Postoperative pain management in the paediatric patient

Diedericks J, MMed(Anees), FCA(SA), BA
Department of Anaesthesiology, University of the Free State, Bloemfontein
E-mail: Prof J Diedericks at gnanjd.md@mail.uovs.ac.za

Abstract
The text provides a brief overview of approaches to and management of pain in children that will be useful for the general practitioner.

Introduction
Pain treatment in children is often insufficient\(^1\) and less potent analgesics are used compared with those used by adults. There is a tendency to use simple analgesics and to use them later in the course of disease. Personnel treating children are often unfamiliar with children, are insufficiently trained and have an unrealistic fear of cardiorespiratory depression and addiction. However, babies, even premature, can sense pain, although the response is less focussed.

Evaluation of pain in children
The psychological age of children will influence their perception of pain (see Table I).

Table I: Developmental age and nociceptive interpretation in children\(^2\)

<table>
<thead>
<tr>
<th>Age</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3 years</td>
<td>Nociception</td>
</tr>
<tr>
<td>3-5 years</td>
<td>Pain is a form of punishment</td>
</tr>
<tr>
<td>5-12 years</td>
<td>Pain evokes fear of harm or mutilation</td>
</tr>
<tr>
<td>&gt;12 years</td>
<td>Pain is a threat to body image and independence</td>
</tr>
</tbody>
</table>

Pain can be evaluated in terms of self-report, physiological changes or behavioural observation.\(^2\) Physiological indicators of pain is often unreliable but may include tachycardia, restlessness, pallor, vomiting, or blood pressure increases. Children older than four years can usually talk about their pain and those older than six to eight years can use visual analogue pain scales in the same manner as adults. Various pain scales can be used to help children express their pain, e.g. a visual analogue scale, a graphic rating scale or a numerical rating scale (see Figure 1). A photographic face scale and a colour visual analogue scale (rulers with increasing intensity of red colour signifying increasing intensity of pain) were found to correlate well in children aged three to seven.

Behavioural rating scales, which use non-verbal behaviour to assess pain, are probably the most reliable indication of pain in children who cannot verbalise their pain accurately. The Children's Hospital of Eastern Ontario Pain Scale (CHEOPS) and CRIES are both reliable and useful.

The approach to pain relief in children
A holistic approach including drugs, but also psychological preparation, regional analgesia, play, music and art therapy, reflexology, aromatherapy, hypnosis, acupuncture, gentle handling and supportive positioning may provide the best results, depending on the cause of pain. The organisational aspects of a pain service for children are very important. Inexperience and uncertainty amongst personnel are reasons why children's pain is treated inadequately. Where definitive protocols and adequate training are present, pain relief for children has been found to be adequate.\(^1\)

Psychological support
Fear, anxiety and stress worsen pain. These can be minimised if good contact is made with both the child and the parents during the preoperative visit. Everything should be explained in concrete terms (abstract thoughts only develop around five to six years). If a picture book or toys can be used to demonstrate procedures, understanding will be greatly enhanced, leading to far less anxiety. The parents' fears and misconceptions should again be addressed by honest and understandable explanations.\(^2\)

Drugs
Drugs can be administered orally, intravenously, intramuscularly, mucosally, subcutaneously, transcutaneously and rectally. The exact mode of administration will depend on the available resources and on the training and experience of the caring personnel. A multimodal approach, using more than one method, increases the success rate.

