Interventions for acute and procedural pain in children

Improving management now and in the future

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A range of pharmacological and nonpharmacological options are available for pain relief in children. Use of appropriate interventions can have a positive impact on a child's future pain experience.

Early implementation of both nonpharmacological (physical and psychological) and pharmacological pain relief interventions can improve acute and procedural pain management in children. Suboptimal pain management can result in escalated pain, fear and distress during future experiences.[1-3] This article aims to review the strategies to improve paediatric procedural and acute pain management and provide an update on the debate of on- and off-label analgesic use for children.

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Why are pain management strategies underutilised in children?

Scientific support for pain management in children has accrued over the past three decades, but translation to best practice lags years behind the evidence published to date. This is complicated by an inherent fear of immediate and long-term side effects of interventions in children.

Parents are often proxy reporters for their children and they

tend to under-report the child's condition. Children may be held down during consultations and staff or parents are told to 'get on with it'. Even when parents recognise that their children are in severe pain and are given analgesia to take home, this sometimes does not result in analgesic administration.[3-5] Evidence-supported strategies are also underutilised by specialist and generalist medical staff in community paediatric care and in emergency departments.[6-10] Slowly, the message that 'it doesn't have to be that way' is being promulgated.[11] Pain assessment using age-appropriate tools is a cornerstone to assist medical staff and parents in providing appropriate analgesic intervention (Figure 1).[12] The three case scenarios in Boxes 1 to 3 discuss the various evidence-based interventions that can be implemented in children with acute pain.

Key points

- **There is increasing evidence that early intervention and optimisation of acute pain management in children impacts on future pain experiences.**
- **Parents and medical staff recognise the severity of a child's acute pain experience, but this does not always result in the use of best evidence-supported interventions.**
- **Simple and opioid analgesics (available in various oral tablet and liquid formulations) are effective to treat multiple acute pain states in children. Both over the counter and prescribed formulations are generally safe, but toxicity risk is an ongoing consideration.**
- **Clear individually tailored information must be provided to medical staff and parents to ensure children receive effective analgesic agents in appropriate doses and frequency. Adverse event profiles should also be advised.**
- **Nonpharmacological strategies, such as distraction, hypnosis, relaxation, non-nutritive sucking, sweet-tasting solutions and physical interventions (e.g. cold or positioning), are effective in children and their use should be promoted.**

Effective nonpharmacological interventions that can be used in a GP practice

Procedural modifications

Procedural modifications have been assessed to reduce pain in children during immunisation. These include:

- use of a longer (25 *vs* 16 mm) and wider (23 *vs* 25 gauge) needle[13,14]
- rapid intramuscular needle insertion
- injection without aspiration, stroking or possibly applying pressure close to the injection site
- choosing a combined vaccine formulation to reduce the number of injections needed.[1]

Physical interventions

Physical interventions such as parental holding and positioning an older child upright are beneficial.[1] Use of cold in older children effectively reduces the pain response to venipuncture and IV cannulation. Ice application is cheap but requires three minutes to work, whereas a vapocoolant spray is effective within 10 to 15 seconds of application, although equipment costs are higher. A

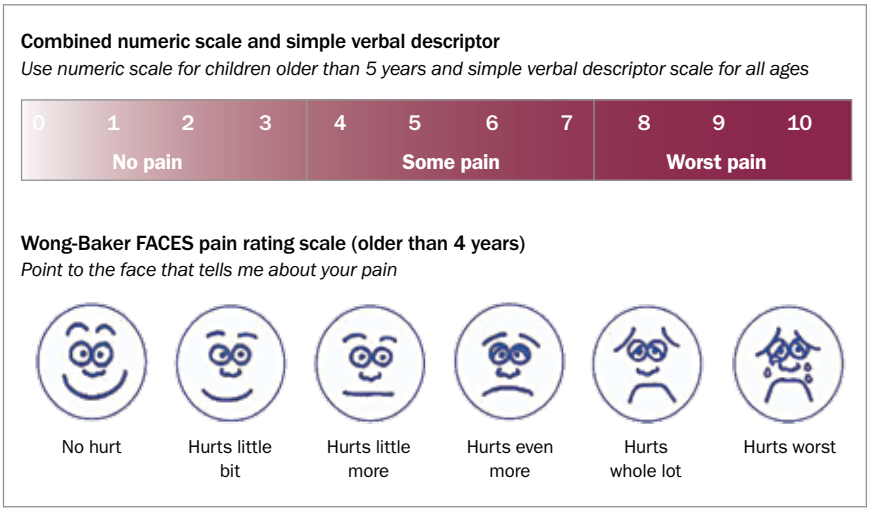


Figure 1. Pain scales to use in young children: numeric, verbal descriptor and Wong-Baker FACES Pain rating scale.[12] © Wong-Baker FACES Foundation (2016). Wong-Baker FACES® Pain Rating Scale. Used with permission from http://www.wongbakerfaces.org

