



EM CASES SUMMARY

Episode 76 –Pediatric Procedural Sedation

With Dr. Amy Drendel

Prepared by Dr. Michael Kilian, edited by Dr. Anton Helman, February 2016

Bridging Analgesics: Triage to Procedural Sedation

Your initial approach to pain control when the patient hits the ED door will depend on severity of pain. For presentations of **severe pain**, intranasal fentanyl is a recommended first line agent as it is fast and easy to administer, avoids requiring cooperation with oral medications, and provides reliable analgesia that has been shown to be equivalent to intravenous morphine. For **mild to moderate pain**, consider oral agents such as ibuprofen, which has been shown to be more effective than acetaminophen for pain control in orthopedic injuries in children.

Intranasal (IN) Fentanyl

A general rule of thumb for dosing IN fentanyl is *twice the IV dose*.

Agent	Dose	Onset of Action
Fentanyl IN	1-2mcg/kg (max 100mcg)	2- 3 min

Tips to increase your success with intranasal fentanyl and other IN medications:

- Avoid intranasal medications in children with obviously congested nares since absorption will decrease and dosing will be unreliable
- Choose the highest concentration formulation of fentanyl as this will allow you to use a smaller volume
- Use BOTH nostrils for volumes over 0.3 ml to double the absorptive surface and reduces runoff
- Consider administering an oral analgesic concurrently for continued pain management after the Fentanyl has worn off
- Respiratory depression is rare with correct dosing, however naloxone is also effective intranasally, if needed, as a reversal agent
- Instruct the child to take deep breath in “like smelling a flower”

For guidance around use of intranasal medications we recommend www.intranasal.net. This resource provides evidence-based recommendations for a variety of applications of intranasal medication including pain control, sedation and seizure management.

Distraction Techniques

There is good evidence to support the use of distraction techniques to help decrease the child's anxiety and pain experience during a procedure. Familiar faces and various technological devices such as smartphones and tablets may be effective at calming the child and can help move things along more smoothly.

See [Error! Hyperlink reference not valid.](#) for a more in-depth discussion on Distraction Techniques

Assessment for Pediatric Procedural Sedation

As in the adult population, every procedural sedation must begin with a **focused history** to help you plan your sedation. Any history of procedural sedation and details surrounding their experience and effects will be important in planning which agents you employ. In the past medical history, be sure to screen specifically for asthma, viral respiratory infections and obstructive sleep apnea as these

are important risk factors for complications. Reviewing the allergies and potential medication interactions will also influence what agents you use. Perform a thorough physical exam for high risk airway features as well as cardiorespiratory exam.

Is Fasting Required Prior to Pediatric Procedural Sedation?

It is helpful to know when the patient had their last meal but there is not a lot of research that supports mandatory fasting to prevent complications of aspiration in procedural sedation. A large study addressing this question found no difference in adverse events in children who had been fasting 2, 4, 6 or 8 hours. A conservative approach based on The American Society of Anesthesiologists fasting guidelines would be to wait 3-4 hours after their last meal but there is no indication to wait if you need to urgently perform a procedure. Emesis is a known side effect of ketamine. There is evidence to support the use of ondansetron in conjunction with ketamine to reduce the risk of emesis (NNT= 9) . If you are really concerned about the risk of vomiting, consider using propofol for your sedation as it has a lower risk of vomiting with subsequent aspiration than ketamine.

Preparation for Pediatric Procedural Sedation

Remember that anatomical differences in children compared to adults, render them more prone to airway obstruction. Perform an equipment check to ensure that the following equipment is working:

- Cardiovascular monitoring
- Pulse oximetry
- Capnography (has been shown to detect apnea sooner than pulse oximetry; if capnography is not available use *direct visualization of the chest wall* to monitor for apnea)

Position the child appropriately (avoid supine position when possible) in a monitored setting and have extra help available in the room. Ideally, one nurse dedicated to monitoring the vital signs of the child.

A study by Grunwell et al. of 8000 children identified **risk factors for a failed pediatric sedation** (hypoxia or apnea) outside the operating room:

- Obesity
- Sleep apnea or history of snoring
- Age > 7 years
- History of upper respiratory tract infection
- American Society of Anesthesiologists class 2 or greater

Family Presence During Pediatric Procedural Sedation

The EM literature has shown over and over that families prefer staying at the bedside for procedures. Parents use of distraction techniques with music or videos from smartphones or tablets, and even helping out in the procedure can improve parental satisfaction and decrease the child's anxiety. So generally speaking it's a good idea to have mom or dad at the bedside helping out. However, we've all been in the situation when mom or dad starts freaking out during the procedure – and usually we can anticipate which family members will react this way – so for those folks, you may elect to ask them to step out of the room during the procedure.

Medications for Pediatric Sedation

Ketamine

Ketamine has become the most common agent for pediatric procedural sedation. It provides the desired trifecta of analgesia, sedation and amnesia in one single agent. Some routes and combinations are described in the following table.

	Ketamine IV	Ketamine IM	Ketamine + Midazolam IV
Dose	1-2 mg/kg slow IV push.	4-5 mg/kg IM	Ketamine 1-2 mg/kg + Midazolam 0.01-0.5mg/kg IV
Onset	1-5 min	4-5 min	Same as IV
Duration	Approx. 20min	Approx. 25 min	> 25 min
Benefits	1. Provides Analgesia, Sedation and Amnesia 2. Predictable onset and offset. 3. Does not decrease respiratory drive.	Same as IV	1. Theoretically postulated to reduce emergence reaction → no evidence to support this. 2. Good for long procedures. 3. Reduced emesis
Side-effects	Emesis Laryngospasm Emergence reaction	Similar IV but higher rate of emesis	Prolongs recovery time
Recovery	Approx. 60 min	Approx. 90-120 min	> 120 min

IV Ketamine is generally preferred over IM Ketamine. IM Ketamine has a longer recovery period, a higher rate of emesis and is also difficult to titrate if more sedation needed.

