The Management of Pain in Children (and Adults)

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Disclosure

- I am on the Data Safety Board of Purdue Pharma and Endo Pharmaceuticals
- I am a funded investigator for Cadence, Hospira, Astra, and Endo Pharmaceuticals
- Since very few analgesic drugs have been studied in children, this lecture will include “off label” use of drugs.
Objectives

- Discuss common myths and misconceptions that prevent appropriate pain management in children (adults)
- Provide a new ABC paradigm for pain management
- Provide an overview of the most commonly used drugs in pediatric pain management
Pain Management

Nociceptive transmission via ascending pain pathway (spinothalamic tract)

Descending control pathway from base of brain

Brain, Brainstem, Nociceptor, Dorsal Root Ganglion, Spinal Cord, Enkephalin Interneuron
Munch, Edvard

The Scream (or The Cry) 1893; Casein/waxed crayon and tempera on paper 35 7/8 x 29'';
National Gallery, Oslo
Pain - Complex Sensation

- Age
- Culture
- Socio-economic
- Previous pain experience
Age Differences
Chronic Pain: Cancer as an Example of Age Differences

- **Adults**
  - Solid organ tumors
  - Pain
    - Direct extension
    - Obstruction
    - Nerve compression
    - Bone metastases
  - Rx: sustained release oral opioids

- **Pediatrics**
  - Leukemia, lymphoma
  - Pain
    - Procedure
      - Bone marrow
      - Lumbar puncture
    - Treatment
      - Mucositis
      - Graft vs Host
  - RX: IV PCA
Pediatric Pain Demographics

- **Acute Pain 90%**
  - 70% Surgical
    - Post operative
    - Post traumatic
  - 30% Medical
    - Sickle cell vaso occlusive crisis
    - Acute Cancer Pain
      - Procedure Pain
      - Pain 2o to therapy (mucositis)

- **“Chronic” < 10%**
  - Palliative care
    - Cystic Fibrosis
    - Cancer
    - Neuro/development catastrophies
  - Headache
  - Neuropathic pain
  - Detoxification
  - Arthritis
Chronic Pain Pediatrics

- Diseases and Illnesses Associated with Chronic Pain
  - Sickle Cell Anemia
  - Inflammatory Bowel Disease
  - Juvenile Arthritis

- Chronic Pain Conditions
  - Headaches
  - Complex Regional Pain Syndromes I
  - Childhood Fibromyalgia
  - Functional Bowel Disorders
  - Chronic Fatigue Syndrome
Myths and Misconceptions Concerning Childhood Pain

- Children neither experience nor remember pain to the same degree that adults do.
Fetal Pain
A Systematic Multidisciplinary Review of the Evidence

Susan J. Lee, JD
Henry J. Peter Ralston, MD
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OVER THE LAST SEVERAL years, many states, including California, Kentucky, Minnesota, Montana, New York, Oregon, and Virginia, have considered legislation requiring physicians to inform women seeking abortions that the fetus feels pain and to offer fetal anesthesia. This year, Arizona and Georgia enacted state statutes. Current legislation is considering legislation requiring physicians to inform women seeking abortions 20 or more weeks after fertilization (ie, 22 weeks’ gestational age) that the fetus has "physical structures necessary to experience pain," as evidenced by "drawing away from surgical instruments." The physician must also inform the woman of pain and the potential for long-term damage. Although this legislation would not affect most US abortions because only 1.4% are performed after 23 weeks’ gestational age, this legislation raises important scientific, ethical, and policy issues. What is the evidence regarding the capacity for pain? What is the evidence regarding anesthesia or analgesia that is safe and effective for treating fetal pain? As a first step in answering these questions, we reviewed the literature on fetal pain and fetal anesthesia and analgesia.

Context: Proposed federal legislation would require physicians to inform women seeking abortions at 20 or more weeks after fertilization that the fetus feels pain and to offer anesthesia administered directly to the fetus. This article examines whether a fetus feels pain and if so, whether safe and effective techniques exist for providing direct fetal anesthesia or analgesia in the context of therapeutic procedures or abortion.

Evidence Acquisition: Systematic search of PubMed for English-language articles focusing on human studies related to fetal pain, anesthesia, and analgesia. Articles included studies of fetuses of less than 30 weeks’ gestational age or specifically addressed fetal pain perception or nociception. Articles were reviewed for additional references. The search was performed without date limitations and was current as of June 6, 2005.

