Pediatric Pain and Sedation

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Disclosures

No relevant financial relationships to disclose

Objectives

- Pain management basics
  - Pain Assessment
  - Treatment options
    - Non-pharmacologic options
    - Pharmacologic options
- Sedation basics
  - Medication choices and dosing
  - Dosing
  - Plan your sedation

Lessons Learned Ped VS Adults

- Less is more
- Series, not parallel
- APAP, IBU early
- Power of non-pharmacologic treatments
- Sucrose, IN (Fentanyl, Versed), Topical (EMLA), Gas > IV
- Nerve blocks

How Big of a Deal is Pediatric Pain?

- Contributing factor in up to 80% of ED visits
- Historically, pain is undertreated
- Prehospital setting
  - >1/3 of children acute pain
  - Of those stating they have pain, 2/3 describe it as intense to severe
  - ¼ of pediatric patients received prehospital analgesia
- ED setting:
  - 30-60% of those in pain receive pain medication

What About Pediatric Pain?

- 1960s: “landmark” paper claimed children don’t require pain management
  - “Pediatric patients seldom need relief of pain after general surgery. They tolerate discomfort well.”
- 1970s: increase in pediatric pain research
- Late 1980s: drug development
- 1990s: first pediatric pain management guidelines

Room For Improvement

Administration of analgesia in children:

- Varies by age
  - Youngest patients are the least likely to receive adequate analgesia
- Rates lag behind those for adults
- Varies greatly by practitioner
- Varies by ethnicity and social economic status
- Varies by ED factors: Crowding (Sills, et.al, 2011)
  - Less timely medication
  - Less overall delivery

Identifying the Problem

ED: Todd et al 2007

- Pain assessed in 83%, median score 8/10
- 60% received analgesia
- Median time to analgesia for moderate-severe pain was 90 minutes
- 74% discharged in moderate-severe pain

Prehospital: Abbuhl et al 2003

- 102 patients, 12.5% received prehospital analgesia → mean time **23 minutes**
- 91 patients received 1st dose in ED → mean time **75 minutes**

Identifying the Problem

Pre-hospital care

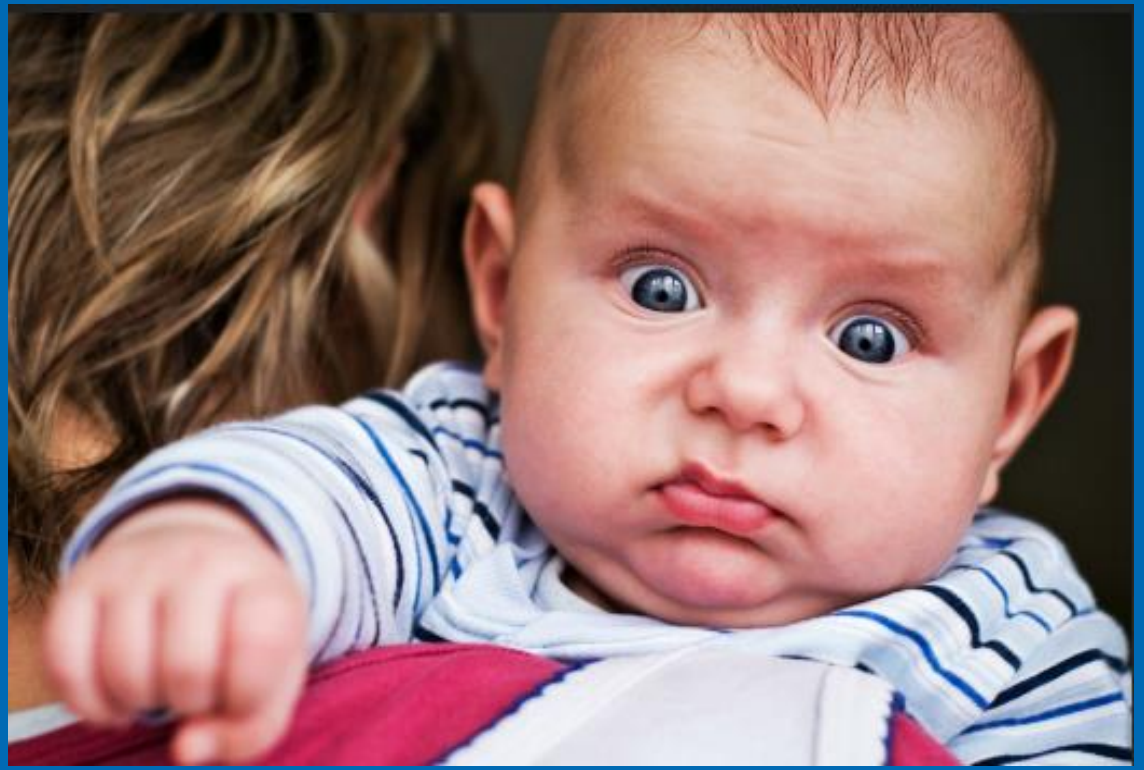
- Browne et. al, 2015:
  - 2 year period: 1,368 children with pain
  - 25% with score documented, of those 85% moderate to severe pain
    - 15% treated with opiates (2x more likely to treat if pain score documented)

