Pain in children
we can manage it better now!

Major advances have been in made in paediatric pain management in the last decade. Excellent evidence based guidelines are now available to assist in the treatment of acute pain and procedure related pain in neonates, children and adolescents.[1-3]

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Even the most premature neonate has the neural pathways to respond to noxious stimuli. Children suffer from many different types of pain, including:

- everyday pain, such as bumps and bruises, and procedural pain – e.g. that associated with immunisation or blood tests
- significant acute inflammatory pain such as acute tonsillitis and middle ear infections and pain following surgery and bone fractures
- disease-related chronic and recurrent pain – e.g. juvenile arthritis and sickle cell disease
- recurrent pains – e.g. abdominal pain or headaches, which often lack an obvious pathological basis and are complex and multifactorial in origin
- complex pain states that may involve neuropathic elements – e.g. HIV/AIDS and complex regional pain syndromes
- cancer related pain – pain related to disease progression and painful medical interventions can be compounded by increasing disability, failing nutrition and psychological distress.

Pain is now referred to as the fifth vital sign, after heart rate, respiratory rate, systemic blood pressure and temperature. As such, it warrants objective and repeated measurement for both diagnostic purposes and to assess the response to therapy.

Many different validated pain scales exist for all ages and developmental levels, including for noncommunicating patients with neurological impairment.[4] One commonly used scale is the 'Faces Pain Scales – Revised', which may be downloaded, together with instructions for its use, from the website of the *Pediatric Pain Sourcebook* (www.painsourcebook.ca); it is available free of charge for noncommercial use (see the box on page 41).[5]

IN SUMMARY

- **Excellent evidence based guidelines are available for the treatment of acute and procedural pain in neonates, infants, children and adolescents.**
- **Nonpharmacological techniques are underused in children to reduce anxiety before and during medical procedures.**
- **Validated pain measurement techniques are available for children of all ages and stages of development.**
- **The dosage of paracetamol given for pain should not exceed 90 mg/kg/day for two days then 60 mg/kg/day, and should be reviewed every two days. The dose should be based on lean body mass if the patient is obese.**
- **Conversion of codeine to morphine may vary significantly in different racial groups and other oral opioids (e.g. morphine or oxycodone) may be more reliable.**
- **Generally, opioid dependence is not a problem in children when opioids are used with appropriate monitoring for the treatment of acute pain of short duration.**
- **Appropriate analgesia should be used if neonatal circumcision is indicated.**

Pain experiences early in life may influence the processing of pain for many years.[6] Male neonates circumcised without analgesia showed an increased behavioural response to immunisation several months later.[7]

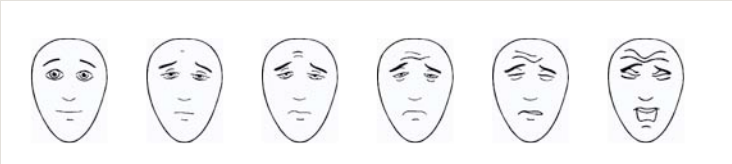
Most pain in children can be treated effectively using a combination of pharmacological, psychological and physical techniques. Techniques such as cognitive and behavioural therapy, imagery, hypnosis and progressive muscle relaxation are effective for reducing distress from invasive procedures. These measures may be of particular benefit to children undergoing repeated painful procedures.

Analgesic use should be considered in the context of the disease process. If there is an unexplained increase in analgesic requirements, consider the potential for progression of underlying pathology – e.g. the development of compartment syndrome after a fracture or progression of metastatic disease. Patients with chronic non-malignant pain may need referral to a multidisciplinary paediatric pain clinic.

This article reviews the use of analgesics in the management of pain in children. NHMRC levels of evidence are quoted where available.[1]

Faces Pain Scale – Revised[5]

In the following instructions, use the word 'hurt' or 'pain', whichever seems most appropriate for the particular child. Do not use words like 'happy' or 'sad'. This scale is intended to measure how children feel inside, not how their face looks.



'These faces show how much something can hurt. This face *[point to left-most face]* shows no pain. The faces show more and more pain *[point to each from left to right]* up to this one *[point to right-most face]* - it shows very much pain. Point to the face that shows how much you hurt [right now].'

Score the chosen face 0, 2, 4, 6, 8 or 10, counting from left to right, so that 0 = no pain and 10 = very much pain.