Evidence Synthesis: Pain perception requires conscious recognition or awareness of a noxious stimulus. Nociception withdrawal reflexes, nor hormonal stress responses to invasive procedures prove the existence of fetal pain, because they can be elicited by nonpainful stimuli and occur without conscious cortical processing. Fetal awareness of noxious stimuli requires functional thalamocortical connections. Thalamocortical fibers begin appearing between 23 and 30 weeks’ gestational age, while electromyography suggests the capacity for functional pain perception in preterm neonates probably does not exist before 29 or 30 weeks. For fetuses, women may receive general anesthesia and/or analgesics intended for placental transfer, and postnatal opioid may be administered to the fetus under direct or sonographic visualization. In these circumstances, administration of anesthesia and analgesia serves purposes unrelated to reduction of fetal pain, including induction of fetal movement, prevention of fetal hormonal stress responses, and induction of uterine activity.

Conclusions: Evidence regarding the capacity for fetal pain is limited but indicates that fetal perception of pain is unlikely before the third trimester. Little or no evidence addresses the effectiveness of direct fetal anesthesia or analgesic techniques. Similarly, limited or no data exists on the safety of such techniques for pregnant women in the context of abortion. Anesthetic techniques currently used during fetal surgery are not directly applicable to abortion procedures.

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Lee SJ, Ralston HJ, Drey EA, Partridge JC, Rosen MA

Fetal pain: a systematic multidisciplinary review of the evidence.

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Penile Nerve Block

- 25, 27 gauge needle
- 10:30 1:30 o’clock position at the penile base
- 3-5 mm below skin surface
- 0.4 mL local anesthetic NO EPINEPHRINE
Heart Rate Response

Oxygen Saturation Response
Does the Newborn Remember Pain?

Myths and Misconceptions Concerning Childhood Pain

- Pain builds character
- Physicians and nurses can identify children in pain
- Therapeutic doses of opioids leads to addiction
- The risk of analgesic therapy outweigh the benefits.
HALOTHANE–MORPHINE COMPARED WITH HIGH-DOSE SUFENTANIL FOR ANESTHESIA AND POSTOPERATIVE ANALGESIA IN NEONATAL CARDIAC SURGERY

K.J.S. Anand, M.B., B.S., D.Phil., and P.R. Hickey, M.D.
Sufentanil PRN

Non-survivors
Survivors
Adverse physiologic effects of acute pain

- Respiratory
  - $\downarrow$ Tidal volume, FRC, $V_E$

- Cardiovascular
  - HR, BP, Myocardial $VO_2$

- Increased release of stress hormones
  - Catabolism, Na$^+$ and H$_2$O retention

- Infection
- Bleeding
Myths and Misconceptions Concerning Childhood Pain

- The “WHO” pain ladder
- Multi-modal v. incremental
ABCs of Pain Management

- **A**ssess pain at regular intervals using a self-report measure if possible
- **B**elieve the patient
- **C**hoose the appropriate therapies
- **D**eliver therapy in a logical, coordinated fashion
- **E**mpower and **E**ducate patients to control their pain
- **F**ollowup
ABCs of Pain Management

- Assess pain on admission, at regular intervals during hospitalization, and on discharge
- Use appropriate measures…Pain assessment is the 5th vital sign
  - Which measure to use
  - Pain history and assessment
  - Frequency of assessment
  - Documentation of measurement
Pain Assessment
Which Measure to Use

- Self report measures
  - Visual analogue pain scale
  - Faces pain scale
    - children > 3 years
    - non-English speaking

- Behavioral pain assessment
  - Unable to self report
  - Cognitive impairment

- Objective pain scale
  - non-verbal pediatric patients

- CRIES scale
  - newborn
ABCs of Pain Management

**JCAHO requirements**

- **A**ssess pain at regular intervals using a self-report measure if possible
- **B**elieve the patient
- **C**hoose the appropriate therapies
- **D**eliver therapy in a logical, coordinated fashion
- **E**mpower and **E**ducate patients to control their pain
- **F**ollowup
Phospholipid

Arachidonic Acid

Lipo-oxygenase
Leukotrienes

Cyclo-oxygenase
Prostaglandin endoperoxidase
Prostaglandin
Thromboxane

NSAIDs
Anti-pyretic Analgesics

- NSAIDs and salicylates provide their anti-inflammatory action by blocking cyclo-oxygenase in the periphery
- Acetaminophen blocks prostaglandin synthesis centrally
  - central inhibition of NMDA receptor, Substance P, and Nitric Oxide synthesis
- Degradation into an endocannabinoid
Acetaminophen

