Management Update on Pain, Agitation, and Sedation in the Emergency Care of Children

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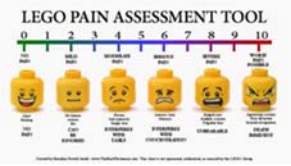
Learning Goals

- Determine a stepwise approach to pediatric PSA
- Review key concepts, controversies and new approaches
- Provide resources
- Presentation does not include:
  - pain assessment tools and scores
  - definitions
  - every drug and dose
  - studies that don't change practice



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Background

- Very broad topic
  - 1 screaming child with a fishhook injury + 2 hysterical parents=disruption of your entire ED flow
  - Are you treating pain only, anxiety, or performing procedural sedation???
- Renewed emphasis on pain
  - Joint Commission, HCAHPS scores
  - Pain medications are one of most common categories in reported pediatric medication errors
  - Readmits secondary to inadequately treated pain
  - Additional evidence that inadequately treated acute pain leads to chronic pain
  - Search for nonopioid solutions to pain

Pain 101

- Metabolic effects of pain
  - Increased release of catecholamines, glucagon and corticosteroids
  - Catabolic state induced by acute pain may be more damaging to infants and young children due to their higher metabolic rates and lower nutritional reserves than adults
- Complex components in pain transmission
  - Chemical mediators, nociceptors, A delta fibers, C fibers, dorsal horn of spinal cord, thalamus, limbic system, cerebral cortex, endorphins…..

All components are present by 24 weeks gestation

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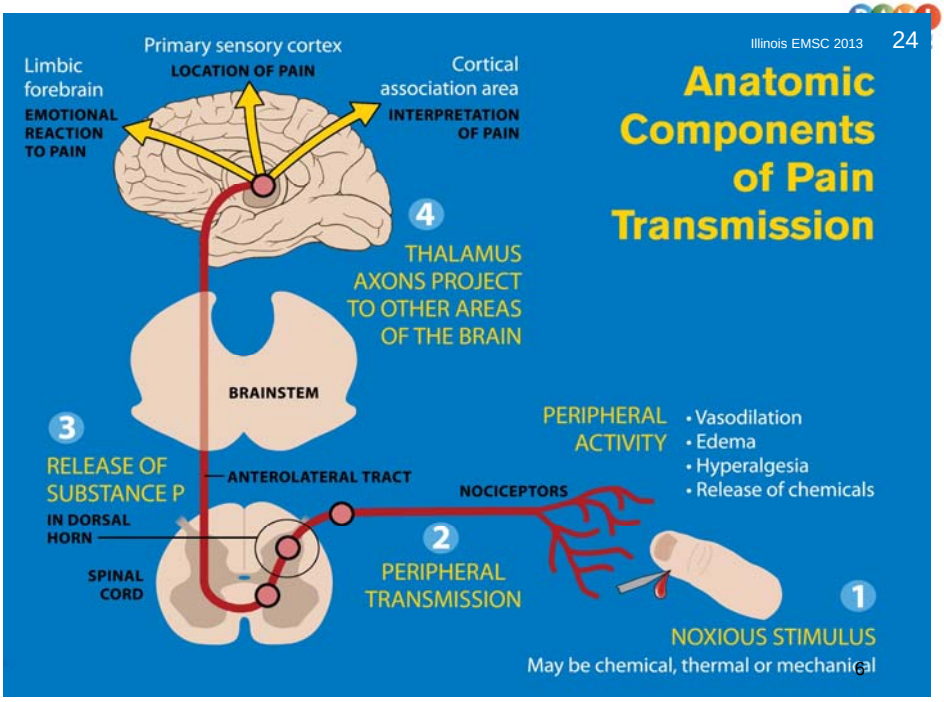

Physiologic Consequences of Unrelieved Pain in Children

Responses to Pain	Potential Physiologic Consequences
Respiratory Changes	
Rapid shallow breathing Inadequate lung expansion Inadequate cough	Alkalosis Decreased oxygen saturation, atelectasis Retention of secretions
Neurological Changes	
Increased sympathetic nervous system activity and release of catecholamines	Tachycardia, elevated BP, change in sleep patterns, irritability
Metabolic Changes	
Increased metabolic rate with increased perspiration; Increased cortisol production	Increased fluid and electrolyte losses Increased cortisol and blood glucose levels
Immune System Changes	
Depressed immune and inflammatory responses	Increased risk of infection, delayed wound healing
Gastrointestinal Changes	
Increased intestinal secretions and smooth muscle sphincter tone, nausea, anorexia	Impaired gastrointestinal functioning, poor nutritional intake, ileus
Altered Pain Response	
Increased pain sensitivity	Hyperalgesia, decreased pain threshold, exaggerated memory of painful experiences

Factors affecting patient response to painful stimuli

- Age, Gender, Ethnicity
- Socioeconomic and Psychiatric factors
- Culture and Religion
- Genetics
- Previous experiences
- Patient/family perceptions
- Patient/family expectations
- Catastrophizing

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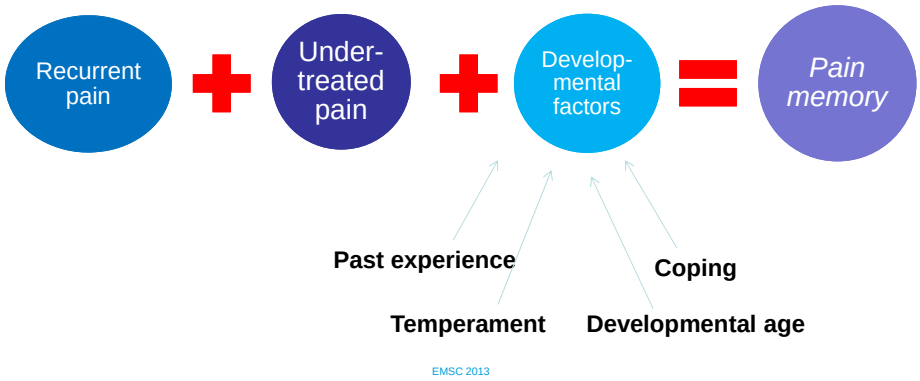
Creation of pain memory in children

What we do in the ED during a child's first painful experience has lasting effects!



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Background: Sedation and Analgesia on a Continuum

- Sedation levels exist along a **continuum** but it is clinically challenging to use discrete sedation stages or terminology.
- The Joint Commission and American Society of Anesthesiologists (ASA) adopted definitions to define the continuum of levels that range from minimal sedation to general anesthesia:
  - Analgesia →
  - Minimal sedation→
  - Moderate sedation and analgesia →
  - Deep sedation and analgesia →
  - General anesthesia
  - *Dissociative sedation*

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Background-Definition of PSA

Procedural sedation and analgesia (PSA) is a standard practice of emergency physicians, recognized by the American College of Emergency Physicians (ACEP) as integral to the practice of emergency medicine.

PSA is **defined** as the use of pharmacologic agents to provide anxiolysis, analgesia, sedation, **or** motor control during procedures or diagnostic tests.

- Procedural sedation and analgesia reduces the discomfort, apprehension, and potential unpleasant memories associated with procedures and facilitates improved performance.

Procedural Sedation Definitions

Organization	Definition or Statement
ACEP	Technique of administering sedatives or dissociative agents with or without analgesics to induce an altered state of consciousness that allows the patient to tolerate painful or unpleasant procedures while preserving cardiorespiratory function. **The intent of the sedation, not the agent itself, determines whether medication is being delivered to relieve anxiety or to facilitate a specific procedure as with procedural sedation**
ASA	Administration of sedatives or dissociative agents with or without analgesics to induce a state that allows the patient to tolerate unpleasant procedures while maintaining cardiorespiratory function.
AAP	The sedation of children is different from the sedation of adults. Sedation in children is often administered to control behavior to allow the safe completion of a procedure. A child's ability to control his or her own behavior to cooperate for a procedure depends both on chronologic and developmental age. *AAP uses the terms minimal, moderate and deep sedation.*

When to consider PSA?

- Fracture reduction & orthopedic procedures
- Burn & wound debridement
- Cardioversion, endoscopy or bronchoscopy
- IV or blood draw Lumbar puncture
- Chest tube insertion
- Radiographic studies in agitated or uncooperative patients
- Abscess incision & drainage
- Laceration repair
- Foreign body removal

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Other scenarios requiring sedation, analgesia, and/or anxiolysis

- Chronic pain conditions
  - Cancer
  - Rheumatologic
- Adolescents posing a threat to themselves or staff
- Mental health or chronic disease disorders with a new onset painful condition
  - Autism plus foreign body or fracture
  - Oncology patient on baseline pain meds with a fracture
- Post-op pain
  - Tonsillectomy

Case Scenario Examples

- 14 yo male who collided with another player during "football frisbee" presents with obvious deformity and swelling of his lower leg. He is cooperative and polite during exam but his facial expressions indicate he is severe pain. His father is at the bedside wringing his hands. The patient's mother arrives and begins yelling at the father saying " I knew I couldn't leave him with you for even one weekend much less the whole summer". The patient begins crying and asking why no one is helping him…… family meltdown!