1. Case scenario 1: Infant vaccination

A 6-month-old infant is brought to see you for his third round of immunisations. He was very distressed during his first two procedures and is screaming in the waiting room. The carer is also distressed.

Psychological intervention

Preprocedural preparation is important. Ideally, a plan should have been discussed with the carer before today's appointment. If this was not possible, then time should be made now to provide the carer with an explanation and a plan for the procedure. This aims to reassure the carer and reduces the anxiety/distress both now and in the future. This will help the infant have less sensing of the carer's apprehension/distress. During the procedure, the child can be distracted with bubble blowing or an active light, glitter or button-pressing toy and calming music can be played.

Physical intervention

Prepare equipment before the infant and carer enter the room. Draw up the vaccines and preload with the longest and largest injection needle that is appropriate, and prepare the skin and a plaster. Prewarm the room and arrange for the carer to wrap the child leaving the limbs out of the wrap. Ask the carer to prepare to breastfeed or bottle feed the child and then invite them to hold and cuddle the child and to commence feeding before the injection. An alternative to feeding is use of a dummy/pacifier for non-nutritive sucking.

Pharmacological intervention

Local anaesthetic cream can be applied to the skin before the procedure. A sucrose syringe can be prepared and 0.5 to 1 mL sucrose given immediately before, during and after the procedure. Paracetamol can also be given afterwards.

device called Buzzy® uses both cold and vibration modalities to effectively reduce pain and the number of cannulation attempts required.[12]

In infants, there is good evidence for the use of non-nutritive sucking (of a dummy, finger or syringe),[15] facilitated tucking (or swaddling)[16] and external warming[17] and these practices can be practically implemented in a GP practice. Kangaroo care (ventral skin to skin contact) also effectively reduces pain and behavioural responses to skin puncture in young infants.[18] These strategies have increased efficacy when combined with breastfeeding or administration of sucrose solutions.

Sweet-tasting solutions

Administration of sweet-tasting solutions, such as sucrose or glucose 12 to 50% in small volumes (less than 2 mL), is a simple, safe and effective way to reduce pain in children. It should be routinely offered before and during skin-breaking procedures for infants up to 12 months of age,[15,19,20] but not in older children in whom the use of sweetened chewing gum was found to be ineffective.[21]

Psychological interventions

A recent meta-analysis supports the use of psychological interventions for multiple procedure types.[22] Distraction can be simple to employ using books, toys, music, videos and hand-held smart devices; it requires no child preparation, just an additional calm person who is unlikely to faint.[22-25]

Hypnosis, although effective, requires the skills of a trained health professional and time for the child to learn the technique.[22,26] Use of relaxation strategies and biofeedback for adolescents with migraines results in clinically significant changes in various headache indices.[27]

Simple pharmacological interventions for mild to moderate pain and their toxicity considerations

Many pharmacological interventions are available to treat children with mild to moderate pain. These preparations may be available on prescription or as pharmacy medicines. The Table provides information on the recommended dosing of pharmacological interventions in children and precautions and practical tips for their administration.

Local anaesthetic cream

Local anaesthetic cream is rarely toxic. It should be routinely applied and adequate time allowed for effect before performing skin-breaking procedures (e.g. venepuncture, IV cannulation, lumbar puncture) or laceration repair in children. Topical amethocaine

2. Case scenario 2: Child with a burn on the arm

A 6-year-old child was helping his mother drain some pasta and hot water has splashed on to his arm. He presents with a minor burn on his hand and forearm.

Psychological intervention

The child should be distracted using techniques such as talking to him, singing songs or playing music, telling stories or reading, playing a game, watching a video or playing with a handheld device such as a phone or tablet.

Physical intervention

The mother had called the practice after the incident and was instructed to place the child's arm under a running cold water tap or immerse it in a sink of cold water for 20 minutes. Ice blocks can be added to the water (not applied directly to the arm) to keep the water cold. She was told to then apply a moist clean dressing (such as a clean facewasher) or to wrap it in cling film plastic wrap (which means the wound can be looked at without removing the dressing). In the surgery, the wound is then assessed; best practice is to administer analgesia before removal of the dressing.

