

Postoperative pain management in the paediatric patient

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Abstract

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

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Introduction

Pain treatment in children is often insufficient¹ 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

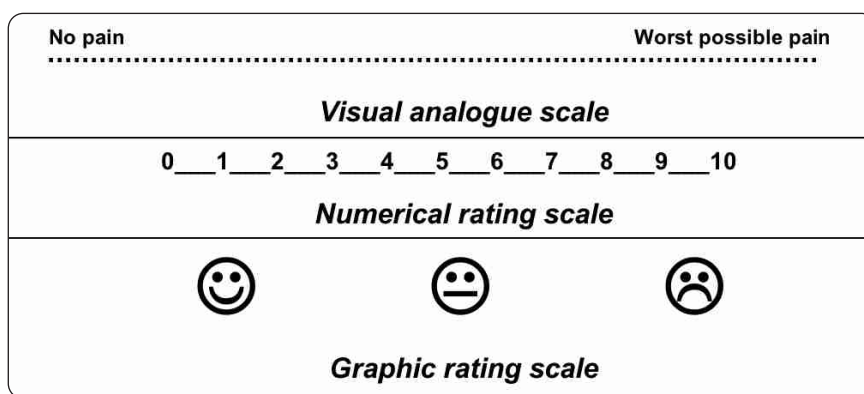
The psychological age of children will influence their perception of pain (see Table I).

Table I: Developmental age and nociceptive interpretation in children²

Age	Interpretation
0-3 years	Nociception
3-5 years	Pain is a form of punishment
5-12 years	Pain evokes fear of harm or mutilation
>12 years	Pain is a threat to body image and independence

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

Figure 1: Three possible pain scales for children.²



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.⁷

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

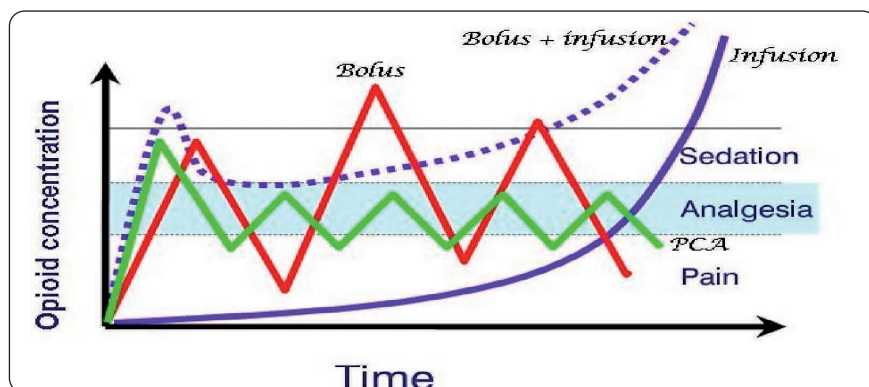
Drugs can be administered orally, intravenously, intramuscularly, mucosally, subcutaneously, transcutaneously and rectally. The exact mode of administration will depend on the available resources and on the training and experience of the caring personnel. A multimodal approach, using more than one method,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

Drug	Paediatric postoperative dose
Paracetamol	10-15 mg/kg (max 60 to 100 mg/kg/24h)
Diclofenac drops	1-2 mg/kg q8h (1drop = 0,5mg)
Ibuprofen	4-5mg/kg q6h
Naproxen	5-7,5 mg/kg twice per day
Codeine phosphate	0,5-2 mg/kg q4h
Clonidine	1-3 mg/kg

Figure 2: The effect of bolus, bolus plus infusion, continuous infusion and PCA on target blood levels. PCA gets close to be continuously at the targeted level of analgesia without side effects.**Table III:** Commonly used intravenous analgesics for children

Drug	Administration
Pethidine	Intermittent: 0,5 mg/kg q2hourly
Pethidine	Continuous infusion: 0,4 mg/kg/h, bolus 0,3 mg/kg
Morphine sulphate	Intermittent 0,05 mg/kg 2 hourly
Morphine sulphate	Continuous infusion: 40 µg/kg/h, bolus 30 µg/kg
All opioids	Half the dose < 3 months age
Morphine sulphate	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
Ketamine	0,5-0,75 mg/kg
Clonidine	1-3 mg/kg
Ketorolac	0,3-0,5 mg/kg 3 to 4 times per day
Paracetamol	Load 20 mg/kg, then 15 mg/kg/4h; max 60 mg/kg (if >33 Kg weight)

patient recovers. 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.^{3,9} 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 post conceptual age.³ Oral NSAIDs have few gastrointestinal side effects, but may have better analgesia compared with paracetamol.¹⁰ 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.

