Procedural Sedation and Pain in Pediatrics: An Overview

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• I have NO financial disclosures
Goals and Objectives

• Describe the sedation services at Children’s Healthcare of Atlanta
• Discuss how children are prepared for Procedural Sedation
• Describe the basics of Pediatric Procedural Sedation (PPS)
• Review the basics of pain control
• Introduce various methods of medication delivery
CHOA Sedation Services

• Who we are:
  – Dedicated group of sedation providers
  – Anesthesia, Critical Care, Emergency Medicine physicians
  – Dedicated Sedation nursing staff
  – Child Life Specialists within the sedation units

• Children’s Healthcare of Atlanta provides sedation services at different campuses
  – Egleston
  – Webb Bridge
  – Scottish Rite
  – Town Center
CHOA Sedation Services

• What We Do
  – ~11,000 sedated procedures annually all throughout our campuses
  – Satellite campuses for lower acuity outpatient scans
    • For example – Webb Bridge and Town Center
  – Radiology, Invasive Procedures, Oncologic Procedures and Emergency Departments
CHOA Sedation Services

Radiology
- CT Scans
- MRI
- Nuclear Medicine Scans

Aflac Cancer Center
- Lumbar Punctures
- Bone Marrow Aspirates
- Chemotherapy

Invasive Procedures
- IV Starts
- Lab Draws
- Line Placement
- Biopsies: Liver, Kidney
- Joint Injections
CHOA Sedation Services

• Who We Sedate
  – Often with guidance and consultation of Anesthesia if needed
  – Simple and healthy out-patient procedures as well as more complex inpatient needs
Our Sedation Screening Process

- Procedures are scheduled by outpatient providers as well as our inpatient teams
- Our experienced sedation nurses perform a detailed prescreening assessment of all scheduled cases: previous sedation history, airway issues, NPO/feeding times, previous illnesses are discussed and documented. Any concerns are brought to the attention of the sedating MD at this time
- 1-2 days prior, a second assessment is performed by phone by our assessment coordinators
Outpatient Screening Timeline

procedure ordered—2 week to 1 month wait—sedation RN and sedation MD screen—procedure scheduled—week of procedure—call from sedation team: guidelines reviewed, including recent illnesses, NPO times, metal procedures—day prior to procedure—follow up call from scheduling team
Our Sedation Screening Process
Our Sedation Screening Process
High Risk Patients: Who to Refer for Evaluation

- American Society of Anesthesiology Physical Status III or above
- **Cardiac RED Flags:** Pulmonary HTN, CHF, Single Ventricles, Arrhythmias, Shunt Dependent Lesions (BT/Glenn), Cardiomyopathies: likely to need ECHO/EKG prior to sedation
- Obstructive Sleep Apnea (OSA): combined with URI and obesity=higher risk of failed sedation
- Extreme prematurity
- Neuromuscular Disease
- History of difficult sedation, failed sedation or problematic airway
- Active Infection (wheezing, bronchiolitis)
# American Society of Anesthesiologists Physical Status

<table>
<thead>
<tr>
<th>Classification</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASA I</td>
<td>Normal, healthy patient</td>
<td>Healthy Non-Smoking Minimal or no alcohol use</td>
</tr>
<tr>
<td>ASA II</td>
<td>Mild systemic disease</td>
<td>Mild diseases only without substantive functional limitations Example: mild lung disease, well controlled diabetes</td>
</tr>
<tr>
<td>ASA III</td>
<td>Severe systemic disease</td>
<td>One or more moderate to severe diseases with functional limitations Examples: Premature infant, BMI&gt;40, poorly controlled diabetes, moderate reduction of ejection fraction, ESRD requiring dialysis</td>
</tr>
<tr>
<td>ASA IV</td>
<td>Severe systemic disease that is a constant threat to life</td>
<td>Examples: recent MI, CVA or TIA, severe reduction of ejection fraction, sepsis, DIC</td>
</tr>
<tr>
<td>ASA V</td>
<td>Moribund patient who is not expected to survive without the procedure</td>
<td>Examples: massive trauma, intracranial bleed with mass effect, multiple organ/organ system dysfunction</td>
</tr>
<tr>
<td>ASAVI</td>
<td>Declared brain-dead and organs are being removed for donor purposes</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Addition of “E” denotes emergency procedure</td>
<td></td>
</tr>
</tbody>
</table>
# The Sedation Continuum

