Procedural sedation has three major goals.

1) that the child have available a range of diagnostic and therapeutic procedures otherwise inaccessible because of pain or the requirement that the child “hold still”;

2) that the procedure not result in post traumatic stress disorder or equivalent; and,

3) foremost, that the sedation and procedure be accomplished safely.
2001 JCAHO Levels of Sedation and Analgesia

- **Minimal sedation** (anxiolysis)
  - responds normally to verbal commands
- **Moderate sedation/analgesia** (conscious sedation)
  - depressed consciousness with purposeful response to verbal command or light touch
- **Deep sedation/analgesia**
  - depressed consciousness, cannot be easily aroused
  - may require airway support
- **General Anesthesia**
  - pharmacologically induced coma-like state
  - protective reflexes assumed to be lost

Standard definitions.
An important concept is that the thresholds between these various levels is not neatly stepwise but rather is a “slippery slope”.
Practitioners intending to produce a given level of sedation should be able to rescue patients whose level becomes deeper than initially intended.

Individuals administering moderate sedation/analgesia should be able to manage patients who enter a state of deep sedation/analgesia, while those administering deep sedation/analgesia should be able to manage patients who enter a state of general anesthesia.

Because of the “slippery slope”, credentialing for a given level of sedation must consider the concept of rescue competence and therapies: the practitioner be able to rescue a child from the next deeper and unintended level of sedation. While covering many of the principles for deep sedation, we will focus on moderate sedation during this session. Credentialing for deep sedation is generally available only for anesthesiologists, intensivists, and ER physicians. Deep sedation requires that the practitioner be able to handle a patient under general anesthesia.
AAP Guidelines

The state of deep sedation requires:

- Must be one person available whose only responsibility is to constantly observe the patient’s vital signs, airway patency and adequacy of ventilation, and administer drugs.
- At least one person must be present who is trained in pediatric advanced life support.

The practitioner performing the procedure is responsible primarily for the procedure. Another professional must be independently responsible for watching the patient. Care of the sedated child requires close attention by all to the details in order to prevent patient injury under conditions in which the patient’s own protective reflexes may be diminished or absent.
Monitoring

- A dedicated individual with PALS training
- Continuous pulse oximetry
- HR, RR, BP q 5 minutes during the procedural period

The pulse oximeter monitors both cardiovascular (HR and perfusion) and respiratory (oxygenation but not ventilation) functions continuously. When the oximeter doesn’t work, then the first condition to be considered is occult shock and perfusion failure for only when perfusion is intact does the oximeter function properly. Standard vital signs are recorded in the medical record every 5 minutes.
Emergency Equipment

• Pediatric code cart
• Pediatric intubation kit
  • Pulse oximetry
• Cardiorespiratory monitor
  • Oxygen & suction
  • Reversal agents

It is imperative to have emergency equipment immediately available during pediatric sedation. One should ensure that suction and oxygen sources are functioning and appropriate sized equipment is available.
Pre-sedation History

• Primary diagnosis
• Allergies: drugs and environmental
• Current medications, including herbals
  • Previous surgery
  • Previous anesthesia experience
  • or reactions
  • Familial anesthesia reactions
• Date of last anesthesia or sedation
• NPO status

This information is collected and recorded in the medical record, best by interview with the parents and child. Review of the medical record is also acceptable.
Components of Pre-Sedation History

• AMPLE Pneumonic
  • Allergies
  • Medications
  • Past History
  • Last meal
  • Events

This is the pneumonic used in the PALS sedation module and is a handy, simplified reminder for some.
Pre-sedation History
Review of Systems

• Respiratory:
  • asthma, snoring, obstructive sleep apnea, BPD, recent URI, apnea monitor, cough

• Cardiovascular:
  • congenital, murmur, hypertension

• GI
  • reflux, ulcer, bleeding

• Renal:
  • renal insufficiency, infections

• Hematological:
  • anemia, sickle cell

An abbreviated and focused review of systems is designed to uncover issues that may increase risks of the sedation or that may require particular preparation before the procedure. Snoring and/or obstructive sleep apnea are of major concern, since these conditions represent predisposition to partial or complete airway obstruction. A recent URI may call for glycopyrrolate to prevent bronchospasm or phenylephrine nose drops to open the nasal airway. Occasionally a significant heart condition will be discovered for which endocarditis prophylaxis is indicated if a “dirty”, invasive procedure is planned. Sickle cell disease may require hyperhydration or exchange transfusion prior to certain procedures.
Pre-sedation History
Review of Systems