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.¹³ 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.¹⁴ 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

Table IV: Commonly used intravenous analgesics for children

Transmucosal route	Drug
Sublingual	Tilidine 0,5 to 1 mg/kg/dose 4 to 6 hourly
Buccal	Fentanyl (OTFC) 15-20 µg/kg (Not available in SA)
Intranasal	Sufentanil 0,5 µg/kg; Fentanyl 1,4 µg/kg ¹⁹
Rectal	Paracetamol 40 mg/kg, then 20 mg/kg 8-hourly Ketamine 5 mg/kg Diclofenac 1-3 mg/kg/24hour
Corneal	Local anaesthetics Amethocaine 2,5%

0,01 mg.kg⁻¹ must be administered intravenously (a similar dose may be administered intramuscularly to extend the duration of the effect, as naloxone is shorter acting than most opioids). In the case of children younger than six, nurse-activated patient-controlled analgesia is now widely used.¹⁵

Pethidine does not provide good analgesia compared with morphine,¹⁶ 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.³ Opioids (morphine) can be successfully infused subcutaneously, but sudden respiratory arrest was reported when a patient was rehydrated.¹⁷ 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.

Transmucosal and transdermal drugs (table IV): A very useful potent opioid for use in children is tilidine, which may be administered through the oral mucosa (sublingually). In children younger than one year the drug can be diluted in syrup and an appropriately reduced dose given orally (concentration was traditionally given as 2,5 mg per drop – an inaccurate way to calculate dose). The dose of opiates should be halved in a baby younger than three months of age. Fentanyl transdermal patches are useful for severe pain in children with cancer.¹⁸ Fentanyl has a slow onset and variable absorption and is contraindicated as an initial treatment for patients who have not received opioids before.³

Rectal administration:

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.²⁰

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 mg plus prilocaine 25 mg per gram that can be applied to the skin (dose varying from 0,5 to 2gram²¹). 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.²²

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.²³ Among these are that the spinal cord (L3) and dural sac (S2-S4) are more caudate.

Caudal epidural block

This block is very useful for intraoperative and postoperative pain relief for all surgery of the abdomen. The technique is simple and relatively safe. Bupivacaine (0,25%) or ropivacaine (0,2%) is usually used. The volume administered is calculated using Armitage's formula of 0,5 ml/kg for sacrolumbar dermatomes (perineum and lower abdomen), 1 ml/kg for lumbar thoracic dermatomes (below the umbilicus), and 1,25 ml/kg for midthoracic dermatomes (upper abdomen) respectively. Infusions may also be given through the caudal route (adequately trained personnel, monitors and safety precautions must be present). Side effects are rare, but include systemic toxicity (intravenous or intraosseus injection), bloody tap, urinary retention and delayed micturition (concentration dependent and not frequent with 0,25% bupivacaine or 0.2% ropivacaine solution), motor blockade and inability to walk, nerve injury, neurological deficit, and intrapelvic injections.

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.

Comforting such as rocking, cuddling or rubbing may reduce pain on a spinal level, similar to acupuncture. Vibration, massage and transcutaneous electrical stimulation (TENS) may also be useful.

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 disease, otitis media, musculoskeletal pain due to traumatic bruises etc. Paracetamol or other anti-inflammatory drugs are usually sufficient to treat these kinds of pain and will often aid the healing process. Local anaesthetic applications such as suction tablets (only older children) or EMLA cream may be used for superficial pain. Other supportive measures such as appropriate splinting, heat application etc should also be used as indicated.

For severe pain of fractures, opiates or Codis® tablets (over 12 years) may be used.

Chronic pain management in children

Children with cancer pain need therapy for procedures, as well as for their chronic pain. Procedural pain should be relieved by using a combination of analgesic and behavioural measures, e.g. hypnosis.²⁷ Opioids are usually the preferred drugs for chronic pain, but attention should also be given to other symptoms, such as sleeplessness and


depression.³ Doses usually have to be increased as tolerance develops. Pain treatment should be part of a broader supportive palliative programme. Chronic non-cancer pain is divided into nociceptive pain (caused by inflammatory processes) and neuropathic pain (due to abnormal excitability of the peripheral and central nervous system). The treatment of neuropathic pain is complex and should be handled by an experienced team.