Oral analgesics (Table II):
These are used for mild to moderate pain, e.g. for peripheral surgery or following more potent therapy as the...
Table II: Oral analgesics commonly used for children

<table>
<thead>
<tr>
<th>Drug</th>
<th>Pediatric postoperative dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paracetamol</td>
<td>10-15 mg/kg (max 60 to 100 mg/kg/24h)</td>
</tr>
<tr>
<td>Diclofenac drops</td>
<td>1-2 mg/kg q8h (1 drop = 0.5 mg)</td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>4-5 mg/kg q6h</td>
</tr>
<tr>
<td>Naproxen</td>
<td>5-7.5 mg/kg twice per day</td>
</tr>
<tr>
<td>Codeine phosphate</td>
<td>0.5-2 mg/kg q4h</td>
</tr>
<tr>
<td>Clonidine</td>
<td>1-3 mg/kg</td>
</tr>
</tbody>
</table>

Table III: Commonly used intravenous analgesics for children

<table>
<thead>
<tr>
<th>Drug</th>
<th>Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pethidine</td>
<td>Intermittent: 0.5 mg/kg q2hourly</td>
</tr>
<tr>
<td>Pethidine</td>
<td>Continuous infusion: 0.4 mg/kg/h, bolus 0.3 mg/kg</td>
</tr>
<tr>
<td>Morphine sulphate</td>
<td>Intermittent 0.05 mg/kg 2 hourly</td>
</tr>
<tr>
<td>Morphine sulphate</td>
<td>Continuous infusion: 40 µg/kg/h, bolus 30 µg/kg</td>
</tr>
<tr>
<td>All opioids</td>
<td>Half the dose &lt; 3 months age</td>
</tr>
<tr>
<td>Morphine sulphate</td>
<td>PCA: 15-20 µg/kg, lockout time 7-15 minutes; 4-hourly limit 300 µg/kg. Not for opioid- or medically-naïve patients. If a basal infusion is used concurrently: 10-15 µg/kg/h</td>
</tr>
<tr>
<td>Ketamine</td>
<td>0.5-0.75 mg/kg</td>
</tr>
<tr>
<td>Clonidine</td>
<td>1-3 mg/kg</td>
</tr>
<tr>
<td>Ketorolac</td>
<td>0.3-0.5 mg/kg 3 to 4 times per day</td>
</tr>
<tr>
<td>Paracetamol</td>
<td>Load 20 mg/kg, then 15 mg/kg/4h; max 60 mg/kg (if &gt;33 Kg weight)</td>
</tr>
</tbody>
</table>

**Figure 2:** The effect of bolus, bolus plus infusion, continuous infusion and PCA on target blood levels. PCA gets close to continuously at the targeted level of analgesia without side effects.

**Intravenous analgesics (Table III):** The best way for intravenous administration is frequent, small (but adequate) doses, which are ideally achieved with patient-controlled analgesia (PCA). When this is not available, the analgesics should be administered at regular intervals with appropriate supervision (see Figure 2). The chosen dose should be administered, after which the child should be observed directly for 15 minutes. Continuous infusion can also be used to achieve this goal, but care must be taken not to cause accumulation of the drug. Accumulation occurs easier in babies younger than six months in age.

Appropriate monitoring by adequately trained personnel is essential if intravenous opioids are used. Naloxone and other resuscitation drugs and resuscitation equipment must be available at the bedside. If used appropriately, and at the correct dose, opioids are safe. A child should not be denied adequate pain relief for fear of respiratory arrest or addiction, which is not a problem if the drugs are used correctly. A special group of babies is the ex-premature babies, who tend to get respiratory arrest postoperatively when opioids are used intraoperatively. In this group of children, opioids should be avoided until 60 weeks post conception. Children should always be observed with at least a pulse oximeter, respiratory monitor and apnoea blanket in a high care unit if they received any opioids.

Intravenous paracetamol is now available in South Africa. A loading dose of 20 mg/kg, followed by 15 mg/kg four hourly to a maximum of 60 mg/kg, may be used in children heavier than 33 kg.