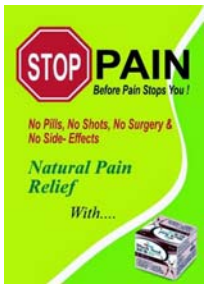
- 5 year old female with 2 cm cut to her eyelid arrived via EMS from school. She is crying hysterically and saying "please don't tell my momma I was a bad girl". Father arrives ten minutes later and appears quiet and exhausted. ED staff is concerned that he doesn't seem to be doing anything to comfort his daughter. During your evaluation you ask if he has notified the child's mother of the accident. The child's eyes light up but he shakes his head. Finally you ask why he has not called the girl's mother- he responds "she died 3 months ago"…….

Case Scenario Discussion Examples

- 9 year old male hit by a car while playing in a parking lot. The driver fled the scene and a neighbor drove him to your ED. He is covered in blood and has a severe degloving injury of his lower extremity. There are no other injuries and he is alert and oriented. He is given morphine twice and is now cooperative, talking, and calm but alert. Several hysterical family members have arrived and are now at bedside. Patient tries to sit up during his radiographs to see his leg. Nursing staff is asking for a Versed order for "anxiety" and to make him be still during x-rays. You decline to order since you have already given 0.2 mg/kg of morphine. After x-rays are completed the patient becomes lethargic with shallow breathing even though he was screaming five minutes ago while being forced to lay down.

Give up looking for the "Cookbook"- No universal *kid* recipe

- What do you want to cook?
- Know your ingredients
- Recipe options
- Use careful measurements
- Follow the steps
- Bake and observe
- Don't leave the kitchen!



Stepwise Approach to PSA or Pain Management in Children

1. Situation checkpoint
2. Developmental checkpoint or "time out"
3. Family dynamic checkpoint
4. Facility/staff checkpoint
5. Patient assessment checkpoint
6. Management checkpoint-Choose your "recipe"
7. Monitoring and discharge checkpoint

Step 1: Determine the situation-what are you trying to accomplish or treat?

- Pain only
- Pain and anxiety or agitation
- Anxiety only
- Agitation only
- Procedure that will induce pain or anxiety
- Chronic pain exacerbation
- Parents are a pain but kid is great

Determination accomplished after a brief history and PE or triage

Step 2: Perform a developmental or "time out" Checkpoint

- What is the developmental stage?
- Is development normal for age?
  - Developmental delay
  - Autism
  - Special health care needs
  - Mental health
  - Recent traumatic events

- **What are characteristics of this developmental stage in response to pain?**
- **How do you adapt your approach based on developmental level?**
- **Kids and teens don't always follow the charts!**

Domains of Development

Physical Domain:

- body size, body proportions, appearance, brain development, motor development, perception capacities, physical health.

Cognitive Domain:

- thought processes and intellectual abilities including attention, memory, problem solving, imagination, creativity, academic and everyday knowledge, metacognition, and language.

Social/Emotional Domain:

- self-knowledge (self-esteem, metacognition, sexual identity, ethnic identity), moral reasoning, understanding and expression of emotions, self-regulation, temperament, understanding others, interpersonal skills, and friendships.

Child's Understanding of Pain, Behavioral Responses, and Verbal Descriptions by Developmental Stage

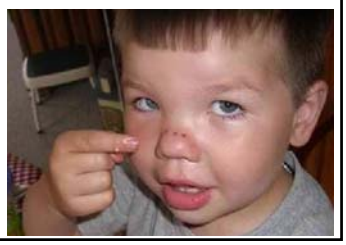
Age Group	Understanding of Pain	Behavioral Response	Verbal Description
		Infants	
6 months	No understanding of pain; is responsive to parental anxiety	Generalized body movements, chin quivering, facial grimacing, poor feeding	Cries
6–12 months	Has a pain memory; is *responsive to parental anxiety*	Reflex withdrawal to stimulus, facial grimacing, disturbed sleep, irritability, restlessness	Cries
		Toddlers	
1–3 years	Does not understand what causes pain and why they might be experiencing it	Localized withdrawal, resistance of entire body, aggressive behavior, disturbed sleep	Cries and screams, can't describe intensity /type of pain; *Use words for pain such as owie and boo-boo*
		Preschoolers	
3–6 years (preoperational)	Pain is a hurt; Does not relate pain to illness; may relate pain to an injury; *Often believes pain is punishment;* Unable to understand why a painful procedure will help them feel better or why an injection takes the pain away	Active physical resistance, directed aggressive behavior, strikes out physically and verbally when hurt, low frustration level	Has language skills to express pain on a sensory level; Can identify location and intensity of pain, denies pain, may believe his or her pain is obvious to others
		School-Age Children	
7–9 years (concrete operations)	Doesn't understand cause of pain; Understands simple relationships between pain and disease and need for painful procedures to treat disease ; May associate pain with feeling bad or angry; recognize psychologic pain related to grief and hurt feelings	Passive resistance, clenches fists, holds body rigidly still, suffers emotional withdrawal, engages in *plea bargaining*	Can specify location and intensity of pain and describes pain physical characteristics in relation to body parts
10–12 years (transitional)	Better understanding of relationship between an event and pain; More complex awareness of physical and psychologic pain,(moral dilemmas , mental pain)	May pretend comfort to project bravery, *may regress with stress and anxiety*	Able to describe intensity and location with more characteristics, able to describe psychologic pain
		Adolescents	
13–18 years (formal operations)	Has a capacity for sophisticated and complex under-standing of causes of physical and mental pain; Recognizes pain has qualitative and quantitative characteristics; *Can relate to pain experienced by others*	Want to behave in socially acceptable manner -like adults; controlled response; May not complain if given *cues* from other healthcare providers	More sophisticated descriptions with experience; may think nurses are in tune with their thoughts, so don't need to tell nurse about their pain

Step 3: Family Dynamic Checkpoint

- Who is there with the child?- parents, siblings…..
- Who is the legal guardian?
- Who actually cares for the child?
- Who do you want at the bedside?
- Culture, past experience
- What can they tolerate
- Time commitments
- Family personality
- Family stress level

A quick visual or peek in the door is invaluable.

- What is child's personality?
- What is caregiver's personality?
- Is caregiver going to be a help or hindrance?



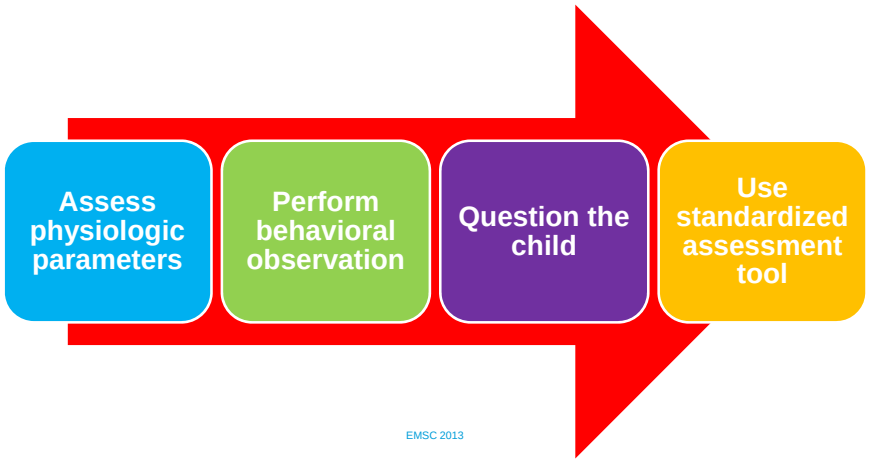
Step 4: Facility Checkpoint

- Staffing and setting
  - Community, rural, children's hospital
- Staff/team experience
  - Pediatric
  - Sedation
- Hospital policies on PSA
- Acuity of the ED
- Other priorities
- Equipment
- Monitoring
- Backup

Step Five: Patient Assessment Checkpoint

- Standard Pre-procedural Sedation Assessment
- Assessment of pain and injury severity
  - short or long procedure
- Focus on risk factors from history and PE
- CSHCN, genetic syndromes,…
- Chronic illness
- History of failed sedation
- Psychiatric and mental considerations
- Body habitus
  - Weight- ideal or real?