• Endocrine:
  • hypoglycemia, thyroid, diabetes

• CNS:
  • seizures, CP, stroke, ADHD, hydrocephalus

• Teeth:
  • loose, broken, capped

• Eyes:
  • glaucoma

Children with hypoglycemia may require glucose infusion while NPO. Even while NPO, children with seizures are generally allowed to take their regularly scheduled medications with small sips of water.
Pre-sedation
Physical Examination

- **General**: anxiety, asthenic, obese
- **Airway**: large tongue, retroposed or small mandible, loose teeth, nasal congestion, snoring, large tonsils
- **Neck**: short and muscular, range of motion
- **Chest**: wheezing, equal breath sounds
- **Heart**: murmurs, distal perfusion
- **CNS**: CP, spasticity, protective reflexes

The physical exam should be performed with an anticipatory eye for managing this child while unconscious and with upper airway obstruction. Special attention is due as regards anatomical features which may complicate endotracheal intubation or LMA placement.
Physical assessment and ongoing management requires keeping normal anatomy in the mind’s eye at all times. Upper airway obstruction is a major issue for many problems encountered during sedation. Becoming facile with manually handling the airway of a sedated child is mandatory. Upper airway obstruction during sedation rarely requires intubation but commonly requires manual manipulation and airway positioning to relieve obstruction.

*Anatomy: a Regional Atlas of the Human Body*  
Carmine Clemente  
1987  
*Fig. 723*
The purpose of this assessment is that one stop to consider the potential for the necessity of establishing an artificial airway during the upcoming sedation and procedure. This assessment is often difficult or impossible to perform on an infant. However, it still serves to make one stop and consider. It should be assumed that establishing an artificial airway may become necessary during any procedure, and one should anticipate any obstacles before the real time occurrence. Airway safety is especially at risk during procedures involving the upper airways, such as GI endoscopy or bronchoscopy.
ASA Physical Status Classification

• Class I:
  • Healthy, normal child

• Class II:
  • Child with mild systemic disease

• Class III:
  • Child with severe systemic disease

• Class IV:
  • Child with severe systemic disease that is a constant threat to life

• Class V:
  • Child who is moribund and not expected to survive without the procedure

For example, a child presenting for upper GI endoscopy for evaluation of GERD. To require such an invasive procedure in a disease process that is affecting daily life, then usually class II. If the GERD is causing weight loss and respiratory symptoms, it may become class III. If the respiratory component is as severe as to cause recurrent apnea or an artificial airway, then the complicated GERD has reached class IV. ASA IV cases are generally performed only in an operating room or ICU.
Fasting Guidelines

- Clear liquids, juices, tea 2 hr.
- Breast milk 4 hr.
- Infant formula, 6 hr.
  - non-human milk,
  - light meal
Medication Administration

- Before beginning the sedation, prepare everything you plan to use
  - Label clearly all syringes and note as the syringe is filled
    - Beware of different strengths
  - Inject small aliquots q 2-5 minutes
  - Beware of dead space in tubing
  - Inject small volumes near the vein and flush liberally

In the practice of procedural sedation, one is likely to prepare hundreds of doses of various medications annually. My own practice is to personally prepare each and every dose. It is almost impossible that a human perform such manual activity hundreds of times annually without error. Therefore, considering the sources of error as one prepares is perhaps the most effective means of avoiding such error. Likewise, considering the physics of drug administration such as losing small doses of drugs into significant dead spaces can be the difference between success and failure.
Define the terms.
The medications used in procedural sedation can be classified into these categories. Between analgesics and anesthetics the line is a bit arbitrary, and any analgesic, and some sedatives, may become anesthetic agents. However, the distinction between anxiolytics, amnestic, and analgesics/anesthetics is practically quite useful. Midazolam produces amnesia and anxiolysis but does nothing for pain. Fentanyl is an excellent analgesic but has no amnesic properties. Propofol is an excellent hypnotic but with limit for analgesia and not a complete amnesic in subanesthetic doses. However, the dosing range of safety is relatively narrow with propofol and if used, then conditions must exist for care of the child under general anesthesia. Ketamine is excellent for fast fiber pain and amnesia, thus approaching anesthetic properties.
Morphine

- **Dose**: 0.05 mg/kg Q 2-5 minutes to max 0.2 mg/kg
- **Side-effects**
  - itching
  - bronchospasm
  - hypotension
  - respiratory depression
  - seizures

- **Reversal agent: Naloxone**

Morphine is a standard for analgesia but has no amnesic properties. It is a bit of a “dirty” drug, in that it produces histamine release which is occasionally clinically bothersome. For procedural sedation, it also has a bit slower onset of action, compared to fentanyl. Seizures and muscle rigidity are reported but rare.