Hicks CL, von Baeyer CI, Spafford P, van Korlaar I, Goodenough B. The Faces Pain Scale – Revised: toward a common metric in pediatric pain measurement. Pain 2001; 93: 173-183.

Analgesic medications

Although the oral route of administration for medications is usually preferred, the clinical situation may demand other routes. Patients with severe acute pain (e.g. following long bone fractures) are often best managed by titrating intravenous opioids. Suppositories may be of value in infants who vomit oral medication. Recent advances in analgesic drugs include the formulation of intravenous paracetamol (Perfalgan), slow release oral opioids and transdermal fentanyl (Durogesic) for paediatric use. Appropriate and tolerable formulations of various drugs are important for different age groups and compliance.

Analgesic options for the different types of pain are summarised in the box on page 42.

Mild to moderate acute pain

Paracetamol

Paracetamol is effective for mild pain in children and a useful adjunct to other treatments for more severe pain. Oral doses have a bioavailability of 60 to 90%, and peak plasma concentrations are reached in 30 minutes. When administered rectally, paracetamol has much slower and more erratic absorption.

Although paracetamol has a remarkable safety record in paediatric practice, practitioners should be aware of the potential for hepatoxicity, especially following prolonged administration in sick children. Risk factors for paracetamol hepatotoxicity include prolonged fasting, vomiting, dehydration, systemic sepsis, pre-existing liver disease and protracted paracetamol intake.

Current dosage guidelines allow no more than 90 mg/kg/day for acute pain (in children who are free of the above risk factors) for a maximum of two days, with a subsequent dose limit of 60 mg/kg/day. Paracetamol dosages should be reviewed medically every 48 hours. Prolonged use may require the monitoring of the child's liver transaminases and INR. Caution should be exercised in obese children, and doses should be calculated on lean body weight (see the box on page 45).

Intravenous paracetamol is now available in Australia and has found a place as an adjunct to opioid analgesia in children with moderate to severe pain who are unable to have oral analgesia.

The maximum recommended daily dose should not be exceeded and care should be taken that paracetamol is not given concomitantly by another route.

NSAIDs

NSAIDs are effective analgesics in children and infants older than 6 months for mild and moderate pain. Assuming the use of equianalgesic doses, studies suggest NSAIDs have a similar efficacy to paracetamol (level II). Combination of an NSAID and paracetamol may be beneficial for children with postoperative pain. In the setting of moderate to severe pain, NSAIDs decrease total opioid requirements – i.e. they are opioid sparing.

NSAIDs are generally avoided in children with sensitivity reactions to this class of drugs (including aspirin), a history of peptic ulcer disease, renal dysfunction, or bleeding diathesis or in those preparing for major surgery. Importantly, short term use of ibuprofen does not appear to have an adverse effect in children with mild asthma (level II). The influence of NSAIDs on the risk of perioperative bleeding (e.g. following tonsillectomy) remains controversial as the evidence is inconclusive.

There is little clinical experience with COX-2 specific inhibitors in children.

Tramadol

Current studies of tramadol in children are of small sample size. In Australia, tramadol is approved only for children over 12 years, but it is used in those under this age in some tertiary centres.

Analgesic use in children

Mild to moderate acute pain

Pain associated with tonsillitis, middle ear infection, sprains, lacerations, and minor surgery

- Paracetamol: 15 mg/kg orally, maximum 90 mg/kg/day for two days only then 60 mg/kg/day
- Ibuprofen: 10 mg/kg orally, up to three times a day
- Use the combination of paracetamol and ibuprofen for short periods of time (two days)

Moderate to severe pain

Pain from fractures, burns, and acute sickle cell crises and postoperative pain

- Morphine or fentanyl via intravenous infusion, patient controlled analgesia or nurse controlled analgesia
- Adjuncts include intravenous paracetamol, NSAIDs and ketamine (Ketalar)
- Step down to oral codeine, oxycodone, or morphine

Chronic or ongoing pain

Cancer pain and pain following major burn injuries, trauma and major surgery

- Slow release oral opioids in combination with immediate release preparations
- Slow release transdermal opioids are useful in opioid tolerant patients, especially for cancer pain
- Adjuncts include NSAIDs, simple anxiolytics and agents targeting neuropathic pain mechanisms (e.g. gabapentin and amitriptyline [Endep, Tryptanol])
- When prescribing potent oral opioids for use following inpatient care, thought should be given to a weaning regimen. Careful accounting and disposal of unused drug is mandatory

Procedural pain

Pain from immunisation, venepuncture, minor lacerations, lumbar puncture, dressing changes, suture removal