**PCA:** Though patient-controlled analgesia is ideal, it is probably not practical until the child is five years or older. This is used in hospital setting. Theoretically, any child who understands that he or she needs to press a button when feeling pain can use it. However, a higher level of supervision is probably necessary in comparison to adults. Good nursing facilities and an available doctor on site are essential if it is used in children. Clear, written standing orders must be available for the nursing personnel. When oversedation or a respiratory rate of lower than 10 per minute is present, the pump must be stopped. If this is accompanied by hypoxia on pulse oximetry, naloxone

Patient recoveries. It became routine for these drugs to be used in combination with other drugs (particularly opioids) to provide more effective pain relief and limit side effects. The drugs used include paracetamol, NSAIDs (ibuprofen, diclofenac and ketorolac, but not aspirin for fear of Ray syndrome), and opioids (codeine phosphate, dihydrocodeine and morphine syrup). Over the past few years, paracetamol has re-established itself as an important drug in the postoperative period in children. An average maximum dose of 60 mg kg⁻¹ should not be exceeded. However, age and the general condition of the patient will guide the maximum daily dose administered either orally or rectally. This dosage is 100 mg/kg for children, 75 mg/kg for infants, 60 mg/kg for term and preterm neonates of >32 weeks postconceptual age, and 40 mg/kg for neonates of 28 to 30 weeks postconceptual age. Oral NSAIDs have few gastrointestinal side effects, but may have better analgesia compared with paracetamol. Little is known about the selective cyclooxygenase-2 inhibitors in children, except from studies on rofecoxib and nimesulide, and the place and cost-effectiveness of these drugs still needs to be examined. Short-term use may avoid the cardiovascular side effects that lead to the discontinuation of some of these drugs from the market.
Pethidine does not provide good analgesia compared with morphine, and should never be used long term because its long-acting metabolite, norpethidine, may cause dysphoria and seizures. Fentanyl can be used for rapid analgesia for short periods of time, but as an infusion it becomes a long-acting drug due to context-sensitive half-life prolongation. Methadone (oral or IV) has a prolonged action, but variable long clearance, and administration should be carefully monitored to prevent oversedation. Opioids (morphine) can be successfully infused subcutaneously, but sudden respiratory arrest was reported when a patient was rehydrated. This emphasises the need for adequate fluid resuscitation when opioids are administered, otherwise rehydration may cause unexpected kinetics, particularly along the subcutaneous or intramuscular route.

Table IV: Commonly used intravenous analgesics for children

<table>
<thead>
<tr>
<th>Transmucosal route</th>
<th>Drug</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sublingual</td>
<td>Tildine 0.5 to 1 mg/kg/dose 4 to 6 hourly</td>
</tr>
<tr>
<td>Buccal</td>
<td>Fentanyl (OTFC) 15-20 µg/kg (Not available in SA)</td>
</tr>
<tr>
<td>Intranasal</td>
<td>Sufentanil 0.5 µg/kg; Fentanyl 1.4 µg/kg</td>
</tr>
<tr>
<td>Rectal</td>
<td>Paracetamol 40 mg/kg, then 20 mg/kg 8-hourly Ketamine 5 mg/kg Diclofenac 1-3 mg/kg/24hour</td>
</tr>
<tr>
<td>Corneal</td>
<td>Local anaesthetics Amethocaine 2.5%</td>
</tr>
</tbody>
</table>

Unfortunately, absorption may vary, but this is a useful route for the administration of analgesics in children who cannot or will not take oral medication. It was recently shown that target concentrations of paracetamol could be reached by rectal administration despite large inter-individual variability kinetics.

Regional analgesia
In neonates, specific factors influence regional analgesia and should be noted. There is less liver blood flow and immature enzyme, less -feto glycoprotein and albumin, and also less right to left shunts. This will lead to easier accumulation and an increased free fraction, in addition to rapid absorption, compared with adults. The dose should be carefully calculated to avoid toxicity, particularly if continuous infusions are used. Newer drugs such as ropivacaine and levobupivacaine have less cardiotoxicity than bupivacaine. In contrast, toddlers need a higher dose than adults for all routes of administration.

Topical analgesia
EMLA® cream is a tectonic mixture of lignocaine 25 plus prilocaine 25 mg per gram that can be applied to the skin (dose varying from 0.5 to 2 gram21). After an hour covered with plastic drape, the area covered is analgised and there is prominent venodilatation. This is widely used to facilitate painless intravenous cannula placement, but is ineffective for surgical analgesia.