Pharmacological intervention

Mild pain can be managed with paracetamol or ibuprofen. If the pain is moderately severe, the child can be given oral oxycodone or morphine. If the pain is severe, options include either morphine intravenously/subcutaneously or fentanyl intranasally via a metered aerosolised device (Figure 2) or methoxyflurane via an inhaler. The latter three options are available for administration by Australian ambulance services if not available in the practice. See Table for dosing suggestions.

4% gel (available in some states as Local AnGel 4%) and liposomal lignocaine 4% cream have faster onset than lignocaine 2.5% and prilocaine 2.5% cream (the latter two medications are pharmacy medicines). The recommended application time for amethocaine is 45 to 60 minutes before the procedure compared with 60 to 90 minutes for lignocaine and prilocaine.[28]

Intradermal injector devices are effective in a short time, but are expensive and require cartridge refills.[28] Amethocaine, lignocaine and adrenaline gel (ALA; called LAT/LET in the USA) placed into wounds reduces the pain of intradermal injection.[29]

Paracetamol

Paracetamol has a long history of safe use in children and is effective by all routes: IV, oral and rectal.[12] If the oral route is refused, rectal administration may be practical; the slow erratic absorption via the rectal route results in delayed onset and lower peak plasma concentration but longer duration of effect.

Paracetamol dosing should be reduced in patients with prolonged fasting, liver impairment or chronic dosing and need not be increased in the setting of obesity. Paracetamol has been used in people with asthma and those with aspirin-sensitive asthma (now termed NSAID-exacerbated respiratory disease [ERD]). The literature currently proposes associations between paracetamol use in both pregnancy and infancy and later childhood wheezing and asthma; this is likely confounded by the indication for paracetamol use (for pain in pregnancy and fever with viral respiratory tract illness) rather than a true association.[30]

Nonselective NSAIDs

Nonselective (ns) NSAIDs (e.g. ibuprofen, diclofenac, naproxen) have known efficacy in paediatric pain management. The minimum age limit for use of ibuprofen was recently reduced to 3 months. However, this is not based on new safety data and most paediatric centres retain 12 months as the lower age limit for use, with cautionary use in younger infants based on the indication, comorbidities present and a risk benefit assessment.

Renal, gastric and platelet effects of nsNSAIDs remain an issue.[31] Therefore, these agents are avoided in patients with low output states (with risk of acute kidney injury[32]) or when thrombocytopenia, active bleeding or high blood loss risk are present.

Worldwide practices vary in the use of nsNSAIDs for post-tonsillectomy analgesia. Some clinicians feel that nsNSAID use is contraindicated in adenotonsillectomy. Notably, conclusions from a recent Cochrane review about the incidence of postoperative bleeding with nsNSAID use are marred by a small sample size.[33] In many paediatric centres, intraoperative and postoperative nsNSAID use is routine. Pain in the week after a tonsillectomy is moderate to severe and patients frequently visit their GP for additional pain relief.[34]

Use in fracture management acutely or in the short term (for three to 14 days) is acceptable but is avoided in patients at risk of or demonstrating poor union (e.g. bony disorders such as osteogenesis imperfecta and after bone grafting), especially as a further indication for nsNSAID use is to inhibit heterotopic ossification. nsNSAIDs are protective in children with mild asthma but can precipitate bronchospasm in some patients with moderate to severe asthma and nasal disease (rhinosinusitis/polyps) who have NSAID-ERD.[35]

COX-2 inhibitors

COX-2 inhibitors are selective NSAIDs with reduced peptic ulceration rates and without platelet inhibition and bronchospasm precipitating effect compared with the nsNSAIDs. They are used off-label in children (under 18 years of age) and are a consideration when nsNSAIDs are contraindicated, such as in children with NSAID allergy or NSAID-ERD.

The celecoxib capsule contents can be dispersed in water for divided administration and some pharmacies can make up a suspension. There is renewed interest in using selective celecoxib for post-tonsillectomy analgesia,[35] Pharmacokinetic data are required to guide celecoxib dosing in younger children.