<table>
<thead>
<tr>
<th></th>
<th>Verbal Response</th>
<th>Pain Response</th>
<th>Airway Response</th>
<th>Breathing</th>
<th>Circulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No sedation</td>
<td>++++</td>
<td>+++++</td>
<td>+++++</td>
<td>+++++</td>
<td>+++++</td>
</tr>
<tr>
<td>Minimal Sedation</td>
<td>+++</td>
<td>+++++</td>
<td>+++++</td>
<td>+++++</td>
<td>+++++</td>
</tr>
<tr>
<td>Moderate Sedation</td>
<td>+</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>+++++</td>
</tr>
<tr>
<td>Deep Sedation</td>
<td>0</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Anesthesia</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0/+</td>
<td>++</td>
</tr>
<tr>
<td>Anesthesia Overdose</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0/+</td>
</tr>
</tbody>
</table>
At the Start…

• What are you trying to accomplish?
• What is the developmental/cognitive level of the child?
• What are the family’s expectations? Who is caring for the child?
• What type of staffing do you have? What are your facility’s policies?
• What are the patient’s major risk factors?
• Can the patient be safely discharged home?
Case 1

A 5 year old male presents to you 2 days after a tonsillectomy. Mom states that the procedure was done at an outside facility, but she came to you because it was closer. She tells you that the procedure went well, however, her son has been unable to swallow for the past day. He took Norco for the first post-operative day for pain. Mom is unsure of the dose.
Pain Scales

0  No Hurt  
2  Hurts Little Bit
4  Hurts Little More 
6  Hurts Even More 
8  Hurts Whole Lot 
10  Hurts Worse
## Pain Scales

### FLACC scale

<table>
<thead>
<tr>
<th>Categories</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Face</strong></td>
<td>No particular expression or smile; disinterested</td>
</tr>
<tr>
<td></td>
<td>Occasional grimace or frown, withdrawn</td>
</tr>
<tr>
<td></td>
<td>Frequent to constant frown, clenched jaw, quivering chin</td>
</tr>
<tr>
<td><strong>Legs</strong></td>
<td>No position or relaxed</td>
</tr>
<tr>
<td></td>
<td>Uneasy, restless, tense</td>
</tr>
<tr>
<td></td>
<td>Kicking, or legs drawn up</td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td>Lying quietly, normal position, moves easily</td>
</tr>
<tr>
<td></td>
<td>Squirming, shifting back and forth, tense</td>
</tr>
<tr>
<td></td>
<td>Arched, rigid, or Jerking</td>
</tr>
<tr>
<td><strong>Cry</strong></td>
<td>No crying (awake or asleep)</td>
</tr>
<tr>
<td></td>
<td>Moans or whimpers, occasional complaint</td>
</tr>
<tr>
<td></td>
<td>Crying steadily, screams or sobs, frequent complaints</td>
</tr>
<tr>
<td><strong>Consolability</strong></td>
<td>Content, relaxed</td>
</tr>
<tr>
<td></td>
<td>Reassured by occasional touching, hugging, or talking to. Distractable</td>
</tr>
<tr>
<td></td>
<td>Difficult to console or comfort</td>
</tr>
</tbody>
</table>

Each of the five categories (F) Face; (L) Legs; (A) Activity; (C) Cry; (C) Consolability is scored from 0-2, which results in a total score between 0 and 10.
Case 1: Pain Control Basics

• Most common in Peds, especially post procedures
• Often poorly recognized
• Consider Norco PO for home, especially for Ortho cases
  – 0.2mg/kg/dose based on hydrocodone component, if less than 50 kg (max of 5mg per dose)
  – If greater than 50kg, 5-7.5mg hydrocodone is PLENTY
  – Only needed for 1-2 days