- PO or IV Dose: 10-15 mg/kg, max 60-90 mg/kg/day or in adults 4,000 mg/day
- PR Dose: Initial 25-40 mg/kg (30)
- Frequency: q 4-6-8 hours
- Lacks anti-inflammatory activity
- No effect on platelet aggregation
- Minimal GI irritability
- IV form available but $$$
Ibuprofen

- **Dose:** 4-10 mg/kg, max 2,400 mg/day
- **Frequency:** q 4-6 hours
- **Available as oral suspension** (100 mg/5mL) and as chewable tablet
- **Temporary inhibition of platelet aggregation** (vs aspirin which is permanent)
- **GI irritability**
Ketorolac

- **Dose:** 0.5 mg/kg, max single dose 30 mg, max daily dose: 120 mg
- **Frequency:** q 6 hours X 48-72 hours
- **ONLY commonly used parenteral NSAID**
- **Inhibits platelet aggregation**
- **GI irritability**
- **Oral form available but very $$$**
What’s wrong with the traditional “PRN” approach?

- Pain is not constant
  - Even when steady state blood levels can be achieved, the intensity of pain is not constant resulting in too little or too much pain medication
    - changing position, ambulation
    - dressing changes
    - coughing
    - recovery
What’s wrong with the traditional “PRN” approach?

- Once pain achieves a critical threshold, more drug is required to treat pain than would be required if it is treated pre-emptively.
- The presumption of PRN dosing is that a registered nurse is readily available to assess and treat pain.
Patient Controlled Analgesia

Indications for Use

- Postoperative, post traumatic, burns
- Severe medical pain (cancer, sickle cell crisis, pancreatitis)
- Pre-emptive treatment important
  - dressing changes
  - prior to eating in mucositis
Patient Controlled Analgesia

- **Intravenous**
  - Opioids (morphine, hydromorphone, fentanyl)

- **Epidural**
  - Local anesthetics (bupivacaine, lidocaine)
  - Opioids (fentanyl, hydromorphone, morphine)
  - Other (ketamine, clonidine)
Patient Selection Criteria

- Willingness on the part of the child, family, nurse and physician to use the device
- The ability of the child, family, nurse, and physician to follow directions
- Physical ability to push the button
Patient Controlled Analgesia

Age limitations

- Initially only in teenagers and older
- Then any child who could play Nintendo (4+)
- In our practice no age limitation:
  - Parent
  - Nurse
IVPCA Pediatrics

- Basal infusion .. **Always**
- Who can trigger?
  - Patient
  - Parent
  - Nurse
- Max bolus doses
  - Hour
  - 4 hour
Adverse Effects of Opioids

- Respiratory depression
  - higher density of μ2 receptors
  - immature blood-brain barrier
  - decreased clearance
  - reduced metabolism
- Sedation
- Seizures
- Nausea/vomiting
- Decreased bowel motility
- Urinary retention
- Histamine release
What’s New--What’s on the Horizon?


**Postoperative Surgical Patients**
- ASA PS 1 - 3
- 6-18 years of age
- N = 46

**IVPCA morphine**
- Basal infusion 0.02 mg/kg/H
- Demand dose 0.02 mg/kg
- Lockout 8 minutes
- Max # of demand doses = 5/H

**Comparison Groups**
- Normal Saline
- Naloxone 0.25 mcg/kg/H
Naloxone Study Results

![Graph showing the reduction in pruritus and nausea with naloxone compared to control. The Y-axis represents the percent reduction, and the X-axis represents the conditions (Pruritus and Nausea). The graph indicates a significant reduction in both symptoms with naloxone treatment.](image-url)
Naloxone Study Results

Number

Control
Naloxone

Pain Score
Pain Score with cough
Morphine mg/kg/day

Number

Pain Score
Pain Score with cough
Morphine mg/kg/day
What’s New--What’s on the Horizon?

- Currently, all patients being treated with IVPCA (morphine, hydromorphone, fentanyl) at the Children’s Center of the Johns Hopkins Hospital have a concomitant Naloxone infusion (1-1.5 mcg/kg/HOUR)

- All patients are treated with a bowel regimen (Miralax, Senna etc)
Pediatric Pain Management

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