Elements of pain assessment



Why children might not disclose pain

- Avoid painful treatments
- Fear of being sick
- Fear of healthcare professionals
- Protect their parents or caregiver
- Avoid hospitalization
- Desire to return to activities
  - Sports
  - Social events
  - School

Step 6: Management Checkpoint- Choose your "recipe"

Non-pharmacologic "ingredients" (by age)

- Everyone in ED needs a little child life 101 course
- Engage parents, volunteers, etc.
- Lobby for child life specialist in your ED if ↑ ped volume

Pharmacologic "ingredients"

- Topical
- Local anesthetics or blocks
- Oral, nasal, IV preferred over IM/rectal

Usually need both pharm and non-pharm

Non-pharmacologic measures- infants

- Swaddling
- Holding
- Rocking
- Sucking
  - Sucrose pacifier
  - Non-nutritive sucking
- Dim lighting
- Music
- Picture reading
- Toys
  - Key chains
  - Rattles
  - Blocks

Non-pharmacologic measures - toddlers

- Provide distraction with music
- Provide a pacifier
- Provide light touch or massage
- Try repositioning, splinting
- Apply cold or hot pack
- Offer play with blocks
- Drawing with crayons and paper
- Encourage picture reading
- Encourage singing
- Blowing bubbles

Non-pharmacologic measures – pre-schoolers

- Provide a calm environment
- Apply cold or hot pack
- Provide a position of comfort
- Provide light touch or massage
- Suggest music or TV to entertain
- Coach child through the ED process and/or procedures
- Draw in coloring books
- Play with puzzles
- Look at or read storybooks
- Encourage singing or storytelling
- Hold cold or hot pack
- Engage in distracting conversation
- Bubbles

Non-pharmacologic measures – school age child

- Provide a calm environment
- Suggest new positions for comfort
- Suggest music, TV
- Read books
- Coach child through the ED process and/or procedures
- Share jokes
- Provide light touch or massage
- Hold cold or hot pack
- Demonstrate relaxation techniques such as breathing exercises
- Use squeeze balls
- Encourage conversation about favorite things
- Play with electronic tablet/wireless internet device

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Non-pharmacologic measures - adolescent

- Apply cold or hot pack
- Suggest repositioning or positions of comfort
- Encourage talking about favorite places or activities
- Provide light touch or massage
- Listen to music
- Read
- Visit with friend
- Coach about ED processes and procedures
- Discuss preferred relaxation techniques
- Demonstrate relaxation techniques, if unfamiliar
- Use squeeze balls
- Encourage making choices
- Play with electronic games or tablets

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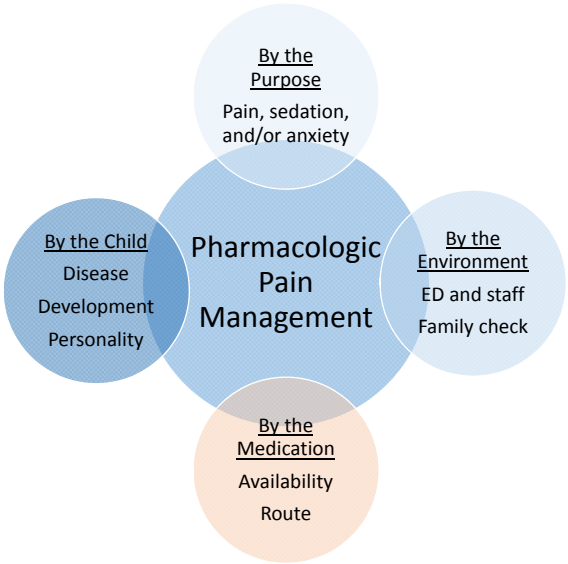
Incorporate evidence-based pharmacologic pain interventions-examples

- Provide analgesia for children with abdominal pain prior to the surgical consult
- Provide pain medication for children in triage with a pain rating greater than 6 out of 10
- Provide anesthetic ear drops for ear pain

- Apply topical anesthetics prior to IV insertions, blood draws and laceration repairs
- Provide pressure to IM site before giving injections
- Use lidocaine as a diluent if giving IM ceftriaxone
- Use buffered lidocaine for local anesthesia

Pharmacologic approach



Medications

- See resources at end of presentation and visit PAMI website at http://pami.emergency.med.jax.ufl.edu/
- Infants- use with caution and lower dosages
- Teens
- Obesity
  - As a rule of thumb, never prescribe more than the maximum adult dose for a child

Example of dosing chart for pain medications

Harborview Medical Center – Basic Pediatric Equipment and Dosing Guide

Broselow Color Zone	GRAY			PINK	RED	PURPLE	YELLOW	WHITE	BLUE	ORANGE	GREEN		
Approximate Weight (kg)	3	4	5	6	8	10	13	16	20	26	32	40	45
Approximate Age	Newborn	Newborn	2 mos	4 mos	8 mos	1 yr	2 yr	4 yr	5 - 6 yr	7 – 8 yr	9 – 10 yr	12 yr	13 yr
HR	100 - 160	100 - 160	100 - 160	100 - 160	100 - 160	90 - 150	90 - 150	80 - 140	70 - 120	70 - 120	70 - 120	60 – 100	60 -100
RR	30 - 60	30 - 60	30 - 60	30 - 60	30 - 60	24 - 40	24 - 40	22 - 34	18 - 30	18 - 30	18 - 30	12 - 24	12 - 20
Minimum SBP	40	40	50	60	60	70	70	80	80	80	90	90	90
ETT [*uncuffed /* cuffed >1 y/o*]	3.0 / 2.5	3.0/ 2.5	3.5/ 3.0	3.5/ 3.0	3.5/ 3.0	4.0/ 3.5	4.5/ 4.0	5.0/ 4.5	5.5/ 5.0	6.0/ 5.5	6.5/ 6.0	6.5/ 6.0	7.0/ 6.5
NG / Foley	5 Fr	5 Fr	5 Fr	5 - 8 Fr	8 Fr	8 - 10 Fr	10 Fr	10 Fr	12 Fr	14 Fr	14 Fr	14 Fr	16 Fr
Chest Tube	10-12 Fr	10-12 Fr	10-12 Fr	10-12 Fr	10-12 Fr	16 -20 Fr	20-24 Fr	20-24 Fr	24-32 Fr	28-32 Fr	32-36 Fr	36-40 Fr	36-40 Fr
Central Venous Line	3.5-5 Fr UVC		3	3-4	3-4	3-4	3-4	4	4	4-5	4-5	5+	5+
Vent Settings - VT (mL)	24 – 36	32 – 48	40 – 60	48 – 72	64 – 96	80 -120	104 -156	128 -192	160 -240	208 - 312	256 -384	320 – 480	360 -540
Vent Settings - Rate (BPM)	24 - 30	24 - 30	24 - 30	20 - 25	20 - 25	15 - 25	15 - 25	15 - 25	12 - 20	12 - 20	12 - 20	12 - 16	12 - 16
C-Collar (Jerome Sizing)	P-0	P-0	P-0	P-0	P-1	P-1	P-1	P-2	P-2	P-2	P-3	use adult collar	
Fluid Bolus (mL)	60	80	100	120	160	200	260	320	400	520	640	800	900
Maintenance Fluids (mL/hr)	12	16	20	28	35	40	45	55	65	70	75	100	115
PRBC (mL) [*unit = 350 mL*]	30-45 **	40-60 **	50-75 **	60-90	80-120	100-150	130-195	160-240	200-300	260-390	320-480	400-600	450-675
FFP (mL)	30-45	40-60	50-75	60-90	80-120	100-150	130-195	160-240	200-300	260-390	320-480	400-600	450-675
Apheresis Platelets (mL)	15-30	20-40	25-50	30-60	40-80	50-100	65-130	80-160	100-200	130-260	160-320	200-400	225-450
Cryoprecipitate	5-9 mL	6-12 mL	8-15 mL	9-18 mL	12-24 mL	15-30 mL	20-39 mL	24-32 mL	30-60 mL	39-78 mL	6 units	6 units	6 units
** call blood bank (292-6525); consider Pedi-Pak				PINK	RED	PURPLE	YELLOW	WHITE	BLUE	ORANGE	GREEN		
Acetaminophen PO/PR (mg)	40	40	60	80	80 - 120	120	160	160 - 240	240	320	320 - 400	650	650
Fentanyl IV (mcg)	6 -9	8 -12	10 -15	12 -18	16 -24	20 - 30	26 - 39	16 - 32	20 - 40	26 - 52	32 - 64	20 - 40	22 - 45
Flumazenil IV (mg)	0.03	0.04	0.05	0.06	0.08	0.1	0.13	0.16	0.2	0.2	0.2	0.2	0.2
Glucose IV (mL of $D_{25}W$)	6 (D_{10})	8 (D_{10})	10 (D_{10})	3-6	4-8	5-10	6-13	8-16	10-20	13-26	16-32	20-40	22-45
Lorazepam IV (mg)	0.15 - 0.3	0.2 – 0.4	0.25 - 0.5	0.3 - 0.6	0.4 - 0.8	0.5 - 1	0.65 - 1.3	0.8 - 1.6	1 - 2	1.3 - 2.6	1.6 - 3.2	2 - 4	2 - 4
Mannitol IV (gm)	3	4	5	6	8	10	13	16	20	26	32	40	45
Metoclopramide IV (mg)	0.3	0.4	0.5	0.6	0.8	1	1.3	1.6	2	2.6	3.2	4	4.5
Midazolam IV (mg)	0.15 - 0.3	0.2 - 0.4	0.25 - 0.5	0.3 - 0.6	0.4 - 0.8	0.5 - 1	0.65 - 1.3	0.8 - 1.6	0.5 - 1	0.65 - 1.3	0.8 - 1.6	0.5 - 2	0.5 - 2
Morphine IV (mg)	0.15	0.2	0.25	0.3	0.4 - 0.8	0.5 - 1	0.65 - 1.3	0.8 - 1.6	1 - 2	1.3 - 2.6	1.6 - 3.2	2 - 4	2.2 - 4.5
Naloxone IV (mg)	0.03	0.04	0.05	0.06	0.08	0.1	0.13	0.16	0.2	0.26	0.32	0.4	0.45
Oxycodone PO (mg)	0.15 -0.45	0.2 - 0.6	0.25 -0.75	0.3 - 0.9	0.4 - 1.2	0.5 - 1.5	0.65 - 1.9	0.8 - 2.4	1 - 3	1.3 – 3.9	1.6 – 4.8	2 - 6	3 - 8
Pancuronium/Vecuronium (mg)	0.3	0.4	0.5	0.6	0.8	1	1.3	1.6	2	2.6	3.2	4	4.5
Phenobarbital - IV Load (mg)	60	80	100	120	160	200	260	320	400	520	640	800	900
Phenytoin - IV Load (mg)	45	60	75	90	120	150	195	240	300	390	480	600	675

