Acute Pain in Children – Past, Present & Future

Stefan Lundeberg

Astrid Lindgren Children’s Hospital, Stockholm
H R H Crown princess Lovisa

Institution for Child Care

1848  1899  .............
Pain relief in the pediatric patient.

Swafford, LI, Allan, D.


Only two out of sixty (3%) children on their surgical floor required pain relief.
Past analgesic treatment: paracetamol & morphine, regional anesthesia
Strategy and pharmacological treatment in acute and procedural pain
Studies on the hormonal regulation of fuel metabolism in the human newborn infant undergoing anaesthesia and surgery.

Randomised trial of fentanyl anaesthesia in preterm babies undergoing surgery: effects on the stress response.
Why treat pain?

humanitary reasons

shorter hospital care

decrease nerve cell death

limit the risk of long term pain
Chronic pain after surgery in children.

*Nikolajsen L1, Brix LD.*  *Curr Opin Anaesthesiol.* 2014
2017 Global Year Against Pain After Surgery
Pain After Surgery in Children and Infants

Children have at least the same amount of pain from surgery as adults do, although it may not last as long because children usually heal more quickly. Children deserve protection, cannot advocate for themselves, and often may not complain of pain, so they need special consideration and pain assessment. All health professionals should know how to recognize, assess, and treat pain in children [5].

Untreated acute pain can result in chronic pain in children and adolescents [3], and failure to prevent pain in newborns can cause lifelong adverse effects, such as increased pain sensitivity [6].

Surgical pain should be prevented whenever possible. Avoid unnecessary procedures and plan the management before the surgery. Assess pain using age-appropriate validated tools. Develop standard protocols that can be adapted to individual patients, so that when surgery is required, a combination of medications are available to provide the best possible analgesia with the lowest risk and side-effects, along with non-pharmacological pain control techniques. [AAP 2001] [APAGBI 2012]
Pain in children is still under-recognized and undertreated in Scandinavia

A. Hiller, P. K. Suominen
Pain prevalence in hospitalized children: a prospective cross-sectional survey in four Danish university hospitals

S. Walther-Larsen ¹, M. T. Pedersen ¹, S. M. Friis ¹, G. B. Aagaard ¹, J. Rømsing ², E. M. Jeppesen ³ and S. J. Friedrichsdorf ⁴,⁵
Results: Two hundred and thirteen children (37%) responded that they had experienced pain in the previous 24 hours. One hundred and thirty four (24%) indicated moderate to severe pain and 43% would have preferred an intervention to alleviate the pain. In children hospitalized for more than 24 hours, the prevalence of moderate/severe pain was significantly higher compared to children admitted the same day. The single most common painful procedure named by the children was needle procedures, such as blood draw and intravenous cannulation.
Pain prevalence in hospitalized children: a prospective cross-sectional survey in four Danish university hospitals

Number of patients

- No pain: 357
- Mild pain: 79
- Moderate pain: 70
- Severe pain: 64

Acta Anaesthesiologica Scandinavica
http://onlinelibrary.wiley.com/doi/10.1111/aas.12846/full#aas12846-fig-0002
<table>
<thead>
<tr>
<th>Procedure/Condition</th>
<th>N = 213 (VAS&gt;0)</th>
<th>Worst pain score *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needle pokes</td>
<td>77 (36%)</td>
<td>3.8 (2.7–6.8)</td>
</tr>
<tr>
<td>Other invasive procedures†</td>
<td>43 (20%)</td>
<td>4.4 (2.7–6.5)</td>
</tr>
<tr>
<td>Accident/injury, other medical</td>
<td>42 (20%)</td>
<td>6.5 (5.0–7.3)</td>
</tr>
<tr>
<td>Acute illness</td>
<td>27 (13%)</td>
<td>7.5 (5.1–8.3)</td>
</tr>
<tr>
<td>Known disease</td>
<td>16 (8%)</td>
<td>6.3 (4.4–8.1)</td>
</tr>
<tr>
<td>Surgery</td>
<td>8 (4%)</td>
<td>6.5 (4.9–9.1)</td>
</tr>
</tbody>
</table>
Table 6Negative family response (qualitative) to staff members’ performance on pain management.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Waiting time and bustle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Changing staff</td>
</tr>
<tr>
<td></td>
<td>Lack of communication and planning</td>
</tr>
<tr>
<td>Professional</td>
<td>Staff members not paying attention</td>
</tr>
<tr>
<td></td>
<td>Restraining</td>
</tr>
<tr>
<td></td>
<td>Management was personal dependent</td>
</tr>
<tr>
<td>Pharmacological</td>
<td>Insufficient pain management</td>
</tr>
<tr>
<td></td>
<td>Management depending on family request</td>
</tr>
<tr>
<td></td>
<td>Waiting for pain medication</td>
</tr>
</tbody>
</table>
Table 5 Positive family response (qualitative) to staff members’ performance on pain management