Rapid push dose of IV Ketamine at 0.8mg/kg as an alternative to slow IV push Ketamine, has been evaluated by Chinta et al. in a pilot study of 20 children. The preliminary data are encouraging as the success of adequate sedation and adverse reactions seen were comparable to the standard dose and slow IV push while having a shorter recovery time.

However, rapid push dose IV ketamine can not be recommended for pediatric procedural sedation until a large validated RCT has shown definite results.

Benzodiazepines are useful for *treating* the rare emergence reactions that are associated with Ketamine, but they *do not decreased the likelihood* of an emergence reaction occurring. Furthermore, co-administration of midazolam increases the risk of respiratory complications even though the risk of emesis is reduced.

Contraindications to ketamine

- Age <3month
 - Increased risk of respiratory complications
 - Animal studies suggest NMDA antagonists are associated with apoptosis and neuro-degeneration in developing brains
- History of schizophrenia/psychotic disorder

Etomidate

Etomidate has been shown to be safe for procedural sedation in the pediatric population. Its' benefits include a favorable hemodynamic profile and short duration of action. Consider how much time you anticipate the procedure to last, as Etomidate is best suited for short procedures.

Etomidate Dosing for pediatric procedural sedation:
0.1 to 0.2 mg/kg slow IV push

Propofol

The risks of respiratory depression with Propofol are much higher than with Ketamine. In addition, Propofol does not have any analgesic properties and so it is recommended that it be combined with an analgesic such as fentanyl.

Dosing for pediatric procedural sedation: 0.5-1mg/kg slow IV push

Fentanyl +Midazolam

A combination of fentanyl and midazolam used to be a popular cocktail for procedural sedation. This combination is **no longer recommended** as it has been associated with a high incidence of adverse events including respiratory depression and apnea.

Nitrous Oxide (NO)

Nitrous oxide is weak dissociative anaesthetic and it gives a rapid, reliable change in depth of analgesia and sedation with a rapid recovery. Effective analgesia can often be obtained with local lidocaine or regional nerve blocks but still require a calm and sedated child to complete the procedure. Nitrous oxide is especially well suited for the patient who requires more **anxiolysis** than pain control. Examples of procedures where Nitrous oxide would be a reasonable option include

genital lacerations and reduction of forearm fractures. Studies have shown that nitrous oxide sedation, in conjunction with a hematoma block for forearm fractures, was just as effective as IV ketamine and midazolam, AND had a faster recovery time.

Dosing: Nitrous oxide is delivered by nebulizer via a gas system, usually 50% NO as a baseline dose. Some machines will allow you to adjust the percentage of nitrous the patient is inhaling so you can titrate the depth of sedation. You can add an opioid or benzodiazepine to achieve a deeper sedation.

Time of onset: approximately 3-5 min

Recovery: approximately 3-5 min

How long does a child need to be observed in the ED post procedural sedation?

The effects and duration of each sedative agent will depend on dosing, route of administration and the patient's metabolism of the drug(s). In terms of assessing a child for safe discharge home, they should be able to walk by themselves, tolerate oral fluids without emesis and have reliable caregivers at home who can monitor them closely. The TREKK guidelines published the following recommendation: "Monitor until the patient is able to perform

their baseline (developmentally appropriate) activities (speech, motor, cognitive) as well as tolerate oral intake."

Pediatric Sedation for Diagnostic

For non-painful procedures, **distraction** should be attempted before medications are administered. Some departments are equipped with visual equipment that can distract children in the radiology department.

If distraction techniques are ineffective, **IN midazolam** is recommended as first line therapy for sedation. If IN midazolam is not available, oral midazolam is recommended.

- **Intranasal dose:** 0.3mg/kg (max 10mg); time of onset: 7-10min
- **Oral dosing:** 7mg/kg (max 20mg); time of onset: 15-20min

Before administering midazolam, consider the recovery time and that it may cloud your physical and neurological assessments of the patient. Perform a good neurological exam *before* the sedation!

Pediatric Sedation for Lumbar Puncture

An important intervention to maximize the chances of success with lumbar puncture is adequate local pain control.

Anesthetizing the skin with topical lidocaine (LMX 4%) can be helpful in this regard without having to resort to the discomfort of injected lidocaine. LMX has an onset within 30mins with reliable anesthetic effect at about 7 minutes, and was shown to increase success of lumbar puncture in a two prospective observational studies of 428 and 1,474 patients. Local pain control, along with distraction techniques can often obviate the need for systemic sedation. For young infants who cannot be distracted, **Sucrose has been shown to be an effective sedative**. Sucrose can often achieved the desired level of sedation such that other less safe medications are not required in young infants <3months of age.

Medications of choice for sedation for lumbar puncture

< 6 months old: sucrose

6 months - 5 years: IN midazolam (or oral midazolam if IN is not available)

> 5 years: inhaled nitrous oxide or midazolam

Additional Resources:

For the TREKK Summary and Recommendations for procedural sedation please visit:

http://trekk.ca/resources?tag_id=D016292

EM Cases guest experts Samina Ali and Amy Drendel's latest paper on Procedural Sedation

Ali S, Mcgrath T, Drendel AL. An Evidence-Based Approach to Minimizing Acute Procedural Pain in the Emergency Department and Beyond. *Pediatr Emerg Care*. 2016;32(1):36-42. **Abstract** <http://www.ncbi.nlm.nih.gov/pubmed/26720064>

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*This topic was chosen and experts sought out with the help and collaboration of **TREKK***