Int J Crit Illn Inj Sci. 2012 Sep-Dec; 2(3): 156–162. Sedation and analgesia for the pediatric trauma patients. Ramaiah R, Grabinsky A, Bhananker SM.

Step 7: Monitoring and discharge checkpoint

- Joint Commission standards
- Child should be back to baseline and tolerating some fluids at discharge
  - difficult situation after bedtime
  - ambulation with assistance only
  - beware of sending them walking to the car

The Joint Commission

Key Areas of Focus in Joint Commission Standards applicable to PSA in the ED or non-OR setting

1) Appropriate number and qualifications of providers
2) Appropriate pre-procedural assessment of patient
3) Appropriate resuscitative equipment and monitoring of the patient
4) Appropriate documentation
5) Appropriate monitoring of outcomes
6) Appropriate discharge

Monitoring During PSA

- When are you most likely to see respiratory depression ?

Patient safety tip: Complications from sedation such as respiratory depression are most likely to occur **within 5 to 10 minutes after administration of IV medication and immediately after the procedure when stimuli associated with the procedure are removed**. Thus, monitoring should be especially close during these periods.

Question

Emergency clinician-directed pediatric procedural sedation results in complications and adverse events in _____% of cases?

A. 5%
B. 10%
C. <1%
D. Unknown, no studies available

Sacchetti A, et al. Pediatric Procedural Sedation in the Community Emergency Department: results from the ProSCED registry. Pediatr Emerg Care. 2007 Apr;23(4):218-22.

- 1028 sedations
- Complications were reported in 2 cases (0.6%), 1 episode of apnea requiring a reversal agent and 1 episode of hypoxia responsive to supplemental oxygen. Of procedures attempted, 339 (99.4%) were successfully completed.

K. P. Mason, S. M. Green, and Q. Piacevoli. Adverse event reporting tool to standardize the reporting and tracking of adverse events during procedural sedation: a consensus document from the World SIVA International Sedation Task Force Br. J. Anaesth. (2012) 108 (1): 13-20

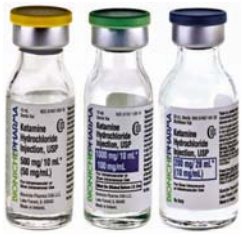
Summary. Currently, there are **no established definitions or terminology for sedation-related adverse events (AEs).** With clear terminology and definitions, sedation events may be accurately identified and tracked, providing a benchmark for defining the occurrence of AEs, ranging from minimal to severe. This terminology could apply to sedation performed in any location and by any provider. We present a consensus document from the International Sedation Task Force (ISTF) of the World Society of Intravenous Anaesthesia (World SIVA). The ISTF is composed of adult and paediatric sedation practitioners from multiple disciplines throughout the world.

Key Concepts

- Remember the sucrose pacifier and swaddling for <2 months
- Two or more drugs usually lead to more complications than a single drug
- Beware of jumping on the new bandwagon when you have something that works well and has withstood the test of time
- Consider the environment when reading new studies or considering use of a new medication, dose, or route
  - What was the study setting: ED, Ped ED, OR, inpatient procedure…
  - Often done by Pediatric Pain and Sedation Services
    - Very different setting than the ED
  - Use caution when extrapolating adult studies

Key Concepts

- Most children reach adult maximum dosages around 35-50 Kg of ideal body weight
- Always double check drug concentrations as many medications used in PSA are available in numerous concentrations
  - Drug shortages have led to frequent substitutions/concentrations
  - Use concentrated solutions for nasal or rectal administration
- Children have difficulty distinguishing between pain, nausea and anxiety
- Kids vomit- give Zofran liberally
  - Consider pretreating before Ketamine
  - 2mg if< 15 Kg; 4 mg if > 15 Kg



Controversies in Pediatric PSA

Pre-oxygenation

- Most children are healthy
- Don't you want to know if desaturation is occurring?
- Masking effect
- Oxygen plus ETCO2 nasal prongs are very irritating and distracting to children

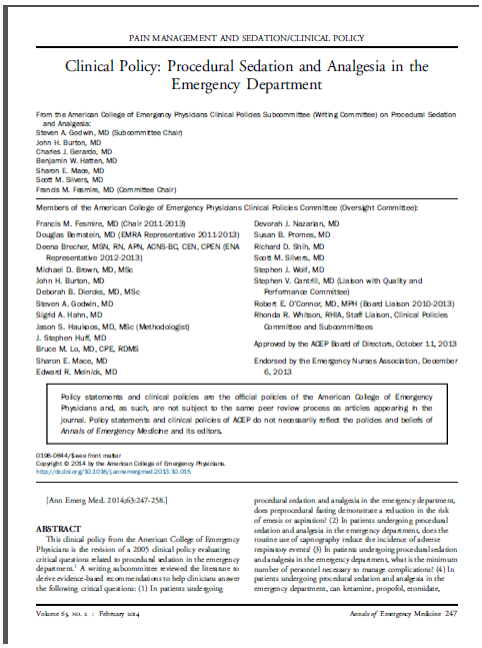
Controversies in Pediatric PSA

NPO controversy

- always remind patients and families at triage to refrain from feeding or giving fluids
- ACEP 2014 Clinical Policy

ETCO2 monitoring

- Why not?
- Look for trend not exact value



PAIN MANAGEMENT AND SEDATION/CLINICAL POLICY

Clinical Policy: Procedural Sedation and Analgesia in the Emergency Department

From the American College of Emergency Physicians Clinical Policies Subcommittee (Writing Committee) on Procedural Sedation and Analgesia:
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Approved by the ACEP Board of Directors, October 11, 2013

Endorsed by the Emergency Nurses Association, December 6, 2013

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[Ann Emerg Med. 2014;63:247-258.]