<table>
<thead>
<tr>
<th>Category</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-pharmacological</td>
<td>Demonstrating positioning</td>
</tr>
<tr>
<td></td>
<td>Good at distraction</td>
</tr>
<tr>
<td></td>
<td>Caring</td>
</tr>
<tr>
<td>Communication and compassion</td>
<td>Caring attitude</td>
</tr>
<tr>
<td></td>
<td>On child condition</td>
</tr>
<tr>
<td></td>
<td>Parental involvement</td>
</tr>
<tr>
<td>Professional</td>
<td>Professional management</td>
</tr>
<tr>
<td></td>
<td>Communicative skills</td>
</tr>
<tr>
<td></td>
<td>Informative</td>
</tr>
</tbody>
</table>
Pain prevalence in hospitalized children: a prospective cross-sectional survey in four Danish university hospitals

- Positioning: 17%
- Distraction: 23%
- Numbing creme: 13%
- Sucrose/breastfeeding: 18%
- Warm/cold pack: 6%
- Pacifier: 9%
- Information/instruction: 23%
- Patient participation: 16%
- Caregiver participation: 34%
- Pain medicine: 23%
- Nothing: 15%
- Other: 16%

Number of responses (several answers were allowed)

Acta Anaesthesiologica Scandinavica
<table>
<thead>
<tr>
<th></th>
<th>Regime</th>
<th>N = 134 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Paracetamol</strong></td>
<td>prn</td>
<td>7 (5)</td>
</tr>
<tr>
<td></td>
<td>Round-the-clock</td>
<td>18 (13)</td>
</tr>
<tr>
<td><strong>NSAID’s</strong></td>
<td>prn</td>
<td>3 (2)</td>
</tr>
<tr>
<td></td>
<td>Round-the-clock</td>
<td>9 (7)</td>
</tr>
<tr>
<td><strong>Opioids</strong></td>
<td>prn</td>
<td>3 (2)</td>
</tr>
<tr>
<td></td>
<td>Round-the-clock</td>
<td>1 (1)</td>
</tr>
<tr>
<td></td>
<td>Continuous infusion</td>
<td>0 (0)</td>
</tr>
<tr>
<td><strong>None of these</strong></td>
<td></td>
<td>93 (69)</td>
</tr>
</tbody>
</table>

Prn, *pre re nata* (‘as needed’); NSAID’s, non-steroidal anti-inflammatory drugs.
ORIGINAL ARTICLE

Pain in children – are we accomplishing the optimal pain treatment?

Stefan Lundeberg1,2

1 Pediatric Pain Treatment Service, Department of Pediatric Anesthesia, Operating Services and Intensive Care, Astrid Lindgren Children’s Hospital, Karolinska University Hospital, Stockholm, Sweden
2 Department of Physiology and Pharmacology, Karolinska Institutet, Stockholm, Sweden
Strategy and modern analgesic regimes

multimodal

multidisciplinary

fear - free
FEAR

Fear - a major challenging factor

Fear - increases nociceptive input
Strategy and modern analgesic regimes today
The paracetamol adventure trip
The paracetamol adventure trip
plasma concentration

paracetamol

intravenous

oral

rectal

time
CONCLUSION:
Among infants undergoing major surgery, postoperative use of intermittent intravenous paracetamol compared with continuous morphine resulted in a lower cumulative morphine dose over 48 hours.

*Effect of intravenous paracetamol on postoperative morphine requirements in Neonates and infants undergoing major noncardiac surgery: a randomized controlled trial.*

*Ceelie I, de Wildt SN, van Dijk M, et al. JAMA. 2013*
Cox inhibitors - NSAIDs

- inflammatory pain conditions
- bone pain/fractures
- betametasone, dexametasone perop.
The balance of evidence in the available literature appears to suggest that a short-duration NSAID regimen is a safe and effective supplement to other modes of post-fracture pain control, without a significantly increased risk of sequelae related to disrupted healing.


Opioids

opioid rotation

opioid combination
morphine-3-glucuronide excitatory
morphine-6-glucuronide analgesic

muscle spasm m-3-g possible cause
codeine – the no opioid

hypo- and hypermetabolizers
Opioids - side effects

Possibilities for better management
Opioids - withdrawal

Possibilities for better management
Alfa 2 receptor agonists

clonidine
dexmedetomidine

large therapeutic window

limited side effects
Alfa 2 receptor agonists

nociceptive & neuropathic pain

additive to local anesthetics

reduce windup
S-Ketamine / Ketamine

major surgery

neuropathic pain

reduce opioid induced hyperalgesia remifentanil

reduce windup
Adenosine infusion

acute alldynia

Naloxone low dose infusion

attenuate opioid tolerance and gliacells activity
Local anesthetics

topical
regional anesthesia

buffered solutions
Gabapentin &

Pregabalin

nociceptive pain?
neuropathic pain

reduce windup – topic for discussion
Aim

Acceptable pain level on individual basis

Pain level that admits mobilization

Limited unwanted side effects
Strategy and modern analgesic regimes
tomorrow
more than 500 different substances being tested but how many will reach the market ??
Opioids

10 different subunits of the µ-receptor

new possible analgesics with less side effects?
Neonatal pain

apoptosis  excitotoxicity

new drugs with less excitotoxicity ?
less invasive procedures ?
Local anesthetics

long term effect after a single block?

specific sodium receptor subunit blocker?