Should naloxone be required for apnea, one strategy is to use a small dose of 3-5 mcg./kg. Such a dose will reverse apnea but not analgesia. And, remember that the mu receptor antagonism of naloxone lasts only a few minutes, whereas morphine effect may last a couple hours. If naloxone is used for apnea, then continue to monitor the patient closely, anticipating return of apnea.
Fentanyl

**Dose:** 0.5-1 micrograms/kg Q 2-5 minutes to max 3 micrograms/kg

**Side-effects**
- respiratory depression
- less itching and bronchospasm (than morphine)
- hypotension
- chest wall rigidity; may represent laryngospasm

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-Reversal agent: Naloxone

Fentanyl is “cleaner” than morphine. Of concern and caution is that the drug is available only as 50 mcg./ml., an “adult” preparation. So-called chest wall rigidity seems to occur only in larger, anesthetic doses beyond the practice of procedural sedation. What may seem clinically to be “chest wall rigidity” may actually represent occult laryngospasm.
Midazolam

• Anxiolytic and amnesic which also diminishes “stress response”

  • Not an analgesic!
  
  • Dose: 0.05 mg/kg Q 1-3 minutes to max of 0.25 mg/kg IV; may also be administered IM, orally, or intranasally

• Side-effects
  
  • Paradoxical reactions (may indicate occult pain)
  
  • Respiratory depression unusual if used alone but potentiates respiratory depression of opioids

• Reversal agent: Flumazinil

An oral dose of 0.5 mg./kg. midazolam may be administered to diminish anxiety so that the child will allow strangers (the care team) to approach and proceed with the business at hand. Remember, it does nothing for pain except ablate the memory of the experience.

Flumazinil is rarely of use, and one must be prepared to deal with seizures if it is used, especially in certain populations.
Respiratory depression usually responds to simple bag and mask support, only rarely requiring intubation.

It behooves anyone who practices procedural sedation to become an expert with bag and mask ventilation. Understanding the equipment and proper application of the E-C clamp technique for mask/airway control is mandatory. Facile use of suction equipment is likewise mandatory.

Volume loading prior to sedation is rarely contraindicated and should be considered if any question of hypovolemia. Legs up may be preferable to Trendelenberg, since the latter may result in abdominal contents restricting diaphragmatic excursion in some patients.
Laryngospasm

- Occurs more commonly in children
- Occurs at light levels of sedation/analgesia
  - IV lidocaine may treat or prevent
- Treat with positive pressure 100% oxygen breaths with tightly fitting mask
  - May require neuromuscular blocker and endotracheal intubation
  - Laryngospasm maneuver

Predisposition to laryngospasm is the rule and perhaps the most common significant complication of procedural sedation. A plan for its management must be part of any procedural sedation.
Laryngospasm Maneuver

Firm inward pressure bilaterally with both index fingers at a spot defined by the posterior aspect of the mandible, the anterior aspect of the mastoid, and the inferior aspect of the ear canal/skull base. This exerts pressure on the styloid process and induces laryngeal relaxation.


Believe me, it works !!! And, the hand positioning for this maneuver allows for excellent manual control of the mandible, especially helpful during invasive procedures threatening or involving the upper airway. Proper positioning of the fingers is nestled up in the notch described and pressing firmly as if the fingers are to meet in midline near the pituitary. One often palpates tip of the styloid process. Avoid the angle of the mandible which places the fingers too low and may threaten the carotids.

(In our own experience with pediatric upper GI endoscopies, at one point we had 12 intubations in ~300 consecutive patients. After introduction of the technique, only one intubation for the next ~300 cases.)
Post-procedural Period

- Most vulnerable period?
  - Pain gone but drugs still present
- Continuous pulse oximetry
- Continuous observation by skilled personnel in a recovery setting
- VS q 15 minutes in recovery period
- Minimum of 60 minutes observation beyond last drug administration

The pain and stimulation of a particular procedure may obscure any tendency for apnea. Likewise, sedated infants are prone to upper airway obstruction, especially with neck flexion. Diminished head and neck control accompany the sedated state and predisposes to positional airway obstruction.

Many recommend that sedated children be continuously observed for several hours even after discharge. The sedated infant placed in a rear facing car seat away from direct observation is at particular risk.
Discharge Criteria

- Airway patency and cardiovascular function are stable and satisfactory
  - Easily arousable and protective reflexes intact
  - Age appropriate head and neck control and sitting unaided
  - Can talk (age appropriate)
  - Can swallow clear liquids

The focus of the discharge assessment is to assure and document the return and presence of airway and other protective reflexes. Prudent advice is that caregivers should watch for ataxia and falls and should continue to keep the sedated child under continuous direct visual observation for a few hours after discharge.
MCNH Pediatric Moderate Sedation Policy

• Click here to view Pediatric Moderate Sedation Policy
Pediatric Moderate Sedation Knowledge Assessment

Click here to complete online knowledge assessment