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, β_2 -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 parents(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

 This article has been peer reviewed

References

1. Schechter NL. The under treatment of pain in children: an overview. *Pediatr Clin North Am* 1989;36:781-94.
2. Travers AM, Diedericks J. Postoperative pain relief in children. *Specialist Medicine* March 1994;12-9.
3. Berde CB, Sethna NF. Analgesic for the treatment of pain in children. *NEJM* 2002;347:1094-103.
4. Beyer JE, McGrath PJ, Berde CB. Discordance between self-report and behavioural pain measures in children aged 3-7 years after surgery. *J Pain Symptom Manage* 1990;5:350-65.
5. Tyler DC, Tu A, Douthit J, Chapman CR. Toward validation of pain measurement tools for children: a pilot study. *Pain* 1993;52:301-9.
6. Krechel SW, Bildner J. CRIES: a new neonatal postoperative pain management score. Initial

testing and of validity and reliability. *Paediatr Anaesth* 1995;5:53-61.

7. Johnston CC, Collinge JM, Henderson SJ, Anand KJ. A cross-sectional survey of pain and pharmacological analgesia in Canadian intensive care units. *Clin J Pain* 1997;14(4):308-12.
8. Shipton EA, Minkowitz HS, Becker PJ. PCA in burn injuries: the subcutaneous route. *Can J Anaesth* 1993;40(9):898.
9. Hatch D. Pain in children. Proceedings of the paediatric anaesthetics refresher course; 1999; Cape Town, South Africa.
10. Baer GA, Rorarius MG, Kolehmainen S, Selin S. The effect of paracetamol or dclufenac administered before operation on postoperative pain and behaviour after adenoidectomy in children. *Anaesthesia* 1992;47:1078-80.
11. Pickering AE, Bridge HS, Nolan J, Stoddart PA. Double-blind, placebo controlled analgesic study of ibuprofen or rofecoxib in combination with paracetamol for tonsillectomy in children. *Br J Anaesth* 2002;88:72-7.
12. Pasquale G, Scariabarozzi I, D Agostino R, Taborelli G, Vallarino R. An assessment of the efficacy and tolerability of nimesulide vs paracetamol in children after adenotonsillectomy. *Drug* 1993;46(Suppl 1):234-7.
13. McNeely JK, Trentadue NC. Comparison of patient-controlled analgesia with and without nighttime morphine infusion following lower extremity surgery in children. *J Pain Manage* 1997;13:268-73.
14. Tobias JD, Rasmussen GE. Pain management and sedation in the pediatric intensive care unit. *Ped Clin North Am* 1994;41:1269-92.
15. Weldon BC, Connor M, White PF. Pediatric PCA: the role of concurrent opioid infusions and nurse-controlled analgesia. *Clin J Pain* 1993;9:26-33.
16. Vetter T. Pediatric patient-controlled analgesia with morphine versus meperidine. *J Pain Symptom Manage* 1992;7:204-8.
17. Wolf AR, Lawson RA, Fisher S. Ventilatory arrest after a fluid challenge in a neonate receiving s.c. morphine. *Br J Anaesth* 1995;75(6):787-9.
18. Collins JJ, Dunkel IJ, Gupta SK *et al*. Transdermal fentanyl in children with cancer pain: feasibility, tolerability, and pharmacokinetic correlates. *J Pediatr* 1999;134:319-23.
19. Manjuschree R, Lahri A, Ghosh BR, Laha A, Handa K. Intranasal fentanyl provides adequate postoperative analgesia in paediatric patients. *Can J Anaesth* 2002;49(2):190-3.
20. Patrick K, Birmingham MD, Tobin J, *et al*. Initial and subsequent dosing of rectal acetaminophen in children. *Anesthesiology* 2001;94:385-9.
21. Taddio A, Ohlsson A, Einarson TR, Stevens B, Koren G. A systematic review of lidocaine-prilocaine cream (EMLA) in the treatment of acute pain in neonates. *Pediatrics* 1998;101(2):E1.
22. Lee JJ, Forrester EF. EMLA for postoperative analgesia for day case circumcision in children. A comparison with dorsal nerve of penis block. *Anaesthesia* 1992;47:1081-3.
23. Bösenberg A. Epidural blockade in children. *Specialist Medicine* 1999; November:725-9.
24. Conroy JM, Othersen HB Jr, Dorman BH, Gottesman JD, Wallace CT, Brahen NH. A comparison of wound instillation and caudal block for analgesia following pediatric inguinal herniorrhaphy. *J Pediatr Surg* 1993;28:565-7.
25. Bösenberg AT. Epidural analgesia for major neonatal surgery. *Paediatric Anaesthesia* 1998;8:479-83.
26. This reference is missing
27. Jay S, Elliott CH, Fitzgibbons I, Woody P, Siegel S. A comparative study of cognitive behavior therapy versus general anaesthesia for painful medical procedures in children. *Pain* 1995;62:3-9.