$\text{NA}_V^{1.7}, \text{NA}_V^{1.8}$

congenital analgesia
Treatment of pain with botulinum neurotoxins is now entering a new era
due to the emergence of newly engineered compounds which by targeting the sensory neurons can offer a more effective means of pain control.

The preliminary data from cell culture and animal experiments suggest a significant potential for these toxins/toxin chimeras and toxin/antibody compounds in relieving human pain.
Genetic Testing in Pain Medicine—The Future Is Coming

Targeted pain therapies and screening for personality traits that may influence pain perception and addiction risk are just some of …

the potential promises of genetic testing in pain management.
The future of pain relief will be ‘technaceuticals,’ doc says

Instead of pharmaceuticals, technology is poised to play an even greater role in medicine, especially in the area of pain management.
Simple pain management

• consider pre-operative conditions

• prevent per-operative windup

• post-operative analgesics on a regular basis

• multimodal analgesic strategy

• individualize to acceptable pain levels & treat side effects
Pain management

• quick reference guides for doctors and nursing staff

• pain assessment

• repeated education

• guidelines in use
PARACETAMOL per os / riktigt

Undelhållsdos Smärtsbehandling
Dygn 1-3, ineliggande patienter

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>p.o.</th>
<th>i.v.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prematura v. 28-32</td>
<td>15 mg/kg x 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prematura v. 33-36</td>
<td>20 mg/kg x 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2 mån</td>
<td>25-25 mg/kg x 3</td>
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<tr>
<td>&gt;2 mån</td>
<td>25 mg/kg x 3</td>
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Efter 3 dygn reduceras dygnsdosen med 20%.

Laddningsdos = engångsdos

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<tr>
<td>Prematura v. 33-36</td>
<td>20-30 mg/kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2 mån</td>
<td>20-40 mg/kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;2 mån</td>
<td>30-40 mg/kg</td>
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PARACETAMOL för intravenöst bruk
Dygn 1-3, ineliggande patienter

<table>
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<tbody>
<tr>
<td>Prematura v. 28-32</td>
<td>7.5 mg/kg x 3</td>
<td></td>
</tr>
<tr>
<td>Prematura v. 33-36</td>
<td>7.5 mg/kg x 4</td>
<td></td>
</tr>
<tr>
<td>0-2 mån</td>
<td>10-15 mg/kg x 4</td>
<td></td>
</tr>
<tr>
<td>&gt;2 mån</td>
<td>15-20 mg/kg x 4</td>
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Efter 3 dygn reduceras dygnsdosen med 25%.

KLONIDIN / Catapresan®

Smärtsbehandling

Catapresan® / Klonidin
1 mikrog/kg x 3-4 i.v. / p.o.

Premedicinering

Catapresan® / Klonidin
1 mikrog/kg i.v.

Klonidin
0.5 mikrog/kg p.o.

Vid avslutad smårtsbehandling trappa ut under 3-4 dagar.

I v läsning Catapresan 150 mikrog/ml spädss till 15 mikrog/ml.

Ges långsamt under 15-30 min.

MORFIN

Spädss till 1 mg/ml – Ges långsamt under 1-3 min.

Alder Mängd i.v intermittent tillförsel
<3 mån 25 mikrog/kg
3-12 mån 50 mikrog/kg
>12 mån 100 mikrog/kg

Dos kan upprepas efter utvärdering av smärtsituation.

Samma dosering gäller för Ketobemidon (Ketogon®) och Oxikodon (Oxynorm®).

NALOXON – motverka opioidbaserade

<table>
<thead>
<tr>
<th></th>
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<th>GBS1 per os</th>
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<tbody>
<tr>
<td>Naloxon</td>
<td>24 mg/kg x 3-4</td>
<td></td>
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Smärtsbehandlingsenheten Astrid Lindgrens Barnsjukhus/
Kardiologiska Universitetssjukhuset
Stefan Lundsborg
Giltig t.o.m. 2017-02-01

Se även Riktlinjer för smärtsbehandling

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COX-HÄMNAME / NSAID

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<th>i.v.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diklofenac (Voltare®)</td>
<td>1.2 mg/kg x 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ibuprofen (Ben® / Brafen®)</td>
<td>4-10 mg/kg x 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ketobrac (Prai®)</td>
<td>0.3 mg/kg x 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Celecoxib (Celebre®) (ot vid EDA)</td>
<td>24 mg/kg x 1</td>
<td>p.o.</td>
<td></td>
</tr>
<tr>
<td>Parecoxib (Dyresta®) (ot vid EDA)</td>
<td>0.5 mg/kg x 1</td>
<td>i.v.</td>
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Se även Riktlinjer för smärtsbehandling
Barriers that hinder implementation

organizational
social
professional
financial
“the knowing doing gap”