- Oral sucrose
- Topical local anaesthetics; always allow enough time for an effect
- Simple oral analgesics
- Combinations of potent analgesics and sedatives; take care with multidrug combinations
- Nitrous oxide analgesia

Moderate to severe pain

Repeated intermittent intramuscular injection of analgesics is a poor method of managing pain, with children often tolerating pain rather than having another intramuscular injection. Distraction and local cold therapy (e.g. ice) can minimise the pain of a 'one off' intramuscular injection such as a vaccination (Figure).[8]

Intravenous opioids

The use of intravenous opioids to manage moderate to severe pain in hospitalised children is now well accepted. Intravenous opioids are administered as a continuous infusion, patient controlled analgesia (PCA), or nurse controlled analgesia (NCA).

Safety is critically dependent on regular observation and review. Opioid sparing is achieved by the use of adjuncts and contributes to the safety and tolerability of such regimens.

Children with pain related to acute sickle cell disease must be referred to appropriate centres without delay, and intravenous opioid pain management should be made a priority.

When severe pain subsides, oral administration of analgesics becomes possible, and 'stepping down' from intravenous regimens can be managed using a combination of oral opioids and simple analgesics. Opioid dependence is not a problem

in children when opioids are used with appropriate supervision for the treatment of acute pain.

Immediate release oral opioids

Codeine is a weak opioid, and analgesia occurs following its conversion to morphine by the liver enzyme CYP2D6. Genetic variants in this enzyme make this drug conversion inefficient in 10% of Caucasians and up to 30% of Hong Kong Chinese, but only 1% of an Arabic population.

Codeine remains a popular additive to over-the-counter paracetamol preparations, but its use in the hospital setting appears to be waning. For acute postoperative pain, oxycodone is gaining wider acceptance. It is available in syrup (OxyNorm Liquid), tablet (Endone) and capsule (OxyNorm) forms, and administered at a dosage of 0.1 to 0.2 mg/kg three to four hourly. Morphine (oral dose 0.2 to 0.4 mg/kg three to four hourly) can also be used and is rapidly absorbed (usually within 20 to 30 minutes) following oral administration.

Chronic or ongoing pain

Slow release oral opioids

There is increasing use of slow release oral opioids for severe and ongoing pain in children. Slow release formulations are usually used to control background pain and combined with immediate release forms to control 'breakthrough' pain. Conditions for which slow release oral opioids are useful include:

- cancer pain, where tolerance can develop as disease progresses
- following severe burns where medical management includes staged or repeated procedures such as debridement, grafting and contracture release over extended periods
- following some major surgery (e.g. spinal surgery and multilevel orthopaedic surgery), which is also associated with significant analgesic needs after discharge from hospital
- opioid weaning after major illness (e.g. burns, pancreatitis, major trauma, major surgery), especially if the illness is associated with prolonged ventilation in intensive care, which can be associated with opioid tolerance and physical dependence.

Weaning regimens often include tapering doses of slow release opioids or opioids with suitably long half-lives (e.g. methadone [Physeptone]). Twice daily administration of these slow release formulations provides convenience with the flexibility to gradually adjust dosage over time.

Morphine formulations include a variety of slow release preparations, such as tablets (MS Contin), granules (Kapanol, MS Mono; which must not be chewed) and a thick suspension of slow release micelles that can be drunk or administered via a nasogastric tube or gastrostomy button (MS Contin Suspension). Oxycodone is also available as a slow release tablet preparation (OxyContin).

Transdermal opioid preparations

Slow release transdermal opioid patches are used occasionally for children with

Lean body weight formulae

Lean body weight (males) = (1.1 x weight [kg]) – (0.0128 x BMI x weight [kg])

Lean body weight (females) = (1.071 x weight [kg]) – (0.0148 x BMI x weight [kg])

BMI = weight [kg] / (height [m])^2 for people aged >18 years

A paediatric BMI calculator is available on NSW Department of Health's website: www.health.nsw.gov.au/obesity/youth/bmi.html

PHOTOLIBRARY

Figure. Distraction can minimise the pain of a 'one off' intramuscular injection such as a vaccination.