• High dose of Motrin also effective, especially when alternated with Norco for post-op kids (good recipe for the Ortho kids). Ok to wean the Norco after ~2 days; consider fixed dosing for moderate pain

• May see use of low dose of Morphine or Fentanyl if these patients come to the ER (IV or IN)
# Common IV Opioid Options

<table>
<thead>
<tr>
<th>Opioid</th>
<th>Potency</th>
<th>Dose</th>
<th>Half-Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>1</td>
<td>0.1-0.15mg/kg/dose MAX: 4-5mg/dose</td>
<td>2-4 hours</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>100</td>
<td>1-2mcg/kg/dose MAX: 50mcg/dose</td>
<td>20-30 minutes</td>
</tr>
<tr>
<td>Meperidine (Demerol)</td>
<td>0.1</td>
<td>0.5-1mg/kg/dose MAX: 50mg/dose</td>
<td>2-3 hours</td>
</tr>
<tr>
<td>Hydromorphone (Dilaudid)</td>
<td>5-8</td>
<td>0.01-0.015mg/kg/dose MAX: 0.2-0.6mg/dose</td>
<td>2-3</td>
</tr>
</tbody>
</table>

*Tobias, et al, 2014*
# Non-Opioid Options

<table>
<thead>
<tr>
<th>Pain Medication</th>
<th>Dose</th>
<th>Concentration</th>
</tr>
</thead>
</table>
| Motrin (Ibuprofen)   | 10mg/kg PO q4-6 (Max 800mg per dose)           | Suspension: 100mg/5mL and 50mg/1.25mL
|                      |                                                | Chewable Tabs: 50mg and 100mg
|                      |                                                | Tabs: 200mg, 400mg, 600mg and 800mg               |
| Tylenol (Acetaminophen) | 10-15mg/kg PO q6 (Max 650mg per dose or 100mg/kg per day in children OR 80mg/kg/day in infants) | Suspension: 160mL/5mL
|                      |                                                | Rectal Suppository: 80mg, 120mg, 325mg, 650mg
|                      |                                                | Tabs: 325mg, 500mg, 625mg                         |
| Ketorolac (Toradol)  | 0.5mg/kg IV/IM q6 (Max 30mg per dose)          | Tabs: 10mg                                        |
| Naproxen (Naprosyn)  | 250-500mg PO q12 (Max 1000mg per day)          | Suspension: 125mg/5mL
|                      |                                                | Tabs: 250mg, 275mg, 375mg, 500mg and 550mg       |
Common Non-Opioid Side Effects

- Headache
- Dizziness
- Ulcer Formation
- Renal Failure
- Bronchospasm
- Platelet Dysfunction
- Bleeding Dysfunction (Ketorolac contraindicated)
Case 2

You are working an overnight shift when a 3 year old girls comes in after a fall. Mom states that she was giving the girl a bath, when she slipped and fell on the edge of the bathtub and hit her chin. There was no loss of consciousness. Mom states that the little girl is acting appropriately. You notice a laceration to the little girl’s chin, about 1.5 cm across, somewhat gapping in the middle. When you try to examine and irrigate the wound, the little girl screams in horror. Now, the nurses call you after 3 failed attempts to start an IV after your order for Versed and pain meds.
Introduction to Intranasal Medications
Introduction to Intranasal Medications
Introduction to Intranasal Medications

• Eliminates the need for IV start (especially if you’re just going for anxiolysis)
• **No first pass effect**, therefore higher drug levels than oral or rectal medications
• Fewer complications when combining sedation medications
• Mild URI will have little to no effect
Intranasal Medications in Pediatric Emergency Medicine

Jeanine Del Pizzo, MD and James M. Callahan, MD

Abstract: Intranasal medication administration in the emergency care of children has been reported for at least 20 years and is gaining popularity because of ease of administration, rapid onset of action, and relatively little pain to the patient. The ability to avoid a needle stick is often attractive to practitioners. In addition, intranasal delivery of medications is especially useful in time-critical situations for which emergent administration of medication is needed; the intranasal route may be associated with more rapid medication administration. This article reviews the use of intranasal medications in the emergency care of children. Particular attention will be paid to anatomy and its impact on drug delivery, pharmacodynamics, medications currently administered by this route, delivery devices available, tips for use, and future directions.