Local infiltration of surgical wounds with either lignocaine or bupivacaine will provide analgesia for a few hours postoperatively. The toxic dose for each drug (3 mg/kg for lignocaine, 2 mg/kg for bupivacaine or ropivacaine) should not be exceeded. This is very useful for abdominal surgery and lateral thoracotomies.

Regional nerve blocks
Frequently used nerve blocks include the penile, ilio-inguinal and ilio-hypogastric, and intercostal block. When adequate nursing facilities are available, continuous interpleural or paravertebral block can be done with in-staying catheters.

Neuraxial blockade
This type of block includes caudal, epidural and spinal blocks. There are important anatomical differences between neonates and adults. Among these are that the spinal cord (L3) and dural sac (S2-S4) are more caudate. Epidural analgesia in children and neonates
Epidural block in children should be performed by trained anaesthesiologists. Continuous infusions may be used postoperatively, and even be patient controlled, but trained nursing personnel are essential for observation and care. This procedure is best left to institutions with a dedicated pain service. Opiates may be added to local anaesthetics.

Spinal analgesia
This technique is used for anaesthesia and limited postoperative analgesia in specialised centres. Combined spinal plus epidural analgesia has been successfully used in neonates ranging from 1 520 to 7 840 gram.26
Other methods of pain relief

Entenox, a mixture of 50% oxygen and nitrous oxide, can be used for frequent wound dressings. This is less effective at high altitude.

Distraction with play, music, stories, television, etc. will reduce the child’s awareness of pain dramatically and should be used more purposefully by doctors and caretakers.

Alternative therapies: These include music and art therapy, reflexology, aromatherapy, hypnosis, transcutaneous nerve stimulation, acupuncture and herbal remedies (beware of side effects).

Treat other problems: Pain is not the only symptom experienced by children. It is also necessary to treat nausea, itching, urinary retention, sleep disturbance and other sequelae of surgery and anaesthesia or chronic disease.

Non-operative sources of pain

This may include pain due to sore throat, body aches with fever or generalised body aches with fever or generalised disease, otitis media, musculoskeletal disease, and also as a result of poor healing process. Local anaesthetic drugs are usually sufficient to treat these manifestations of neuropathic disease. In addition, they often suffer from depression in the knowledge of terminal disease, and also as a result of poor socioeconomic circumstances and a lack of proper care, all of which may influence their experience of pain. All of the abovementioned strategies may be used, although it may also be necessary to use topical or systemic steroids, β₂-adrenergic agonists, antidepressants, anticonvulsants with analgesic effects, NMDA receptor antagonists and antiretroviral therapy, or to discontinue offending drugs. It would be prudent to plan the complicated pain therapy of these children in cooperation with pain specialists.

The doctor must inform the patient and his or her parent(s) about pain and pain treatment A useful source is found at http://pediatric-pain.ca/ selfhp.html, which provides self-help for children in pain and for their parents. See CPD Questionnaire, page 54

Pain in children with AIDS

Children with AIDS experience local inflammatory pain (e.g. of Candida infection in the mouth or other orifices), generalised pain, myopathic pain, and many manifestations of neuropathic pain. In addition, they often suffer from depression in the knowledge of terminal disease, and also as a result of poor socioeconomic circumstances and a lack of proper care, all of which may influence their experience of pain. All of the abovementioned strategies may be used, although it may also be necessary to use topical or systemic steroids, β₂-adrenergic agonists, antidepressants, anticonvulsants with analgesic effects, NMDA receptor antagonists and antiretroviral therapy, or to discontinue offending drugs. It would be prudent to plan the complicated pain therapy of these children in cooperation with pain specialists.

The doctor must inform the patient and his or her parent(s) about pain and pain treatment A useful source is found at http://pediatric-pain.ca/ selfhp.html, which provides self-help for children in pain and for their parents. See CPD Questionnaire, page 54

See CPD Questionnaire, page 54

References

26. This reference is missing