Identifying the Problem

- **TAKE HOMES:**

Poor documentation of pain → poor treatment of pain

Analgesia is underutilized, under dosed, and significantly delayed in administration when treating pediatric patients in pain



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Barriers to Pediatric Analgesic Administration

- Lack of adequate assessment tools
- Difficulty in accounting for developmental stage
- Misunderstanding of how to conceptualize and quantify a subjective experience
- Lack of knowledge
- Lack of time, staffing
- Fear of adverse effects
- A boatload of myths

Pediatric Analgesia Myths

- We already do a good job of providing pain control
- Any amount of medication will provide some analgesia
- Opiate administration can lead to chronic dependence
- Kids exaggerate or are unable to adequately self-assess their pain
- Not worth the risk of oversedation, respiratory depression
- Pain medication may alter or mask presenting signs/symptoms
- Children don’t feel pain the same way as an adult

Is There a Down Side?

- Inadequate pain control DOES have negative implications in children
  - Neonates have long-standing alterations in their response to and perceptions of painful experiences
  - Pediatric oncology patients have increased pain scores in subsequent painful procedures
  - Documented PTSD in previously normal children
  - Extends average length of stay

The Challenge: Application

- Set the stage: we have a responsibility for the continuum of care
- Create an appropriate environment
- Assess every patient for pain
- Act on the assessment
  - Non-pharmacologic intervention
  - Pharmacologic intervention
  - Both
- Re-assess

How Do We Assess Pain?

- Pain Scoring Methods
- Behavioral observation (younger children)
- Self-report (older children)
- Physiologic measures

While taking into account developmental factors, special health care needs, cultural and familial factors, language barriers...

Pain Scales: Behavioral Observational

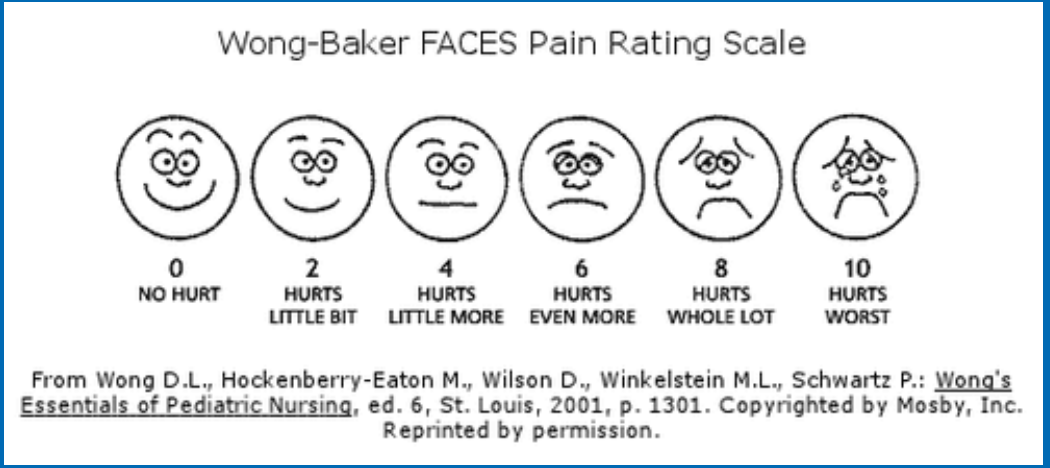
Category	Scoring		
	0	1	2
Face	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant quivering chin, clenched jaw
Legs	Normal position or relaxed	Uneasy, restless, tense	Kicking or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid or jerking
Cry	No cry (awake or asleep)	Moans or whimpers; occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching, hugging or being talked to; distractable	Difficult to console

