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"Taming the Wild Child" Pearls, Pitfalls and Controversies in Pediatric Analgesia and Sedation

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Outline

- Myths and Truths
- Pediatric sedation principles
- Reinforce non-PSA options
- Case Presentations
- Current controversies, updates

Myths

• Myth – Kids don't feel pain

- "Pediatric patients seldom need medication for relief of pain. They tolerate discomfort well..."

- Kids can't use pain scales
- Assessment of pain can be difficult in a nonverbal child

Myths

- Young children have no memory of pain
- Worry about addiction
- Fear of side effects

Truth

- Kids less than 2 years get less pain medications than older patients
 Toddlers view pain as punishment
- JCAHO mandates

Children – Not just Small Adults?

- More likely to have airway obstruction during sedation due to a relatively larger tongue, epiglottis and occiput.
- Children desaturate more quickly after apnea than even moderately ill adults
- Children require more frequent sedation dosing and their sedation level is more difficult to assess.

Children – Not Just Small Adults?

- It is essential that drug dosages be calculated based on a precise weight measurement, not a parent's estimate.
- Resuscitation equipment must be size and age appropriate.

Procedural Sedation – Monitoring/Equipment

- Pulse oximetry
- Heart rate monitoring
- Blood pressure before, after medication administration, during recovery
 - Every 5 minutes during deep sedation
- Age appropriate resuscitation equipment and supplies
- Capnography

Capnography

- Detects hypoventilation prior to desaturation
 - Particularly if using supplemental oxygen
 - Children stimulated after 15 sec of hypoventilaton significantly less likely to desaturate vs. 60 sec of hypoventilation
- More sensitive than clinical assessment

× Burton et al. *Acad Emerg Med.* 2006 May;13(5):500-4.

Procedural Sedation - Capnography

- Study of patients undergoing endoscopy
 - Hypoventilation in 56% of procedures and apnea during 24%
 - Staff watching identified hypoventilation in 3% and no apnea
 - Lightdale. *Pediatrics*. 2006 Jun;117(6):e1170-8.

ETCO2 Normal Capnogram

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Source undetermined

ETCO2 and Apnea

• Flatline on capnogram monitor, no chest movement



Source undetermined Ø PD-INEL

ETCO2 and Laryngospasm

• Flatline on capnogram monitor, chest movement in attempt to breath





 3 week old requires evaluation with lumbar puncture for fever and lethargy. Vitals are normal except for fever and tachycardia.
 What are you going to sedate the child with for the lumbar puncture?

Non-PSA Options for Neonates

Oral sucrose

- Release of endogenous opiates as a result of sweet taste
- Safe and effective
- Studied in heel stick, venipuncture, lumbar puncture
 - Stevens B. et al. Cochrane Database Syst Rev 2004; (3):CD001069



Non-PSA Options for Children

Topical anesthesia

- XAP, LET, TAC
- Get it started early (ie. From triage)
- Have parent/caregiver "paint" it on



Epinephrine 0.05 % Lidocaine 4 % Tetracaine HCl 0.5 %

Non-PSA Options for Children

Protective restraint
Papoosing
Best applicable for preverbal child
Risk/benefit discussion





Quickmedical.com



Drugs.com 1 hour to achieve peak effect



PD-INEL HMP Communications, invasivecardiology.com

Behavioral Techniques

- Gain the child's trust
- Child life resources
- Distraction
- Parental presence, and parental preparation
- Age appropriate language
- Provide a positive environment for the child undergoing a painful procedure.

Injected Lidocaine - Tips

- For wounds that require precise anatomic alignment, regional block preferable to infiltration
- No evidence that lido with epi on face, nose, ear digit or penis has ischemic complications
- Buffering with NaHCO3 decreases pain of injection

(1 part of 1 mEq/ml to 9 parts lidocaine)



Buffering Lidocaine

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1 Parts



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Atomized Fentanyl/Versed

Fentanyl (50 mcg/ml)

- 1 2 mcg/kg
- (max of 100 mcg)
- Repeat ¹/₂ to full dose q10 – 15 min as needed for pain

<u>Midazolam (5mg/ml)</u>

- 0.2 0. 5 mg/kg
- (max of 10 mg)
- Repeat ¹/₂ to full dose in 10 – 15 min if needed to achieve goal sedation



PD-SELF LMA North America, emsworld.com

Case Study

• 20 month old, fall into a coffee table. While waiting in the waiting room, mom gave the child a bag of potato chips and some apple juice. How long should we wait for procedural sedation?