continued

Nonpharmacological interventions for procedural pain

- Distraction:
  - in infants: dummy, toys, bubblemaker
  - in toddlers: songs, pop-up books, toys, party blowers, kaleidoscopes
  - in school-age children: videos, stories, counting, video games, jokes
  - in adolescents: virtual reality, music by headphone, video games
- Deep breathing
- Blowing – e.g. blowing out imaginary candles or blowing away the pain
- Suggestion – e.g. a 'pain switch' to turn off pain
- Imagery – e.g. allowing the child's thoughts to be guided to a favourite place or activity or to being a super hero
- Spot pressure or counterirritation
- Rewards – e.g. stickers, certificates (must be given to all children)
- Cognitive behavioural therapy – e.g. preparation with dolls, role playing desensitisation, hypnosis, progressive muscle relaxation

Practice points on the use of analgesics in children

- Codeine metabolism has a genetic variability and may be a poor analgesic in some patients.
- The use of repeated intramuscular injections of analgesic is a poor form of analgesia in children.
- Slow release opioids are useful for severe ongoing pain in children; patients taking these agents should be monitored regularly.
- Transdermal opioids are used only in opioid tolerant patients.
- Sucrose reduces the behavioural response to heel stick in neonates (level I).
- A combination of pharmacological and psychological interventions reduces pain and distress more than psychological interventions alone (level II).
- Combinations of hypnotic and analgesic agents are effective for procedures causing pain of moderate and major severity (level II).
- Inadequate monitoring, lack of resuscitation skills and equipment, use of multiple drug combinations (particularly three or more) and drugs with long durations of action have been associated with major adverse outcomes.

severe and ongoing pain, often in the management of malignancy. These preparations are used only in opioid-tolerant patients and are not suitable for the management of acute pain. When prescribed for children at home, strict advice must be provided to carers regarding the disposal of used patches.

Procedural pain

Invasive procedures are frequent in paediatric care and can be very distressing and affect the success of future medical interventions in the child. Adequate preparation of patients with a child-centred approach and parental involvement are paramount.

Nonpharmacological interventions can reduce procedural pain and distress and may be of particular benefit in children who need to undergo repeated procedures. Appropriate choices depend on age and development (see the box on this page).

Sucrose

Sucrose will provide analgesia for neonates and infants up to 3 months old for brief painful procedures. Administration of 1 to 2 mL of 25% (w/v) sucrose or glucose orally should be given two minutes before the procedure (e.g. a heel lance).

Local anaesthetics

The use of lignocaine plus prilocaine cream (EMLA) or 4% amethocaine gel is now well established in practice, and anticipation is the key to providing analgesia for brief painful procedures. Although new technologies such as topical liposomal lignocaine and iontophoresis of local anaesthetic and vapocoolant sprays are being introduced, none has made a major impact to date.

For minor skin procedures such as venepuncture or immunisation, topical local anaesthetic application (e.g. of amethocaine) is effective within 30 minutes.

Infiltrated local anaesthetics can be very effective if they are used with care, adequate time is taken, and the technique is explained to patients and parents. Buffering local anaesthetic with sodium bicarbonate reduces the pain of injection (level I). This can be achieved by diluting lignocaine 9:1 with 8.4% sodium bicarbonate.

Other techniques that may decrease injection pain include:

- using very small needles (27 to 30 G)
- warming the local anaesthetic
- injecting the anaesthetic from the wound edge rather than through intact skin
- injecting slowly
- counterstimulating surrounding tissues while injecting.

Inhaled analgesics

Inhalation of analgesics such as nitrous oxide or methoxyflurane (Penthrox Inhalation Analgesic) is common practice.

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Methoxyflurane is analgesic in low concentrations. Its onset and offset are slower than those of nitrous oxide. It is available as a small portable 'whistle' that can have supplemental oxygen connected and is used by the Ambulance Service for analgesia in the field.

The combination of inhaled nitrous oxide and topical or oral analgesia is effective and well tolerated for many procedures – e.g. lumbar puncture, dressing changes, removal of drains, etc. Nitrous oxide (30 to 70%) can be delivered via a continuous flow machine with appropriate breathing circuits, and requires monitoring and trained staff.

Procedural sedation regimens involving drug combinations must be carefully planned and take into account the issues of appropriate patient selection, consent, monitoring, documentation, recovery care, discharge criteria and follow up.

Some important points to consider on the use of analgesics in children are listed in the box on page 46.

Summary

The challenge facing advocates for paediatric pain management has moved from forcing a change in attitudes to finding a scientific evidence base, and now centres on education and further research. Advocates from both the community and specialist pain management centres must focus on providing guidelines, educational tools and clinical experience for healthcare professionals who deal with children. MT

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