Each of the five categories is scored from 0 – 2, resulting in total range of 0 – 10, FLACC = Face, Leg, Activity, Cry, Consolability

- FLACC scale:
  - Behavior interpretation
  - Faces, legs, activity, cry, consolability
  - Score 0 to 2 for each of 5 categories
  - Gives a 0 to 10 scale
  - Used commonly by RNs

Pain Scales: Self-Report

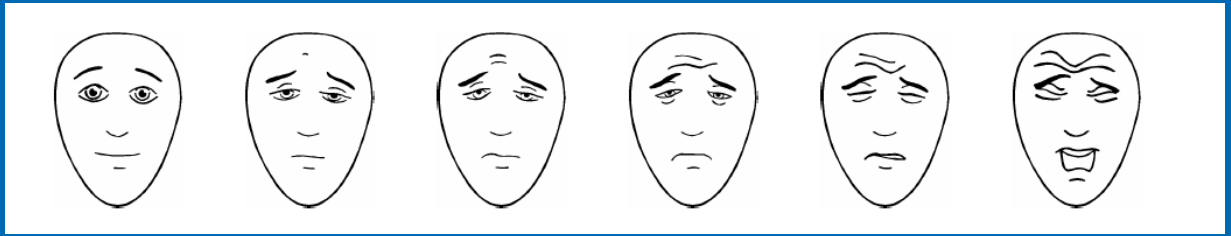
- Wong-Baker Faces Scale
  - Self report scale
  - Child points to face that best represents pain
  - Has been validated but some debate use of happy face at far left



From Wong D.L., Hockenberry-Eaton M., Wilson D., Winkelstein M.L., Schwartz P.: Wong's Essentials of Pediatric Nursing, ed. 6, St. Louis, 2001, p. 1301. Copyrighted by Mosby, Inc. Reprinted by permission.

