NO** reversal agent for Pentobarbital can cause paradoxical excitement in children, particularly those with pain.

Moderate Sedation Agents: *Pediatric Dosages*

- Pentobarbital (Nembutal)
  - IV 0.5-1.0 mg/kg titrate to a max of 6 mg/kg 150 mg
  - Onset Duration
    - 1-10 minutes 1-4 hours
  - Side effects: respiratory depression, laryngospasm, hypotension bronchospasm. No reversal agent

Pentobarbital is titrated in 1mg/kg increments over 3-5 minutes until desired effect is achieved. Pentobarbital is administered no faster the 50 mg/min.

Section 6: Reversal Agents

Specific reversal agents exist for benzodiazepines and opioids. Sedation providers must understand their use in order to responsibly utilize either of these classes of agents.

Flumazenil

Flumazenil can be used to reverse the effects of benzodiazepines and should be immediately available when using benzodiazepines for sedation. A dose of 0.01 mg/kg may be given IV over 15 seconds (up to 0.2 mg total dose). May repeat the dose at 1 minute intervals until desired endpoint is reach or up to 5 total doses of 0.01 mg/kg. The maximum dose of flumazenil is 0.05 mg/kg or 1 mg, whichever is lower. Although rare, resedation may occur and additional doses of flumazenil may be required. Careful observation for this resedation should be maintained for at least an hour following the administration of flumazenil.

Naloxone

Naloxone (Narcan) is an opioid antagonist and can be administered intravenously, intramuscularly, or subcutaneously but the preferred route of administration is intravenous. In the non-arrest situation, use the lowest dose effective (may start at 0.001 mg/kg/dose. The mediation should be given in a slowly titrated manner. The standard preparation contains 0.4mg/ml of naloxone

Section 7: Recovery and Discharge

An objective scoring system is used to asses the patient's recovery from sedative effects and his or her eligibility for discharge from the procedure area or hospital. The Aldrete Post Anesthesia Scoring System (PARS) or the Modified Post Anesthesia Discharge Scoring System (MPADS) should be used to assess the patient for adequate recovery. A score of **eight** (8) or greater **(PARS) and ten** (10) for **MPADS** must be achieved to be eligible for discharge.

	Post Anesthesia Recovery Score	**PAR Score**
Activity	0 = unable to lift head or move extremities 1 = moves two extremities voluntarily or on command and can lift head 2 = able to move four extremities voluntarily or on command. Can lift head	
Respiration	0 = apneic. Condition necessitates ventilator assisted respirations. 1 = labored or limited respirations. May have mechanical airway 2 = can take a deep breath and cough well. Has normal respiratory rate and depth.	
Circulation	0 = has abnormally high or low BP (> 50% pre sedation level) 1 = BP 20-50% of pre sedation level 2 = stable BP and pulse. BP 20% of pre sedation level	

Neurological	0 = not responding or responding to painful stimuli 1 = responds to verbal stimuli but drifts to sleep easily 2 = awake, alert, oriented to time, place and person	
O2 Sat	0 = O2 saturation < 90% with O2 supplement 1 = needs O2 inhalation to maintain O2 saturation > 90% or <95% 2 = able to maintain pre procedure O2 saturation on room air or > 95% on O2	
	Total Recovery Score	

	Modified Post Anesthesia Discharge Score (MPADS) (to be used for outpatients discharged from facility)	**MPAD**
Vital Signs	0 = within 40% or > of pre sedation levels 1 = within 20% - 40 % 2 = within 20 %	
Pain	0 = severe (8-10) 1 = moderate (4 -7) 2 = minimal / none (0-3)	
Nausea & Vomiting	0 = severe 1 = moderate 2 = minimal / none	
Surgical Bleeding	0 = severe 1 = moderate 2 = minimal/ none	
Ambulation	0 = none / dizziness 1 = with assistance 2 = steady gait / no dizziness (age appropriate)	
	Total Discharge Score	

Section 8: Discharge Teaching

It is important the following precautions be taken by the parents on behalf of the pediatric patient:

- The child should not be left unattended. An adult should be with the child for the remainder of the day.
- Adolescents should not drive or operate machinery, drink alcoholic beverages, or make any important decisions that day.
- Children may still be sleepy and nap longer than usual.
- Children placed in car seats must be observed as they may occlude the airway by slumping forward in the seat.
- Child may be awake one minute and asleep the next minute. May last up to 6 hours.
- The child may experience dizziness or lack of coordination
- Sleep problems, nightmares, inability to sleep, fear of sleeping can sometimes occur.
- Call 911 for emergencies or if unable to reach the child's doctor:
    - **Breathing problems**
    - **Prolonged weakness, sleepiness**
    - **Frequent nausea and vomiting**

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