ABSTRACT

This clinical policy from the American College of Emergency Physicians is the revision of a 2005 clinical policy evaluating critical questions related to procedural sedation in the emergency department.[1] A writing subcommittee reviewed the literature to derive evidence-based recommendations to help clinicians answer the following critical questions: (1) In patients undergoing procedural sedation and analgesia in the emergency department, does preprocedural fasting demonstrate a reduction in the risk of emesis or aspiration? (2) In patients undergoing procedural sedation and analgesia in the emergency department, does the routine use of capnography reduce the incidence of adverse respiratory events? (3) In patients undergoing procedural sedation and analgesia in the emergency department, what is the minimum number of personnel necessary to manage complications? (4) In patients undergoing procedural sedation and analgesia in the emergency department, can ketamine, propofol, etomidate,

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Critical questions: In patients undergoing PSA in the ED, (1) does preprocedural fasting demonstrate a reduction in the risk of emesis or aspiration? (2) does the routine use of capnography reduce the incidence of adverse respiratory events? (3) what is the minimum number of personnel necessary to manage complications? (4) can ketamine, propofol, etomidate, dexmedetomidine, alfentanil and remifentanil be safely administered?

Fasting Time: ASA Guidelines

ASA guidelines recommend patients undergoing procedural sedation for **"elective procedures"** fast according to the standards used for general anesthesia. This requires patients not eat or drink for **two hours after drinking clear liquids and six hours after ingesting solid foods or cow's milk.** If these standards cannot be met, the guidelines recommend that the clinician consider delaying the procedure, reducing the level of sedation, or protecting the airway with endotracheal intubation.

Implementing these guidelines in the ED presents several problems:

- It is rare that patients requiring emergent PSA meet these fasting criteria.
- Emergent procedures cannot be delayed.
- **Although fasting to reduce the risk of aspiration during procedural sedation or elective surgery makes intuitive sense, there is little evidence to support this approach.**

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Last Meal: ACEP 2014 Guidelines

The American College of Emergency Physicians (ACEP) 2014 clinical policy on procedural sedation reviews the *critical question*: **In patients undergoing PSA in the ED, does pre-procedural fasting demonstrate a reduction in the risk of emesis or aspiration?**

Answer : Do not delay procedural sedation in adults or pediatrics in the ED based on fasting time. Pre-procedural fasting for any duration has not demonstrated a reduction in the risk of emesis or aspiration when administering procedural sedation and analgesia.

(Level B recommendation) *

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My Favorite "Recipes"

- Simple FB removal, abscess I&D or small wound repair-
  Nasal versed + LET + child life or member of my "ED dream team" + "my toys" + holder
- Pain management only- good old tried and true morphine or fentanyl
- PSA-Ketamine 1 mg/kg IV with extra 1 mg/kg drawn up and ready
  - Pretreatment with Zofran
  - No atropine or midazolam

What's New and on the Horizon in Pain Management

- New discoveries regarding pathophysiology of pain and effects of untreated acute pain
- Ketamine is "King"- current research focus on
  - Low sub-dissociative dose for pain syndromes
  - Nasal ketamine
  - Ketamine for adults
- Dexmedetomidine (Precedex®)
  - Most studies are not in ED setting, minimal analgesic effects
- Pharmaceutical companies working feverishly to find new non-opiod treatment alternatives
- Advances in palliative care and pain management of chronic pain
- Rapid growth of pediatric pain and sedation services
- Devices to measure level of pain via imaging of facial expressions
- What's out- barbiturates and chloral hydrate

NSAIDS vs Opiods

- Poonai N. Oral administration of morphine versus ibuprofen to manage postfracture pain in children: a randomized trial. CMAJ. 2014 Dec 9;186(18):1358-63.
  - Found no significant difference in analgesic efficacy between orally administered morphine and ibuprofen. Morphine was associated with a significantly greater number of adverse effects.
- Kelly LE, Sommer DD, Ramakrishna J, et al. Morphine or ibuprofen for post-tonsillectomy analgesia: a randomized trial. Pediatrics. 2015;135(2):307-313.
  - Randomized controlled trial of 91 healthy children aged 1 to 10 years with diagnosis of sleep disordered breathing and scheduled for tonsillectomy. Given acetaminophen and either morphine or ibuprofen. Concluded that ibuprofen is as effective as and safer than morphine for post-tonsillectomy analgesia in children, without a higher risk of postoperative hemorrhage.

Summary

Objectives

To evaluate the impact of obesity on adverse events and required interventions during pediatric procedural sedation.

Methods

The Pediatric Sedation Research Consortium database of prospectively collected procedural sedation encounters was queried to identify patients for whom body mass index (BMI) could be calculated. Obesity was defined as BMI ≥95th percentile for age and gender. Sedation-related outcomes, adverse events, and therapeutic interventions were compared between obese and nonobese patients.

Results

For analysis, 28 792 records were eligible. A total of 5 153 patients (17.9%) were obese; they were predominantly male and older and had a higher median American Society of Anesthesiologists Physical Status classification ($P < 0.001$). Total adverse events were more common in obese patients (odds ratio [OR] 1.49, 95% confidence interval [1.31, 1.70]). Respiratory events (airway obstruction OR 1.94 [1.54, 2.44], oxygen desaturation OR 1.99 [1.50, 2.63], secretions OR 1.48 [1.01, 2.15], laryngospasm OR 2.30 [1.30, 4.05]), inability to complete the associated procedure (OR 1.96 [1.16, 3.30]), and prolonged recovery (OR 2.66 [1.26, 5.59]) were increased in obese patients. Obese patients more frequently required airway intervention including repositioning, suctioning, jaw thrust, airway adjuncts, and bag-valve-mask ventilation. Multivariate regression analysis demonstrated obesity to be independently associated with minor and moderate but not major adverse events.

Conclusions

Obesity is an independent risk factor for adverse respiratory events during procedural sedation and is associated with an increased frequency of airway interventions, suggesting that additional vigilance and expertise are required when sedating these patients.

Scherrer PD, Mallory MD, Cravero JP, Lowrie L, Hertzog JH, Berkenbosch JW. The impact of obesity on pediatric procedural sedation-related outcomes: results from the Pediatric Sedation Research Consortium. Pediatr Anesth. 2015;25(7):689–697.

Pediatric Pain and PSA Supplemental Resources

Online educational courses

Websites

New literature

Medication Dosing Tables

Resources- not all are ED specific

- EMSC Illinois 2013: Pediatric Pain Management in the Emergency Setting
  - http://www.luhs.org/depts/emsc/pedpainmgmt_main_web.htm
- APLS pain and sedation chapter and presentation
- http://www.swedish.org/for-health-professionals/cme/online-cmes/pediatricproceduralsedation.
- Checklist http://ehced.org/wp-content/uploads/2010/12/PSAChecklistv2emupdates.com_print.pdf.
- Society for Pediatric Sedation : http://www.pedsedation.org/
- 2014 ACEP Clinical Policy: Procedural Sedation and Analgesia in the Emergency Department:
  - http://www.acep.org/Physician-Resources/Procedural-Sedation/
  - http://www.acep.org/workarea/DownloadAsset.aspx?id=93816

Resources:
Society for Pediatric Sedation

- Education – Online Continuing Education
  - http://www.pedsedation.org/education/cme/
- Resources – Sample Documents
  - http://www.pedsedation.org/resource/sample-docs/
- Resources – Lectures
  - http://www.pedsedation.org/resource/lectures/
- Resources – Articles
  - http://www.pedsedation.org/resource/articles/

Resources: UNC Pediatric Procedural Sedation Course

- http://www.med.unc.edu/cce/programs/pse/pediatric-procedural-sedation-course
- Training Modules
  - Course Overview & Introduction to Pediatric Procedural Sedation
  - Pre-sedation: Patient Factors
  - Pre-sedation: Provider Factors, Procedure Factors
  - Pre-sedation: Informed Consent, Sedation Equipment
  - Pre-sedation: Capnography
  - Intra-sedation
  - Post-procedure
  - Pharmacology

Resources: PAMI

UF UNIVERSITY of FLORIDA College of Medicine Jacksonville

PAMI Pain Assessment and Management Initiative

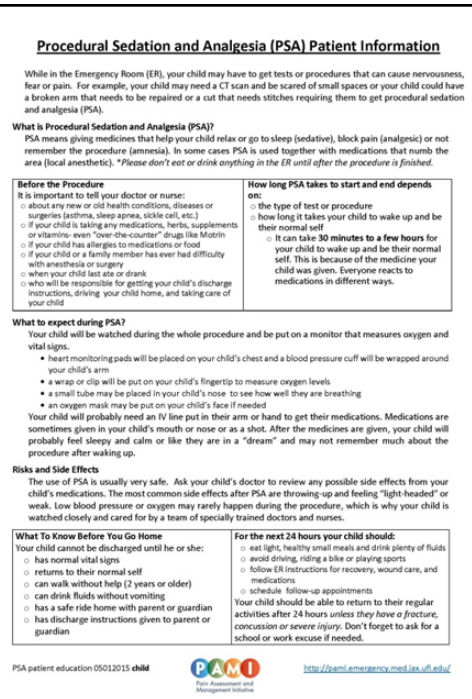
- PAMI Website
  - http://pami.emergency.med.jax.ufl.edu/
- Purpose of the Pain Assessment and Management Initiative (PAMI): A Patient Safety Project is the advancement of pain recognition and treatment in acute care settings.
- PAMI addresses both acute and chronic pain in all ages including high risk populations and settings such as procedural sedation.
- Multidisciplinary Educational Resources
  - Online modules with free CEU/CMEs
    - Free access resources
    - Teaching scenarios
    - Pain related website links
    - Presentations
    - Patient information
    - Newsbriefs
  - PSA Pediatric Patient Education Handout - http://pami.emergency.med.jax.ufl.edu/resources/educational-materials/procedural-sedation/
  - Funding provided by the Florida Medical Malpractice Joint Underwriting Association