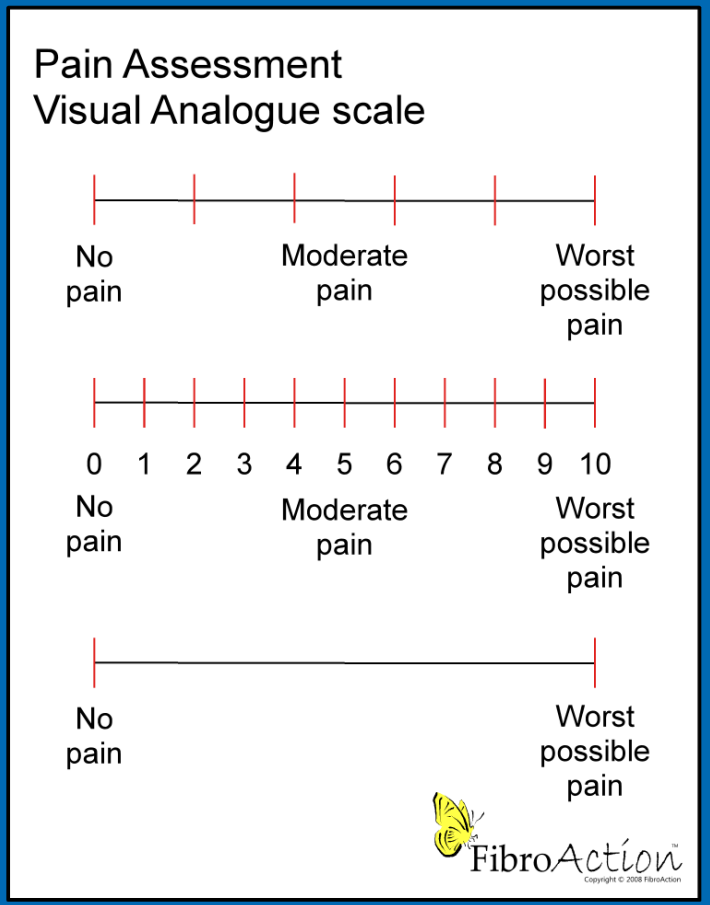
Pain Scales: Self-Report

- Faces Pain Scale-Revised (FPS-R)
  - Used in children 4-16 years
  - Self report scale
  - Validated in multiple settings
  - Thought to be more realistic given more impartial appearance of far left face



Pain Scales: Self-Report

- 10-cm Visual Analog Scale
  - Older children >8 years of age
- Verbal Reporting Scale:
  - "On a scale of 0 to 10… 0 being no pain, 10 means the worst pain in your life…what number represents your pain??"
- Need to have abstract thought ability to use these scales



Management Options

Non-pharmacologic and Pharmacologic

Non-pharmacologic Techniques

Physical Methods

- Immobilization
- Ice/heat
- Position of comfort
- Elevation

Cognitive-Behavioral

- Distraction Toolbox:
  - Bubbles
  - Pinwheel
  - View finder
- DVD player or music
- Adequate preparation
- Imagery
- Storytelling
- Parental support

What About Those Infants?

- Swaddling
- Skin-to-skin contact
- Breastfeeding
- Analgesic effects of the non-nutritive suck
  - Pacifier shown to have analgesic effect during venipuncture
  - Pacifier + sucrose shown to be more effective

Administer 2ml of 25% sucrose solution by syringe into infant's mouth OR Suck the solution out of a nipple no more than 2 minutes prior to the procedure

Fentanyl

- Used more commonly in general
- 100 times more potent than morphine (dosed in mcg)
- Respiratory depression is less common
- Works quickly (onset of relief between 30 sec and 5 min)
- Administered IV, IN, buccal, nebulized
- Dose: 0.5 to 1 mcg/kg/dose
  - IN 1 to 2 mcg/kg/dose
- Unusual side effect: chest rigidity (*super rare…*)

…BUT SCARY!!

IN Fentanyl

Many advantages:

- More rapid and painless administration
- Higher patient and provider satisfaction
- Similar onset of action to morphine
- Decreased time to opioid administration
- Bypasses 1st pass metabolism
- Bioavailability about 70% of IV
- Dose: 1 to 2 mcg/kg IN (50 mcg/mL concentration)

IN Fentanyl

Borland, et al 2007

- Compared 1.7 mcg/kg IN fentanyl with 0.1mg/kg IV morphine
- 67 children in ED with long-bone fractures
- Equivalent onset of action, adverse event rate, adequacy of pain control
- Concluded IN fentanyl superior due to ease of administration, painless, and more rapid control of pain

Bendall, et al 2011

- Retrospective comparative study of 3312 patients 5 to 15 years
- Prehospital IN fentanyl and IV morphine equally effective

Quality of Care with IN Fentanyl

- Children's Hospital Colorado study of 1702 patients 0 to 18 years of age
  - Compared IV opiates to IN Fentanyl
- Improved time to analgesia
- Improved time to discharge
- Shorter length of stay
- Equal effectiveness
- Equal safety

Route	IV	IN
Timeliness (minutes):		
Order to Med	12 (6, 18)	8 (2, 14)
Med to DC	181 (63, 300)	93 (0, 213)
Length of Stay	183 (139, 240)	149 (113, 196)
Effectiveness		
Δ in Pain Score	-4 (-4.2, -3.4)	-4 (-4.5, -3.2)
Repeated dosing	1.00 (ref)	0.5 (0.3, 0.8)

Morphine

- Standard narcotic in ED, hospital, post-operative setting
- Can be administered IV or IM
- Side effects: respiratory depression, histamine release (itching)
- Pediatric dosing: 0.1 mg/kg
- Benefit: works well for pain
- Disadvantage: only parenteral administration

Ketamine for Pain?

