Pain and pain relief in infants and children

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Some questions

- Can you feel pain?
- Can children feel pain?
- Can babies feel pain?
- Can tiny premature infants feel pain?

Background

- Newborn infants do feel and experience pain
  - Unpleasant and/or pain-provoking procedures commonly cause avoidance responses and other expressions of pain.
  - Altered reactions to pain can be demonstrated for a long time after the infant was subjected to a painful procedure without the benefit of analgesia.

Background

- CNS nerve fibers for pain are myelinized already at 30 weeks GA.
  - Besides, even in adults pain impulses are often conducted by non-myelinized fibers.
- Thus, lack of myelinization does not equal lack of sensitivity to pain!

Background

- Mediators and transmitters for relaying pain impulses are present already in the 1st trimester.
- Endogenous opioids are produced in fetal life and can be demonstrated in newborn infants who have been exposed to noxious stimuli.

Background

- Physiological expressions of pain:
  - Increased pulse rate
  - Increased blood pressure
  - Reduced O_2 saturation
  - Increased adrenal hormones
- Emotional expressions of pain:
  - Crying
  - Grimasing
  - Avoidance reactions

Background

- Negative effects of untreated pain:
  - Increased pulse rate and blood pressure
  - Increased oxygen consumption
  - Release of adrenal hormones
    - Release of glucose, lactate, puryvate
      - Hyper-/hypoglycemia, emptying of carbohydrate stores
  - Reduced vagal tone
  - Altered blood supply to vital organs

Background

- There is still no general agreement about the treatment of pain in infants:
  - Does the infant really feel pain?
  - Fear of side effects of analgetics and sedatives.
  - Fear of development of dependency.
  - Insiffucient knowledge about pharmaco-kinetics and other variables in infants.
  - Disagreement about the importance of negative effects of untreated pain.

Indications for pain relief and sedation in infants and children

- Strong and/or long-lasting pain/ discomfort
  - Per- and postoperative pain
  - Respirator treatment which requires neuromuscular blockade because of severe ventilation/oxygenation problems (?)
  - Insertion of chest tubes
  - Circumcision

Indications for pain relief and sedation in infants and children

- Pain/discomfort of moderate intensity and/or duration
  - Intubation
    - Acute vs sub-acute
  - Spinal tap
    - Single stick vs multiple attempts

Indications for pain relief and sedation in infants and children

- Pain/discomfort of low intensity and/or short duration
  - Heel stick for capillary blood sampling
  - Insertion of i.v. cannulae or percutaneous CVK
  - Suction of nose/pharynx or endotracheal tube
  - Bladder catheterisation

Analgetic drugs and techniques in infants and children

- Non-pharmacological methods
  - Resembling hypnosis:
    - Rythmic stroking of the body
    - Talk to / sing for the infant
    - Sucking a pacifier
  - Sucrose/food
    - 25% sucrose in small amounts by mouth or on a pacifier has been shown to have analgetic effects.
    - Having food in your stomach can also have a certain analgetic effects

Analgetic drugs and techniques in infants and children

- Non-pharmacological methods
  - Planning care
    - Reduce stress and agitation by providing longer periods with calm, quiet, and reduced stimuli
      - This is a key element in the NIDCAP approach

Analgetic drugs and techniques in infants and children

- Non-pharmacological methods
  - Hypnosis
    - Useful in children who are old enough to be hypnotized
    - Children can be taught self-hypnosis
      - Can contribute to increased feeling of being in control and of self-confidence
    - Does require the investment in time to learn hypnotic techniques

Analgetic drugs and techniques in infants and children

- Pharmacological methods
  - Local anesthesia
    - Lidocaine injection
      - Chest tube / Circumcision
      - Drawbacks:
        - Prolonged half-life
        - Low concentrations of binding proteins in serum
        - = increased risk for toxicity (dose should be limited to 4 mg/kg (=0.8 ml of a 5 mg/ml solution)

Analgetic drugs and techniques in infants and children

- Pharmacological methods
  - Surface anesthesia/-analgesia
    - EMLA (eutectic mixture of lidocaine and prilocaine)
      - Injections, blood tests, circumcision
      - Drawback:
        - Prilocaine may cause methemoglobinemia in infants by absorption through the skin of the metabolite O-toluidine
        - Infants have low activity of MetHb-reductase

Analgetic drugs and techniques in infants and children

- Pharmacological methods
  - Surface anesthesia/-analgesia
    - EMLA
      - Newer studies have shown that the risk of methemoglobinemia is much less than we have feared.
      - EMLA may be used in newborn infants in single doses as long as it is not combined with other drugs that cause methemoglobinemia (for example trimethoprim-sulfa).