PAMI Modules and Resource Topics for Emergency Care Providers

PAMI Introduction and Basics of Pain Management	Pharmacological Treatment of Pain (Acute & Chronic)
Non-pharmacological Treatment	Management of Acute Pain
Procedural Sedation and Analgesia	Management of Chronic Pain
Discharge and Transition Planning	Patient Safety and Legal Aspects
Prehospital/EMS	Pediatric Pain Management
Pain Management in Special Populations- elderly, cognitively impaired, chronically ill, obese	Alternative and Complementary Treatments

http://pami.emergency.med.jax.ufl.edu/resources/educational-materials/procedural-sedation/

https://com-jax-emergency-pami.sites.medinfo.ufl.edu/files/2015/02/PSA-patient-information-05012015-child.pdf



Procedural Sedation and Analgesia (PSA) Patient Information

While in the Emergency Room (ER), your child may have to get tests or procedures that can cause nervousness, fear or pain. For example, your child may need a CT scan and be scared of small spaces or your child could have a broken arm that needs to be repaired or a cut that needs stitches requiring them to get procedural sedation and analgesia (PSA).

What is Procedural Sedation and Analgesia (PSA)?

PSA means giving medicines that help your child relax or go to sleep (sedative), block pain (analgesic) or not remember the procedure (amnesia). In some cases PSA is used together with medications that numb the area (local anesthetic). **Please don't eat or drink anything in the ER until after the procedure is finished.*

Before the Procedure

It is important to tell your doctor or nurse:

- about any new or old health conditions, diseases or surgeries (asthma, sleep apnea, sickle cell, etc.)
- if your child is taking any medications, herbs, supplements or vitamins- even "over-the-counter" drugs like Motrin
- if your child has allergies to medications or food
- if your child or a family member has ever had difficulty with anesthesia or surgery
- when your child last ate or drank
- who will be responsible for getting your child's discharge instructions, driving your child home, and taking care of your child

How long PSA takes to start and end depends on:

- the type of test or procedure
- how long it takes your child to wake up and be their normal self
  - It can take **30 minutes to a few hours** for your child to wake up and be their normal self. This is because of the medicine your child was given. Everyone reacts to medications in different ways.

What to expect during PSA?

Your child will be watched during the whole procedure and be put on a monitor that measures oxygen and vital signs.

- heart monitoring pads will be placed on your child's chest and a blood pressure cuff will be wrapped around your child's arm
- a wrap or clip will be put on your child's fingertip to measure oxygen levels
- a small tube may be placed in your child's nose to see how well they are breathing
- an oxygen mask may be put on your child's face if needed

Your child will probably need an IV line put in their arm or hand to get their medications. Medications are sometimes given in your child's mouth or nose or as a shot. After the medicines are given, your child will probably feel sleepy and calm or like they are in a "dream" and may not remember much about the procedure after waking up.

Risks and Side Effects

The use of PSA is usually very safe. Ask your child's doctor to review any possible side effects from your child's medications. The most common side effects after PSA are throwing-up and feeling "light-headed" or weak. Low blood pressure or oxygen may rarely happen during the procedure, which is why your child is watched closely and cared for by a team of specially trained doctors and nurses.

What To Know Before You Go Home

Your child cannot be discharged until he or she:

- has normal vital signs
- returns to their normal self
- can walk without help (2 years or older)
- can drink fluids without vomiting
- has a safe ride home with parent or guardian
- has discharge instructions given to parent or guardian

For the next 24 hours your child should:

- eat light, healthy small meals and drink plenty of fluids
- avoid driving, riding a bike or playing sports
- follow ER instructions for recovery, wound care, and medications
- schedule follow-up appointments

Your child should be able to return to their regular activities after 24 hours *unless they have a fracture, concussion or severe injury.* Don't forget to ask for a school or work excuse if needed.

PSA patient education 05012015 **child** http://pami.emergency.med.jax.ufl.edu/

Pharmacologic Resources

- Adapted from PAMI, EMSC Illinois 2013: Pediatric Pain Management in the Emergency Setting, UNC Procedural Sedation Course and current literature.

Pain Management Adjuncts for Procedures

Topical/Local anesthetics

Safety Tip: agents are cardiac depressants; maximum allowable safe dosage should be calculated ***before*** administration to avoid overdose in pediatric cases.

- EMLA®: 60 min onset, lidocaine 2.5% and prilocaine 2%
- LMX4®: 40 min onset, liposomal lidocaine 4%
- LET: 20 min onset, lidocaine , epinephrine ,and tetracaine (A gel form of TAC can be made by adding 150 mg of methyl-cellulose 4000 cps to 3 mL of LET solution)
- Synera®: 20 min onset, lidocaine and tetracaine patch
- Topical Anesthetic Skin Refrigerant (Pain Ease®): < 5 min onset

Topical anesthetics

AGENT	INDICATION	DOSE/ROUTE	TIME ONSET/ DURATION	MAXIMUM DOSE	COMMENTS
L.M.X.4® (Lidocaine 4%)	For external use for pain relief of minor cuts, scrapes, burns, sunburn, insect bites, and minor skin irritations	Apply externally	Onset 20-30 minutes Duration 60 minutes	Externally 3-4 times per day Apply in area less than 100cm² for children less than 10 kg Apply in area less than 600cm² for children between 10 and 20 kg	**Advantages** For use in children 2 years and older over-the-counter (OTC) availability **Risks** Discuss use with physician in children under 2 years old.
LET **Lidocaine** **Epinephrine** **Tetracaine** **(gel or liquid)**	Wound repair (non-mucosal)	Per pharmacy protocol Topical 4% Lidocaine 1:2,000 Epinephrine 0.5% Tetracaine	Onset 10 minute Duration 30-60 minute	3 ml (not to exceed maximal Lidocaine dosage of 3-5 mg/kg)	**Advantages** No physical wound distortion, painless application, decreased repair time, non-cocaine containing anesthetic **Risks** Not for use over end arteriole locations

Topical anesthetics

AGENT	INDICATION	AGE/DOSE/ROUTE	TIME ONSET/ DURATION	MAXIMUM DOSE	COMMENTS
EMLA **(2.5% Lidocaine** **2.5% Prilocaine)** **(for children > 3 months age)**	Dermal analgesic (intact skin)	3-12 months (and >5 kg) maximum area covered 20 cm² 1-6 years (and >10 kg) maximum area covered 100 cm² 7-12 years (and >20 kg) maximum area covered 200 cm² topical/transdermal (cover area with occlusive dressing)	Onset 60 minutes Duration 3-4 hour	2 gm* 10 gm* 20 gm* Maximum application time not to exceed 4 hours (If a patient does not meet the minimum weight requirement, the maximum total dose should be restricted to that which corresponds to the patient's weight)	**Advantages** Painless application, patient compliance, decreased repair time **Risks** Methemoglobinemia, contact dermatitis

NOTE: *Dosages are guidelines to avoid systemic toxicity in patients with normal intact skin and with normal renal and hepatic function

Topical anesthetics

AGENT	INDICATION	DOSE/ROUTE	TIME ONSET/ DURATION	MAXIMUM DOSE	COMMENTS
Pain-Ease®	Cooling intact skin and mucus membranes and minor open wounds	Spray for 4-10 seconds from a distance of 8-18 cm	Onset- immediate Duration- a few seconds, up to a minute	When skin turns white	**Advantages** Quick acting **Risks** Skin freezing may create hypopigmentation especially in dark pigment skin
Viscous Lidocaine	Foley catheter and nasogastric tube insertion; intubation	2%- 4% topical jelly 10% spray	Onset 2-5 min Duration 30-60 min	3-5 mg/kg	**Advantages** Comfort of insertion, lubrication for insertion **Risks** Hematoma, painful, bleeding at site, absorption can cause systemic toxicity.