Procedural Sedation – Fasting

Fasting

- ASA guidelines consensus based
 - × Two hours for clear liquids
 - × Four hours for breast milk
 - × Six hours for formula, non-human milk, and solids
 - Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: application to healthy patients undergoing elective procedures: a report by the American Society of Anesthesiologist Task Force on Preoperative Fasting. Anesthesiology 1999; 90:896.

Procedural Sedation and Fasting

- Fasting ED studies
- 2 large prospective studies involving ketamine, ketamine/versed, fentanyl/versed
- No difference in complications between those that met fasting guidelines and those that did not
 - Agrawal D. et al. Ann Emerg Med 2003 Nov;42(5):636-46.
 - Roback MG. et al. J. Ann Emerg Med 2004 Nov;44(5):454-9.

Clinical Policy: Critical Issues in the Sedation of Pediatric Patients in the Emergency Department

From the EMSC Panel (Writing Committee) on Critical Issues in the Sedation of Pediatric Patients in the Emergency Department:

- 1. Should Pediatric patients undergo a period of preprocedural fasting to decrease the incidence of clinically important complications in the ED?
- Level B recommendation: Procedural sedation may be safely administered to pediatric patients in the ED who have had recent oral intake.

Procedural Sedation and Fasting

- "Empty mouths, not empty stomachs"
- Insufficient evidence to support the position that fasting guidelines crafted for operative anesthesia should be extrapolated to sedation practice

Fasting and Risk Stratification

- Assess the patient's Risk
- Asses the timing and nature of recent oral intake
- Assess the urgency of the procedure
- Determine the prudent limit of targeted depth and length of procedural sedation and analgesia







- 5 yo female was playing on the monkey bars who fell and suffered a both bone forearm fracture requiring reduction.
- Mom asks what you will use for sedation because last time she was got ketamine she woke up hysterical and screaming... then threw up.

Ketamine Controversies

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- Is adjuvant medication (versed or atropine) needed?
- Is there an advantage to IM versus IV administration?
- What about ketamine and propofol (ketofol)?

Ketamine and Midazolam

- Traditionally given to reduce "emergence" reactions
- Emergence reactions rare
- Adjunctive administration added no benefit in preventing emergence rare
 - × Wathen J. Et al. *Ann Emerg Med* 2000 Dec;36(6):579-88.
 - × Sherwin TS. Et al. Ann Emerg Med. Mar 2000; 25(3): 229-238.

Ketamine and Midazolam

- Why not give it?
- Midazolam increases incidence of oxygen desaturation
 - 7.3 versus 1.6 percent
- Effects were more pronounced in children younger than 10 years of age
 - × Sherwin et al. *Ann Emerg Med.* Mar 2000; 35 (3); 229 238.
 - × Wathen JE. *Ann Emerg Med* 2000 Dec;36(6):579-88.

Ketamine and Atropine

- Ketamine causes increased salivation
- Atropine or glycopyrolate given with ketamine reduces salivation
- As long as dosed to avoid paradoxical bradycardia (doses less than 0.1 mg) relatively harmless
- Data suggests no benefit
 - Brown L et al. Acad Emerg Med. 2008 Apr;15(4):314-8.
 - Heinz P. et al. Emerg Med J. 2006 Mar;23(3):206-9.
 - Green SM. Acad Emerg Med. 2010 Feb; 17 (2): 157-162.

Ketamine – Emergence Reactions

- Diminished emergence reactions by decreasing the amount of environmental stimuli
 - Green SM et al. Ann Emerg Med. Sep 1990; 19 (9); 1033-1046.
 - Kumar A. et al. *Anesthesia*. 1992; 47 (5): 438-439.
- "Suggestive dreaming"
 - Sklar GS et al. *Anesthesia*. 1981; 26 (2): 183-187.

IM versus IV Ketamine

- Observational study of 4252 children receiving IV or IM ketamine
 - O 20 of 29 cases of laryngospasm occurred in the IM group
 - Overall rate of laryngospasm 7 per 1000 sedations
 - Melendez E. *Pediatr Emerg Care* 2009; 25:325.