Analgetic drugs and techniques in infants and children

- Pharmacological methods
  - Peroral/rectal analgesia
    - Paracetamol is the main analgesic of this type both in neonates and bigger children
      - Because of immature metabolic pathways neonates are relatively protected against paracetamol toxicity
      - Uptake from rectal mucosa is delayed and incomplete **Ü** demands higher dose
      - Oral dose 10-15 mg/kg x 4 (-6)
      - Rectal dose 20-25 mg/kg x 4 (-6)

Analgetic drugs and techniques in infants and children

- Pharmacological methods
  - Peroral/rectal analgesia
    - Codeine phosphate
      - Useful in moderate pain (e.g. postoperatively). Dose 1 mg/kg
      - May be used alone or in combination with paracetamol
      - Drawbacks:
        - Inhibition of respiration by repeated/ high doses
        - Constipation by long term use

Analgetic drugs and techniques in infants and children

- Pharmacological methods
  - Parenteral analgesia/anesthesia
    - Opiates are the ”backbone” in per- and postoperative analgesia
      - Drawbacks:
        - Inhibition of respiration
        - Inhibition of intestinal motility
        - In experimental animals there have been suggestions of increased organ damage following asphyxia
        - Possibly reduced time interval between ischemia and nevronal damage in experimental animals when fentanyl is used

Analgetic drugs and techniques in infants and children

- Pharmacological methods
  - Parenteral analgesia/anesthesia
    - Opiates
      - Drawbacks:
        - Variable pharmacokinetics, difficult to predict half-life: Morphine 5-28 h; Fentanyl 1-6 h
        - Adaptation with longer use
        - Use of opiate analgesia requires monitoring of the patient

Analgetic drugs and techniques in infants and children

- Pharmacological methods
  - Parenteral analgesia/anesthesia
    - Opiate - dosing:
      - Fentanyl 1-3 (-10) microgram/kg every 2-3 h, or continuous infusion 1-5 microgram/kg/h
      - Morphine 50-100 microgram/kg every 3-8 h, or continuous infusion 10-20 microgram/kg/h

Analgetic drugs and techniques in infants and children

- Pharmacological methods
  - Parenteral analgesia/anesthesia
    - Opiates: fentanyl (F) vs morphine (M)
      - F has less side effects than M:
        - Very little release of histamine and chatecolamines
        - Less/no venous dilatation
        - Less/no negative inotropic effects
        - Better cardiovascular stability
        - Possibly less inhibition of respiration

Analgetic drugs and techniques in infants and children

- Pharmacological methods
  - Parenteral analgesia/anesthesia
    - Opiates: fentanyl (F) vs morphine (M)
      - F may be preferable in pulmonary hypertension because it blocks the increase in pulmonary pressure caused bytracheal suctioning.
      - Theoretically fentanyl may may be less optimal when you want to increase pulmonary flow resitsance – as may be the case in ductal dependent cardiac malformations
        - I don't know whether this has actually been tested

Analgetic drugs and techniques in infants and children

- Pharmacological methods
  - Inhalation analgesia/anestesia
    - Little used aside from operativ anesthesia
    - NO is very soluble and may cause expansion of air pockets (pneumothorax, intestinal obstruction)
    - Inhalation gases in the NICU are tricky to handle from an environmental perspective

Analgetic drugs and techniques in infants and children

- Sedation
  - Sedatives generally do not have an analgetic effect
  - Combinations of sedatives and analgetics are used quite frequently, but the scientific documentation is somewhat limited so far

Analgetic drugs and techniques in infants and children

- Sedation
  - Benzodiazepines
    - Diazepam has a very long half-life and a significant tendency for respiratory inhibition
      - We practically never use it
    - Midazolam – frequently combined with fentanyl (ratio F:M = 1:5) in continuous infusion.
      - Encephalopathy-like effects have been described

Analgetic drugs and techniques in infants and children

- Sedation
  - Barbiturates
    - Frequently used to treat seizures
    - Has no analgetic effect, and may have a hyperalgetic effect
    - Rapid adaptation to the sedative effect, and should not be used for a prolonged period of time as a sedative
    - Thiopental (6 mg/kg) may be used for short-term sedation for intubation

Analgetic drugs and techniques in infants and children

- Sedation
  - Chloral hydrate
    - Previously frequently used for sedation in infants with BPD
      - We haven't used it for years
    - Has no analgetic effect
    - May be given orally or rectally (25-50 mg/kg)
    - Irritates the rectal mucosa if used frequently/repeatedly

Analgetic drugs and techniques in infants and children

- Conclusion
  - Children and infants feel and experience pain
    - Procedures which are painful/uncomfortable for us, are likely to be painful for sick newborns also
    - Untreated pain is destabilizing
    - The need for pain relief should always be kept in mind
    - As a rule analgesia and, if necessary, sedation, should be given to newborn infants if bigger children and grown-ups would have been given such treatment

UN Convention on the Rights of the Child

- Article 3
  - In all actions concerning children, whether undertaken by public or private social welfare institutions, courts of law, administrative authorities or legislative bodies, the best interests of the child shall be a primary consideration

UN Convention on the Rights of the Child

- Article 19
  - ……to protect the child from all forms of physical or mental violence, injury or abuse, neglect or negligent treatment, maltreatment ….
  - …. the right of the child to ….facilities for the treatment of illness and rehabilitation of health ….that no child is deprived of his or her right of access to such health care services.

RIKSHOSPITALET

Oslo University Hospital, Rikshospitalet is owned by Health South-East RHF and consists of Rikshospitalet, Radiumhospitalet, The Epilepsy Center and the Specialist Hospital for Rehabilitation.

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