- More commonly used for sedation, ketamine does have analgesic effects
- Primary use: pain management recalcitrant to first-line medications, intubation
  - Advantages: rapid on-set and offset, no reported overdoses
- Dose: 0.2 to 0.5 mg/kg IV, 0.5 to 1 mg/kg IM
- Benefits: supplements treatment-avoids single receptor pain management

Ketamine

- Multiple routes possible:
  - Reid C, et al 2011: Case report of prehospital intranasal ketamine use in a pediatric burn victim
  - Analgesia achieved without need for IV/IO access

- Norambuena C et al 2013: Oral ketamine and midazolam for pediatric burn patients: a prospective, randomized, double-blind study
  - Oral midaz/ketamine combo superior to midaz/APAP/codeine
    - *J Pediatric Surg. 2013 Mar;48(3):629-34*

IN Ketamine vs IN Fentanyl

PICHFORK (Pain in Children Fentanyl or Ketamine)

- Double-blind randomized controlled trial for pediatric limb injury
  - Fentanyl 1.5 mcg/kg, Ketamine 1 mg/kg
- 73 children (37 Fentanyl, 36 Ketamine)
  - Median age 8 years
  - 63% male
  - Median baseline pain 80 mm
- No difference in:
  - Reduction in pain
  - Patient satisfaction
- Slight difference in adverse events in Ketamine group (3 pts moderate sedation)

Annals of EM. 2015 Mar;65(3):248-254.e1

Pre-Hospital Ketamine

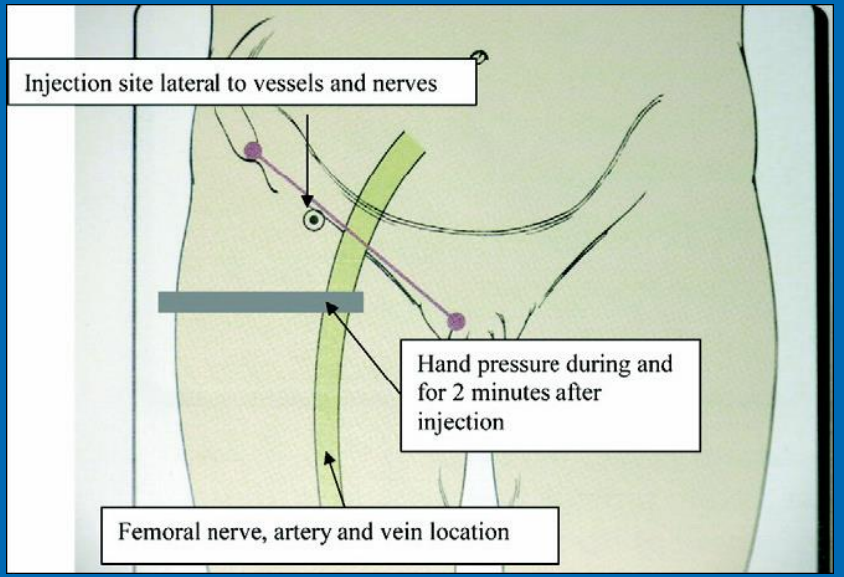
- Bredmose et al, 2009: Ketamine used in prehospital trauma setting by physicians for 164 children < 16 years of age
  - 1mg/kg IV, 4mg/kg IM
  - 43% injuries caused by MVC, 23% burns, 21% falls from height
  - NO adverse events
- Svenson JE, Abernathy MK 2007: Retrospective review of 40 aeromedical transports receiving IV/IM ketamine
  - Age range 2months – 75 years
  - 1mg/kg IV and 5mg/kg IM
  - Indications: hypotension with need for analgesia, combativeness, pain unresponsive to narcotics
  - NO adverse reactions

Did You Know?