Key Words: intranasal, children, emergency, absorption, amphetamine, oxycodone, methylxanthines, levonor, salbutamol, dantrium

Pulser Emer Care 2014;4(3): 496–494

TARGET AUDIENCE
This article is intended for all medical caregivers of children including nurses, nurse practitioners, physician assistants, pediatricians, pediatric emergency medicine physicians, critical care physicians, emergency physicians, family physicians and prehospital emergency providers.

LEARNING OBJECTIVES
After completion of this article, the reader should be able to:
1. Administer intranasal medications to children in the emergency department.
2. Compare the various routes of medication administration.

Delivering medications to children in emergency settings can be challenging. Traditionally, oral and intravenous routes have been the most often utilized methods of drug delivery. However, it is not always possible to use these routes in children due to comorbid conditions. Children may be unable to swallow or vomiting to take medications orally. In addition, the delayed and unpredictable absorption of oral medications may make this route impractical. Obtaining intranasal access may be difficult and even when possible is associated with a painful needle stick and may be associated with a delay in medication administration. Because of these challenges, multiple alternative delivery systems and means of delivery have been explored.

Intranasal medication administration in the emergency care of children has been reported for at least 20 years and is gaining popularity because of ease of administration, rapid onset of action, and relatively little pain to the patient. The ability to avoid a needle stick is often attractive to practitioners, in addition to children and their parents. In time-critical situations for which emergent administration of medication is needed, the intranasal route may be associated with more rapid medication administration. This article reviews the use of intranasal medications in the emergency care of children. Particular attention will be paid to anatomy and its impact on drug delivery, pharmacodynamics, medications currently administered by this route, delivery devices available, tips for use, and future directions.

THEORY AND BASIC SCIENCE

Anatomy

The nose is composed of a bony and cartilaginous foundation. The nasal septum separates the nose into two cavities that join with the pharynx at the choanae posteriorly. Several structures drain into the nose including the maxillary duct and the paranasal sinuses. The blood supply of the nose is quite rich and arises from terminal branches of the internal and external carotid arteries, the maxillary artery, and the ophthalmic artery. The venous drainage of the nasal cavity travels via the facial vein, superior ophthalmal vein, and internal jugular vein. It is essential to emphasize that the internal jugular vein empties directly into the superior vena cava, from there into the right heart, and eventually to the systemic system, all while avoiding first-pass, hepatic metabolism. First-pass metabolism often limits the bioavailability of oral medications, and direct systemic absorption is an important benefit of intranasal drugs orally administered drugs.

The anterior portion of the nasal cavity, known as the nasal vestibule (Fig. 1), is covered by squamous and transitional epithelial cells. The vestibule is the main site of intranasal drug absorption because of its relatively large surface area and rich blood supply. Bloodating on the vestibule is respiratory epithelium with ciliated columnar cells. Olfactory epithelium is located in the superior part of the nasal cavity on the septum and lateral wall. There is some evidence that drug deposition on the olfactory epithelium can offer direct access to the central nervous system. However, because of its small surface area, the olfactory epithelium is difficult to effectively reach.

Pharmacodynamics

Administration of intranasally administered drugs depends on numerous properties as well as specific properties of the drug involved. The time that a drug is in direct contact with the nasal mucosa affects how much is ultimately absorbed. What is not absorbed within 30 minutes may be cleared by the ciliated cells of the respiratory zone via the mucusolitary apparatus. Deposition of drug in the wrong part of the nasal cavity may result in
Common Intranasal Medications

- Midazolam
- Fentanyl
- Dexmedetomidine
- Ketamine
Versed: Common IN Med

- Anxiolytic and Sedative/Hypnotic agent
- Produces amnesia, muscle relaxation but NO analgesia
- Acts via GABA chloride channels
- Good For: Simple Laceration Repairs, Foreign Body Removals
- Versed Concentration: 5mg/mL
## Versed Dosing