NOTE: Not recommended for teething children or young children who cannot expectorate.

Infiltrative anesthetics

AGENT	INDICATION	DOSE/ROUTE	TIME ONSET/ DURATION	MAXIMUM DOSE	COMMENTS
Infiltrative Lidocaine	Vascular access; needle insertion procedures	Subcutaneous 1% Lidocaine with epinephrine 0.5% Lidocaine with epinephrine 1% or 0.5% plain Lidocaine	Onset 4-10 minutes Duration 90-120 minutes	7mg/kg to a maximum of 500 mg 4.5 mg/kg to a maximum of 300 mg Additional dosing after maximum reached, may occur after 2 hours.	**Advantages** Rapid onset, longer duration **Risks** Hematoma, bleeding at site; absorption can cause systemic toxicity
J-Tip® Jet injector of 1% buffered Lidocaine	Vascular access, needle insertion procedures	0.2 ml subcutaneous	Immediate	One application per site	**Advantages** Needleless **Risks** Not for preterm infants; neonates; patients with blood disorders; or in children receiving chemotherapy or blood thinners.

Mild pain agents

NON-OPIOID	INDICATION	DOSE/ROUTE*	MAX DOSE	COMMENTS
Acetaminophen (APAP)‡ NOTE: ‡ All doses of combination products limited by APAP content to 75 mg/kg	Mild pain	10 - 15 mg/kg Every 4-6 hr PO, PR	75 mg/kg/day	**Advantages** Minimal adverse effects on GI tract or renal function **Risks** Liver toxicity
Ibuprofen (Motrin®, Advil®)	Mild pain	5 - 10mg/kg Every 6-8 hr PO	40 mg/kg/day	**Advantages** Inhibits prostaglandin-induced nociception **Risks** Nausea, vomiting, ulcers, platelet dysfunction, liver toxicity

EMSC 2013

Moderate pain agents

NON-OPIOID	INDICATION	DOSE/ROUTE*	MAX DOSE	COMMENTS
Ketorolac ***(Toradol®)*** NOTE: Do not use with other NSAIDs.	Moderate - severe pain	0.25 mg – 1 mg/kg every 6 hr IV, IM* PO for patients > 50 kg	30 mg every 6 hr	**Advantages** Effective alternative to opioids for treatment of moderate to severe pain **Risks** Bleeding diathesis; hyperkalemia; depression of renal function; and hepatotoxicity

****IM routes not recommended as first line treatment.***

EMSC 2013

Moderate pain agents

OPIOIDS[$]	INDICATION	DOSE/ROUTE*	ONSET	DURATION	MAX DOSE	COMMENTS
Codeine/APAP with Codeine	Mild - moderate pain	0.5 - 1mg/kg of Codeine Every 4-6 hr PO	1-2 hr	4-6 hr	60 mg/dose	**Advantages** Rapid onset action, minimal respiratory depression orally **Risks** Nausea, vomiting, constipation, respiratory depression, hypotension, bradycardia, CNS depression

NOTE: Codeine is ineffective in 1/3 of patients.

NOTE: Ibuprofen has provided equivalent pain relief when compared to codeine alone or acetaminophen with codeine.

EMSC 2013

Moderate pain agents

OPIOIDS	INDICATION	DOSE/ROUTE*	ONSET	DURATION	MAX DOSE	COMMENTS
Hydrocodone **(+ APAP: *Lortab*® *Vicodin*®)**	Mild - moderate pain	0.1 - 0.2 mg/kg of Hydrocodone Every 4-6 hr PO	30 min	3 - 4 hr	Limited by APAP component	**Advantages** Oral medication, moderately rapid onset **Risks** Dizziness, sedation, nausea, vomiting, constipation
Oxycodone **(+APAP: *Percocet*®)**	Moderate - severe pain	0.05 - 0.15 mg/kg of Oxycodone Every 4-6 hr PO (immediate release formula)	15 min	3 - 4 hr	10 mg every 4-6 hr	**Advantages** Oral medication, moderately rapid onset **Risks** CNS depression, respiratory depression, hypotension, bradycardia, nausea

NOTE: Generally not recommended in children less than 6 years of age.

EMSC 2013

Severe pain

OPIOIDS	INDICATION	DOSE/ROUTE*	ONSET	DURATION	MAX DOSE	COMMENTS
Fentanyl **(*Sublimaze*®)**	Moderate - severe pain	1-2 mcg/kg/dose IV (administer over 3-5 minutes) IN (divide dose equally between each nostril) IM*	1-2 min IV 10 min IN 7-15 min IM	30-60 min IV 60 min IN 1-2 hr IM	1-3 mcg/kg/dose	**Advantages** Rapid onset, short duration, potent analgesic; preferred medication for renal patients **Risks** Respiratory depression, apnea may precede alteration of consciousness chest wall rigidity if given too rapidly

NOTE: IN route should not be used in patients with facial trauma.

IM routes not recommended as first line treatment.

EMSC 2013

Severe pain

OPIOIDS	INDICATION	DOSE/ROUTE*	ONSET	DURATION	MAX DOSE	COMMENTS
Morphine ***(Roxanol®)***	Moderate - severe pain	IV, SC, IM* <6mo: 0.05-0.1 mg/kg q4h prn; 6 mo-12yo: 0.1-0.2 mg/kg q2-4h prn >12yo: 3-10mg q2-6h prn PO <6mo: 0.1 mg/kg q3-4H prn; 6mo-12yo: 0.2-0.5 mg/kg PO q4-6h prn >12yo: 10-30 mg q3-4h prn Chronic Pain PCA route <50kg: 0.01-0.03 mg/kg IV q6-20 min prn; >50kg: 0.5-2.5mg IV q6-20min prn	5-15 min	3-4 hr	15 mg	**Advantages** Moderately rapid predictable onset. Significant role for patients who need prolonged pain control (e.g., fracture reduction, multiple trauma, sickle cell disease) **Risks** Respiratory depression, hypotension, bradycardia, CNS depression

NOTE: Avoid in children with renal failure.

IM routes not recommended as first line treatment.

EMSC 2013

Severe pain

OPIOIDS	INDICATION	DOSE/ROUTE*	ONSET	DURATION	MAX DOSE	COMMENTS
Hydro-morphone ***(Dilaudid®)***	Severe pain	0.015 mg/kg IV Every 4 hr 0.03 - 0.08 mg/kg PO Every 4 hr	Almost immediately Up to 30 min	2-4 hr 4-5 hr	0.015 mg/kg/dose Every 4 hr	**Advantages** Rapid onset; less pruritis than morphine **Risks** Respiratory depression, CNS depression, sedation

EMSC 2013

Intranasal Medications

- Use an atomizer, if > 1ml divide into nares
- Ketamine ??? dosage
  - Reports of 0.5-10 mg/kg; 50 mg/ml
  - Not routinely used
- Midazolam 0.3 mg/kg, max 10 mg; 5mg/ml
- Fentanyl 2 µg/kg, Max 50 µg
- Dexmedetomidine IN
  - Not well studied in ED setting

- http://intranasal.net/Treatmentprotocols/Sedationprotocol/INsedationprotocol.htm

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The PICHFORK (Pain in Children Fentanyl or Ketamine) Trial: A Randomized Controlled Trial Comparing Intranasal Ketamine and Fentanyl for the Relief of Moderate to Severe Pain in Children With Limb Injuries.
Graudins A, et al. Annals of Emergency Medicine, 2013.

Double-blind, randomized, controlled trial comparing fentanyl at 1.5 µg/kg with ketamine at 1 mg/kg in children aged 3 to 13 years and weighing less than 50 kg, with isolated limb injury and pain of more than 6 of 10 at triage. Intranasal fentanyl and ketamine were associated with similar pain reduction in children with moderate to severe pain from limb injury. Ketamine was associated with more minor adverse events.