- Study of 259 patients
  - 158 with FICNB, 101 with systemic analgesia
- No difference in adverse events
- Improved pain control in FICNB group
  - Pain scores, overall use of systemic analgesia

Fascia Iliaca Compartment Nerve Block Versus Systemic Pain Control for Acute Femur Fractures in the Pediatric Emergency Department

Tara L. Neubrand, MD, Kelley Roswell, MD, Sara Deakyne, MPH, Kendra Kocher, BA, and Joseph Wathen, MD



Pediatric Sedation

Medications, Dosing, indications

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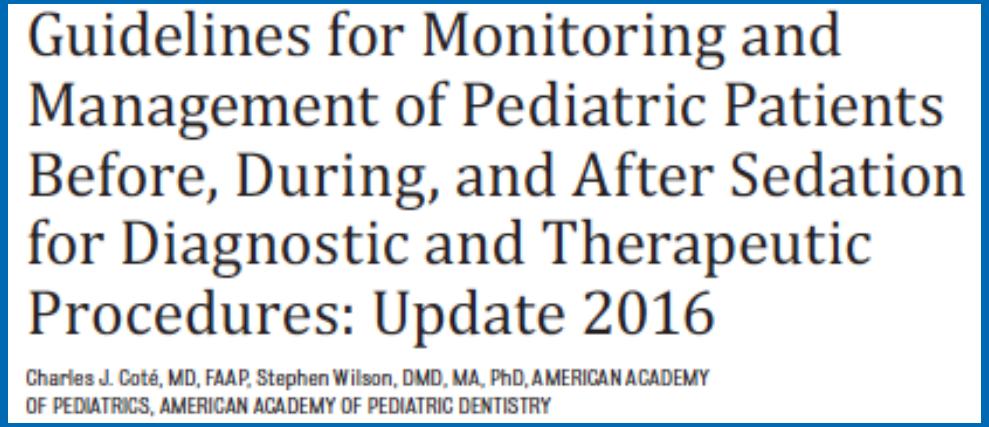
Goals of Sedation

- To guard patients safety and welfare
- To minimize physical discomfort and pain
- To control anxiety, minimize psychological trauma
- To modify behavior and/or movement to allow completion of the procedure
- To return the patient to a state in which discharge is safe

AAP Sedation Guidelines

- Updated in 2016
- Provides recommendations on:
  - Equipment
  - Training
  - Personnel
  - Interventions
  - Follow up care
- New additions in 2016:
  - Recommendation for capnography for all DEEP sedation and consideration of capnography for all MODERATE sedation
  - Recommendation for PALS training of all providers of pediatric sedation


Guidelines for Monitoring and Management of Pediatric Patients Before, During, and After Sedation for Diagnostic and Therapeutic Procedures: Update 2016

Charles J. Coté, MD, FAAP, Stephen Wilson, DMD, MA, PhD, AMERICAN ACADEMY OF PEDIATRICS, AMERICAN ACADEMY OF PEDIATRIC DENTISTRY

Bassett KE, et. al, Ann Emerg Med, 2003

Midazolam

- Most commonly used *anxiolytic*
  - Does not provide deep sedation
  - Does provide amnesia to patients
- Dose(s) are route dependent:
  - IV/IO: 0.1 mg/kg (max 5 mg)
  - IM: 0.2 mg/kg (max 5 mg)
  - IN: 0.2 to 0.4 mg/kg (max 10 mg)
  - PO: 0.5 mg/kg (max 20 mg)
- Can be given in combination with other medications safely
- Primary use: short procedures where anxiety may be high: laceration repairs, GU examinations, IV placements

Discharge After IN Midazolam

How long do you need to wait after IN midazolam before starting the procedure?

- Pharmacokinetic study of 60 children (mean age 3.3 years) undergoing laceration repair using IN midazolam at a dose 0.4 mg/kg (max 10 mg)
  - Median time to peak Midazolam concentration: 10.1 minutes
  - Plasma concentration was 90% of maximum from 5 to 17 minutes)
  - Median time to procedure: 26 minutes
  - 2 adverse events noted: one patient vomited, 1 had a paradoxical reaction

Nitrous Oxide

- Inhaled gas producing sedation, analgesia, amnesia
- First used in the prehospital setting in 1970
- Used in pediatric dentistry, orthopedics, few EDs
- Advantages:
  - Rapid onset
  - Duration of action 3-5 minutes
  - No IV required
  - Patient-administered