<table>
<thead>
<tr>
<th>Route</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>0.05-0.1mg/kg/dose (MAX 3-4mg)</td>
</tr>
<tr>
<td>IN</td>
<td>0.4-0.5mg/kg/dose (MAX 10mg)</td>
</tr>
<tr>
<td>PO</td>
<td>0.5-0.8mg/kg/dose (MAX 15mg)</td>
</tr>
</tbody>
</table>
Intramuscular Medications

Review article

Intravenous vs intramuscular ketamine for pediatric procedural sedation by emergency medicine specialists: a review

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Section Editor: Dr Charles Cote

Summary

Ketamine is a general anesthetic agent widely used for pediatric procedural sedation outside the operating theater by nonanesthesiologists. In a setting where efficacy and safety of the agent are paramount, there are conflicting recommendations in terms of optimal mode of parenteral administration, as well as optimal dosage and need for the coadministration of adjunctive agents to decrease side effects. We investigated existing evidence to determine whether ketamine should be best administered intravenously or intramuscularly. This analysis was made difficult by limited direct comparisons of both modes of parenteral administration and a lack of consistent definitions for key outcomes such as 'effectiveness,' 'adverse events,' 'hypoxia,' 'ease of completion of the procedure,' and 'satisfaction' across studies that have evaluated ketamine. Based on large data sets, the safety and efficacy of both modes of administration are broadly similar. Although data on head to head comparisons of intravenous and intramuscular ketamine is limited, based on our analysis, we conclude that the trends indicate ketamine is ideally administered intravenously.
Case 3

A 10 year-old boy comes into your office after a fall from his bicycle. He is awake and alert and cooperative. Neurologic exam is normal. You notice a small laceration to the palm of his right hand. There is minimal bleeding. You decide to repair the wound.
Local Pain Management Options

• Topical: LET, EMLA
  – Laceration Repairs
  – IV Starts
  – Lumbar Punctures

• Injection: Lidocaine, Bupivacaine
  – Laceration Repair
  – Local Blocks
## Topicals

<table>
<thead>
<tr>
<th>Topical</th>
<th>Indication</th>
<th>Onset</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lidocaine 4% (LMX)</td>
<td>PIV starts, Minor burns</td>
<td>20 minutes</td>
<td>60 minutes</td>
</tr>
<tr>
<td>Lidocaine 2% (Lidocaine Gel)</td>
<td>Foley catheter insertion, Gtube changes, Nasal packing</td>
<td>2-5 minutes</td>
<td>30-60 minutes</td>
</tr>
<tr>
<td>EMLA (2.5% Lidocaine and 2.5% Prilocaine)</td>
<td>Skin analgesic (intact skin)</td>
<td>60 minutes</td>
<td>3 hours</td>
</tr>
<tr>
<td>LET (lidocaine, epinephrine, tetricaine)</td>
<td>Wound repair (i.e. lacerations): non-mucosal surfaces</td>
<td>10 minutes</td>
<td>30-60 minutes</td>
</tr>
</tbody>
</table>
# Injections

<table>
<thead>
<tr>
<th>Medication</th>
<th>Onset</th>
<th>Duration With Epi (hours)</th>
<th>Duration Without Epi</th>
<th>Dose With Epi (mg/kg)</th>
<th>Dose Without Epi (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lidocaine 1%</td>
<td>Rapid</td>
<td>1-6</td>
<td>0.5-2</td>
<td>5-7</td>
<td>4</td>
</tr>
<tr>
<td>Bupivacaine (0.5%)</td>
<td>Slow</td>
<td>4-8</td>
<td>2-4</td>
<td>3</td>
<td>2.5</td>
</tr>
</tbody>
</table>
Case 4

A 3-month-old girl is brought by parents after rolling off the bed and hitting her head on the hardwood floor. She cried immediately but then got sleepy. She is awake and looking around the room now. She has large left parietal hematoma, but otherwise has normal neurological exam. You decide to order an outpatient head CT.
Consider Non-Pharmacologic Options

• Child Life is an EXCELLENT resource if available at your institution; techniques include procedure preparation (for kids and parents), distraction, anxiety relief.