IM versus IV Ketamine

- IM injection had significantly longer recovery times
 - 0 129 versus 80 minutes in the IV ketamine group
- More vomiting
 - 0 26% versus 12% in the IV ketamine group
 - Roback MG; Wathen JE; MacKenzie T; Bajaj L. *Ann Emerg Med*. 2006 Nov;48(5):605-12.

IM versus IV Ketamine Summary

- Possibly higher adverse respiratory events with IM
- Higher rates of emesis with IM
- Longer recovery period with IM ketamine

• When possible, use IV Ketamine



• 10 year old presents with a displaced distal radius fracture with significant apex dorsal angulation requiring reduction. The nurse asks if you want to try the new sedation technique she heard about using both propofol and ketamine.



PD-INEL Source undetermined

Ketofol

- Using sub-dissociative doses of ketamine (0.5 mg/kg IV) and propofol (1mg/kg)
- Improved airway preservation, decreased vomiting, and decreased need for opioid use when applicable.
- Fewer boluses to maintain sedation
- Higher patient and physician satisfaction scores





Ketofol

Adverse Events	Ketamine	Propofol	Ketofol
Airway Events	Infrequent	Frequent	Infrequent
Heart Rate	Tachycardia	Tachycardia/ Bradycardia	Normocardia
Blood Pressure	Hypertension	Hypotension	Normotension
Emesis	Frequent	Infrequent	Infrequent
Emergence	Frequent	Infrequent	Infrequent

Shah et al. - Methodology

- Canadian study: Ketamine vs Ketofol
- Double, Randomized controlled trial
- 2-17 yo (orthopedic procedures only)
- 136 patients
- Ketamine (0.5 mg/kg IV) + Propfol (1 mg/kg)
- Ketamine (1 mg/kg IV)

• Shah et al. *Ann Emerg Med. 2011;* 57: 425-433.

Shah et al. - Results

- There was less vomiting in the ketamine/propofol (2%) group compared with the ketamine (12%) group
- Ketofol has slightly faster recovery times (13 min) compared to propofol (16 minutes)
- Similar efficacy and airway complications
- All satisfaction scores were higher with ketamine
 Shah et al. Ann Emerg Med. 2011; 57: 425-433.

Ketofol (1 ketamine: 1 propofol)

- Draw up 10ml of Propofol in a 20cc syringe.
 - Propofol comes 10mg/ml.
- Discard 2cc from a 10cc saline flush. Drawl up 2cc of Ketamine.
 - Ketamine 50mg/ml (adjust the dose if you use a different concentration)
 - You now have 10mg/ml
- Inject the Ketamine in the saline flush into a 20cc syringe of Propofol.
- Dose at 0.5 mg/kg IV Ketofol, then redose as needed

Case Study

• 3 yo male falls off the bed hitting his head and eye. Positive LOC describe by the older brother (who pushed him). Vomitted x 3 in the ED. Slightly somnolent, but becomes agitated with exam.

Sedation Options

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- Versed
- Ketamine
- Pentobarbital
- Propofol

Pentobarbital

- Best effects IV
- Can be given IM, PO, Rectal
- Dose 1-6 mg/kg given in 2 mg/kg aliquots
- Many centers is the sedative of choice for diagnostic imaging
- Better than midazolam or chloral hydrate

× Pereira JK. *Pediatr Radiol* 1993; 23:341-44.

Pentobarbital Pros and Cons

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• Pros

• Quick onset (3-5 minutes)

• Lasts 30-40 minutes

Cerebroprotective

• Cons

 Burns on infusion unless diluted

 Can cause respiratory depression and hypotension
 Avoid with porphyria

Pentobarbital - Controversies

- Safe, effective sedation
- Standard for diagnostic imaging if propofol not available
- Never been compared directly to propofol



Summary Slide

- In pediatric sedation, children are not just small adults
- Capnography is becoming the standard of care for procedural sedation
- Topical anesthetics and distraction can get you a long way

Summary

- Adjunct medications not needed for Ketamine
- IV Ketamine has less side effects than IM Ketamine
- Keep an eye out for Ketofol to gain popularity
- Pentobarbital probably most reliable method of sedation for imaging