Nitrous Oxide

- German et al 2011: 50% nitrous oxide-oxygen mixture used for pediatric LPs
  - Age range 2-12.
  - Nausea in 2/39 (5%)
  - Vomiting in 1/39 (2.5%)
- Children's Hospital Colorado study examining nitrous oxide for laceration repair:
  - Comparison to intranasal midazolam
  - Outcomes: ED length of stay, provider satisfaction

Ketamine

- Dissociative agent providing combined sedation, analgesia and amnesia
- Use: Intubation for sepsis patients
- Advantages: rapid on-set and offset, no reported overdoses
- Dose: Typically: 1 mg/kg
  - When used with other medications, consider reducing to 0.75 mg/kg
  - Given high concentration per mL-usually dilute to 2-3 mL for a slow push

Ketamine

- Concerns:
  - Respiratory adverse events: respiratory depression, airway compromise, laryngospasm
    - Increased frequency with IM and rapid IV administration
    - Increased frequency with co-administered anticholinergic or benzodiazepines
  - Emergence reaction
  - Vomiting-Can be ameliorated with Zofran
  - Neurotoxicity
  - Psychotropic effects-even with analgesia dosing (dizziness, dysphoria, and confusion)

Propofol

- Deep anesthetic providing rapid onset sedation with rapid metabolism and offset
- ”Milk of Amnesia”…
- Emulsified in albumin (cannot use in patients with allergies to soy, eggs)
- Multiple uses:
  - Migraine headaches, status epilepticus
- Sedative dose: Bolus of 1 mg/kg followed by 0.5 mg/kg doses titrated to effect

Propofol

- Study of 393 patients sedated with propofol
- Majority were for orthopedic indications (2 ocular examinations)
- Median dose: 2.7 mg/kg
- 19 (5%) had hypoxia, 11 (3%) required BMV
- Majority had transient drop in systolic BP, all without signs of poor perfusion

Conclusions: “Propofol sedation is efficacious and can be used safely in the ED setting under the guidance of a protocol. Transient cardiopulmonary depression occurs, which requires vigilant monitoring by highly skilled practitioners. Propofol is well suited for short, painful procedures in the ED setting”

Bassett KE, et. al, Ann Emerg Med, 2003

Ketamine + Propofol = “Ketofol”

- Combination of commonly used sedatives to reduce side effects
  - Reduction of apnea risk with propofol
  - Reduction of nausea and vomiting with ketamine
- Case series of 219 patients (median age 13 years) with orthopedic injuries
  - Median dose was 0.8 mg/kg of Propofol and Ketamine
  - Sedation effective in all
  - 3 patients (1.4%) with airway events (one requiring PPV)
  - 2 patients had an emergence reaction requiring treatment
  - Median recovery time: 14 minutes
  - Mean provider satisfaction: 10 (scale of 0-10).

Andolfatto, et. al. Acad Emerg Med, 2010

Ketofol vs. Ketamine

Prospective randomized trial of Ketamine (KM) vs Ketamine-Propofol (KP) for orthopedic reductions

- 183 patients (96 KM and 87 KP) enrolled
- No difference in adverse events
- Efficacy was higher in KM (99%) vs KP (90%)
- No difference in recovery time
- Provider satisfaction higher for KM compared to KP
- No difference in parent satisfaction

Conclusion: Ketofol seems a reasonable choice for sedation but does not demonstrate a significant advantage over Ketamine alone

Weisz K, et. al, J Emerg Med. 2017

What About Adjuncts?

Most common side effect associated with sedation: nausea and vomiting

- Double-blind randomized placebo-controlled study of ondansetron conducted among 255 patients undergoing procedural sedation
- Outcomes: vomiting in ED or within 12 hours of discharge
- 11% absolute reduction in vomiting with a number needed to treat of 9 for vomiting
- No difference in ED length of stay
- No difference in parental satisfaction

Langston WT et. al., Ann Emerg Med, 2008

Summary

- Make pain assessment a “vital sign” and then act on the assessment
- Nonpharmacologic treatment augments classic, pharmaceutical pain management.
- Sedation outside the operating room to facilitate care in the emergency department is safe with lots of options to choose from

Know your tool box!

Questions?

Thank you!