• Research shows can even decrease the need for anesthesia at some academic centers

• If not, many of their tricks can be easily adopted by nursing staff, techs, etc.
Consider Non-Pharmacologic Options

• Consider comforting measures to promote sleep: bottle (if not NPO), pacifier, swaddling
• If feasible, let the parents hold the child during the procedure or at least stay in the room
• Can be utilized in the ED, office or Urgent Care Center
• Realize that sometimes sedation is overdoing it and not worth the risk: medication risks, recovery time, etc.
Child Life Tips and Tricks
Child Life Tips and Tricks
Child Life Tips and Tricks
Child Life at Work
Child Life at Work
Case 5

You have a 5-year boy in your office with a bead in his ear. You have given Motrin for pain followed by PO Versed for anxiolysis. After about 10 minutes you notice that the patient is breathing slowly and making a gasping/gurgling sound. The oxygen saturations on the monitor initially read 98% but now are at about 85%. What do you do?
Common Adverse Events during Sedation

- Upper Airway Obstruction: Common
- Apnea/Hypoxemia
- Laryngospasm
- Hypotension
- Deeper level of sedation than desired
Basic Interventions: In the Office or in the ED

- Airway Repositioning
- Suctioning
- Jaw Thrust
- Bag Mask Ventilation
- Airway Adjuncts (NP tube, OP airway)
Minor Interventions: Airway Readjustment

Longnecker Anesthesia, 2008
Minor Interventions: Jaw Thrust

- Grasp the angles of the lower jaw and lift with both hands, one on each side, moving the jaw forward.
- If victim’s lips are closed, open the lower lip with your thumb.
Minor Interventions: Nasopharyngeal Tube and Oral Airway

Longnecker Anesthesia, 2008
Minor Interventions: Oral Airway
Basic Management: Apnea

Suggested Management of Apnea

- Bag/mask ventilation
  - successful
  - unsuccessful
- Reposition the airway
  - successful
  - unsuccessful
- Perform a jaw thrust
  - successful
  - unsuccessful
- Insert oral airway
  - successful
  - unsuccessful
- Call for help
- Insert nasal trumpet
  - successful
  - unsuccessful
- Insert supraglottic device (LMA of other)
  - successful
  - unsuccessful
- Tracheal intubation
  - successful
  - unsuccessful
- Surgical airway

Basic Management: Upper Airway Obstruction

Case 6

A 10 year-old Peewee Football player is brought in to you Urgent Care Center. Mom states that she was called to the football field after the patient was tackled and hit his right arm on the helmet of another player. A splint was applied there. When asked, Mom states that she is pretty sure that he last ate “something” two hours before arrival but she is unsure what. You have decided that he needs to be transferred to the local Children’s Hospital for further Orthopedic evaluation.
## NPO Standards

<table>
<thead>
<tr>
<th>Food Type</th>
<th>Hours Prior to Sedation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Food Containing Fat</td>
<td>8</td>
</tr>
<tr>
<td>Solid Food Without Fat</td>
<td>6</td>
</tr>
<tr>
<td>Nonhuman Milk</td>
<td>6</td>
</tr>
<tr>
<td>Human Milk</td>
<td>4</td>
</tr>
<tr>
<td>Clear Liquids</td>
<td>2</td>
</tr>
</tbody>
</table>
NPO...Logic

• All sedation agents have the potential to decrease airway protective reflexes
• Although rare, because of this, there is a risk of aspiration
• Should your patient vomit; the overall incidence for elective procedural sedations is low: 1/1000-1/30,000
• Ok to give routine medications (i.e. seizure medications)
• If you patient should vomit and then aspirate during a sedated procedure, they will be unable to protect their airway
• Rescue maneuvers (i.e. intubation) during sedation may increase risk of aspiration
Questions?
References


5. Beach, Michael, et al. "Major Adverse Events and Relationship to Nil per Os Status in Pediatric Sedation/Anesthesia outside the Operating Room." *Anesthesiology* (2016).


References