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PEDIATRIC PROCEDURAL SEDATION MEDICATIONS

Agent	Dose	Onset (Peak) in mins	Elimination half-life (hours)	Duration (hours)	Comments
Midazolam (Oral)	0.25 – 0.5 mg/kg (MAX 20 mg dose)	10-20 (30)	3-4.5	2	• Availability: Syrup 10mg/5ml • Causes skeletal muscle relaxation, amnesia, and anxiolysis • Can be used to achieve anxiolysis and cooperation, as a single agent for non-painful procedures, in combination with an analgesic or local anesthetic for painful procedures • Advantages: Short duration, Predictable onset, Lack of active metabolites, Low risk of respiratory depression when used alone, Anterograde and retrograde (less frequent) amnesia
Midazolam (Intranasal)	0.2 – 0.3 mg/kg (MAX 7 mg initial dose)	Within 5 (10)	2-4.5	0.5-1	• Availability: Use the 5 mg/ml IV concentration • Use is limited by: Burning upon application to the nasal mucosa, Most children will only accept this route of administration once
Midazolam (IV)	0.05 – 0.1 mg/kg (MAX 2 mg initial dose) May repeat 3-4 min after initial dose to a total dose of 0.2 mg/kg A maximum IV dose of 0.05 mg/kg is recommended when combining with narcotics	1-5 (5-7)	1-4	Average 2	• Slow IV administration recommended with close observation for respiratory depression • Potent sedative effect when combined with intravenous opioids for painful procedures • Pronounced anterograde amnesia and (at times) retrograde amnesia with IV administration • Slurred speech coincides with onset of anterograde amnesia • Effects of midazolam may be altered by underlying medical conditions or medications

Agent	Dose	Onset (Peak) in mins	Elimination half-life (hours)	Duration (hours)	Comments
Flumazenil	0.01mg/kg (MAX 0.2 mg initial dose) May be repeated 5 times as needed Patients > 50 kg – doses up to 1 mg may be used				• Reverses effects of benzodiazepines • Resedation may occur requiring additional flumazenil doses • Monitor children receiving flumazenil for a minimum of one hour prior to discharge, regardless of Aldrete score • Use of reversal agents is discouraged and must never be used to expedite discharge
Fentanyl	• Very potent synthetic opioid, ideal for painful procedures in children • As a sole agent offers: analgesia, mild sedation, short duration of action • Bradycardia may occur from vagal nerve stimulation • Drug metabolism may be prolonged in neonates and children with hepatic dysfunction • Respiratory depression: Significant risk, may outlast opioid effects by 60-90 minutes, Markedly increased when combined with midazolam or other sedatives; IV access recommended • Chest wall rigidity: May occur with rapid intravenous fentanyl dosing				
Fentanyl (Intranasal)	2 µg/kg/dose (MAX 50 µg)	Almost immediate (Maximal analgesic and respiratory depressant effect occurs in 5 minutes)			
Fentanyl (IV)	0.5 – 1 µg/kg/dose (MAX 50 µg) May be titrated to a total dose of 4 – 5 µg/kg	Almost immediate Max analgesic and respiratory depressant effect in 5min	Terminal half-life -> 16 hours	0.5-1	

Agent	Dose	Onset (Peak) in mins	Elimination half-life (hours)	Duration (hours)	Comments
Naloxone	Dose for oversedation 0.01 mg/kg IV, maximum dose 0.4mg IV May repeat after 2 minutes for a total of 2 doses Dose for respiratory arrest 0.1 mg/kg, maximum dose 2 mg Availability: 0.4 mg/ml				• Opioid antagonist: reverses opioids' depressive effects • Administer intravenously, intramuscularly, or intratracheally (Preferred route of administration is intravenous) • Abrupt effect • Sedated children will often be quite disturbed when awakened by naloxone administration • Administer by slow titration when possible • Most common side effect: nausea • Unusual catastrophic events (such as sudden death) described in adults – not reported in children
Fentanyl + Midazolam	Midazolam 0.05 mg/kg IV every 3 minutes to achieve desired level of sedation; Max dose 2 mg; Total maximum dose 0.2 mg/kg Fentanyl 1 mcg/kg IV every 5 minutes to achieve desired level of sedation; Max dose 50 mcg; Total maximum dose 5 mcg/kg or total of 5 doses				• **Administer each drug separately, allow sufficient time to reach full effect before administering another dose**

Dissociative Agent: Ketamine (Ketalar®)

Class:	Dissociative amnesia and analgesia
Action:	Anesthesia, sedation, amnesia, analgesia
Dose:	1-1.5 mg/kg slow IV push over 2-3 mins when given with propofol, reduce initial dose to 0.5 mg/kg Onset: < 1 min; Duration: 5-10 mins IM : 3-5 mg/kg
Contraindications:	Infants ≤ 3 months (higher risk of airway complications) Ketamine increases pressures (BP, IOP, ICP) Acute neurological/head injury (Not mild bump on the head with a laceration) Significant eye injury and/or disease
Common side effects:	Laryngospasm, Emergence reactions, Increased salivation & intracranial/intraocular pressure, Hypertension/tachycardia. Nausea & vomiting
Recommended for:	Painful procedures (e.g., burn debridement, orthopedic, foreign body removal)
Reversal agent:	None
Clinical Cautions:	Active pulmonary infection/ URI, cardiovascular disease, glaucoma or acute eye injury History of airway instability, tracheal surgery/ stenosis, psychosis, porphyria, thyroid disease

Abstract ▾ Send to: ▾

Pediatr Emerg Care. 2008 Aug;24(8):529-33. doi: 10.1097/PEC.0b013e318180fdb5.

Dosing ketamine for pediatric procedural sedation in the emergency department.

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⊕ Author information

Abstract

OBJECTIVE: To describe intravenous ketamine dosing regimens for children requiring brief procedural sedation.

METHODS: Time-concentration and sedation profiles were simulated in children (2, 6, and 12 years old) using published pediatric pharmacokinetic and pharmacodynamic parameter estimates. Single-dose, repeat-dosing, and infusion regimens to achieve sedation level of less than 2 (arouses slowly to consciousness, with sustained painful stimulus) for 15 minutes were investigated.

RESULTS: A single bolus dose of 1.5 and 1.75, 2, and 2.125 mg/kg (for adult and 12-, 6-, and 2-year-olds, respectively) was required to achieve the desired sedation. Anticipated recovery would be slow, and a sedation level of 4 (drowsy, eyes open or closed but easily arouses to consciousness with verbal stimulus) was reached only after 70 minutes. The use of a smaller initial bolus with a subsequent half-dose "top-up" at 8 minutes achieves the same sedation level but with earlier recovery. A smaller initial dose of 0.25 and 0.275, 0.3, and 0.35 mg/kg followed by an infusion 2.5 and 2.75, 3, and 3.5 mg/kg per hour (for adult and 12-, 6-, and 2-year-olds, respectively) for 15 minutes gives a more even sedation level and rapid recovery (20 minutes to sedation level 4).

CONCLUSIONS: Dosing increases with decreasing age. A large single dose is associated with deep sedation, possible adverse effects, and delayed recovery. Between-subjects variability is large, and dose should be tailored to clinical monitoring and requirement. Intermittent pain insult is better suited to a top-up technique, whereas continuous pain is better suited to an infusion technique.

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Sedative-hypnotic: Propofol (Diprivan®)

Class:	Sedative-hypnotic
Action:	Enhances activity of GABA in the central nervous system resulting in sedation and amnesia (NO analgesia)
Dose	Initial: 0.5 - 1 mg/kg IV; Repeat 0.5mg/kg IV every 3-5 minutes. Administer via slow IV push (to decrease risk of hypotension), shake well Onset: <1 min; Duration: 3-10 minutes
Contraindications:	Hypotension Allergy to soy, eggs, glycerol
Common side effects:	Apnea; hypoventilation; respiratory depression Rapid & profound changes in sedative depth Hypotension
Recommended for:	Non-painful diagnostic procedures Ideal for procedures requiring brief periods of deep sedation (e.g., burn debridement)
Reversal agent:	None
Clinical Cautions:	Site injection pain Caution in patients with disorders of lipid metabolism (e.g. pancreatitis) Monitor for propofol related infusion syndrome (rare)

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Sedative-hypnotic: Dexmedetomidine (Precedex®)

Class:	Alpha-2 agonist , provides analgesia via receptors in spinal cord
Action:	Selective alpha-2 adrenergic agonist with sedative, anxiolytic, and minimal analgesic properties
Dose:	1 to 3 mcg/kg loading dose (over 10 minutes) followed by 0.5 to 2 mcg/kg/hour continuous infusion
Contraindications:	Children who are debilitated, inadequately hydrated, or have reduced cardiac output Patients receiving digoxin or other medications acting on sinus node or with sinus node dysfunction
Common side effects:	Bradycardia Hypotension, especially with loading dose or rapid infusions Apnea, bronchospasm, respiratory depression
Recommended for:	Nonpainful procedures, diagnostic imaging (CT, MRI)
Reversal agent:	None
Clinical Cautions:	**Newer agent with limited data in ED setting**

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2015 Articles- What's New?

- New App Calculates Pediatric Pain Medication Dosage
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