A pharmacological intervention no longer considered 'tried and true': codeine

There are increasing reports of serious morbidity and death resulting from codeine administration at therapeutic doses. It is a prodrug converted by the liver enzyme CYP2D6 to morphine to produce an analgesic effect. People of some ethnicities have either no enzyme activity and get no analgesic effect (poor metabolisers: 10% of Caucasians and Europeans; 20% of Africans) or gene duplication with excess activity (26 to 30% of those of African or Arabic descent).[12] People in the latter ultrametaboliser group then experience morphine side effects such as sedation and respiratory depression.

Most people 'handle' codeine normally, but recent articles have reported deaths of neonates of breastfeeding mothers and toddlers and older children receiving codeine for cough suppression or analgesia, for example post-tonsillectomy.[36-38] Regulatory bodies (such as the US Food and Drug Administration and European Medicines Agency[39]) have made recommendations to avoid use of codeine in neonates and children requiring adenotonsillectomy.

When alternative opioids are available, these should be prescribed preferentially. All opioid prescribing should be cautionary in obese patients or those with obstructive sleep apnoea, with consideration for half-dosing under medical supervision and observation for side effects. The same advice should apply to combination paracetamol–codeine preparations, particularly paediatric liquid preparations.

Pharmacological interventions for severe acute and subacute pain

Many pharmacological interventions are available to treat children with severe acute and subacute pain. Hospitals extend the use of these preparations to lower than the product information recommended age. In small infants, doses may be halved.

Opioids and tramadol

Morphine and oxycodone are used interchangeably in paediatric hospitals. Oral tablets and elixirs are available. Morphine elixir (available in various concentrations) is bitter and unflavoured, whereas oxycodone elixir (1 mg/mL; 200 mL bottle) is butterscotch flavoured and well accepted by children. For 'safe discharge dispensing', options include dispensing as a limited number of tablets (i.e. not a full box of 20), as prefilled syringes or decanted into smaller 20 to 50 mL containers by the pharmacist.

Extended-duration sustained-release morphine is available in various tablet sizes and as granules (20 and 30 mg sachets), as is controlled-release oxycodone. These may be used as weaning regimens following hospital discharge, ideally with instructions as to expected duration of therapy. The granules are useful when tablets are refused or gastric tube administration is required. A combination preparation containing oxycodone/naloxone is available to reduce the constipation side effect and also the potential

3. Case scenario 3: Adolescent with severe headache

A 14-year-old girl presents for the third time with severe bifrontal throbbing headache, preceded by flashing lights, with profound nausea.

Psychological intervention

A strong placebo response has been seen in adult and adolescent migraine trials. There has been proven efficacy for psychological interventions in adolescents with frequent headache presentations.[23] Harness this information and engage the teenager. Show her relaxation or distraction techniques, mindfulness or grounding exercises such as deep breathing, progressive muscle relaxation and visualisation/guided imagery.

In a future appointment, note the patient's family headache history and modelled coping style, and educate her and her parent about identifying headache triggers, intervening early and the effectiveness of nondrug therapies. Triggers such as diet, stress (school, study, social, family), sleep deprivation and screen use should be identified and modified. The patient's preferred psychological strategy, such as distraction with music, relaxation techniques or biofeedback training, should be practised at non-headache times and implemented as soon as possible with headache onset. Cognitive behavioural therapy with a school- or community-based psychologist may also be appropriate.

Physical intervention

Environment modifications can be implemented as needed. The patient may seek a quiet, dark room to rest in.

In a future appointment, her sleep hygiene should be assessed. Regular exercise and sometimes specific neck/shoulder physiotherapy can be implemented. Posture and ergonomics of seating when studying or using a laptop can be addressed and advice on boundaries for reduced or paced screen time given.

Pharmacological intervention

Patients are usually offered an abortive therapy plan with medication and then an escalation plan if initial therapy is not successful.
Any class of nonselective NSAIDs can be used, particularly ibuprofen as it is readily available over the counter, or paracetamol when a nonselective NSAID is unavailable.

If nausea and or vomiting are prominent, metoclopramide or another antiemetic agent are considerations in the early or established headache.

Triptans are prescribed as early abortive therapies (but are notably expensive and there are strong placebo response rates in trials). Sedatives are used in the setting where initial abortive 'at home' therapies have failed.

In a future appointment, association of headache with menstruation may be assessed and hormonal therapy (oral contraceptive pill or depot progesterone) considered.

In patients with frequent headaches who are using analgesics regularly the diagnosis can be medication-overuse headache and weaning of medications is then indicated. Engaging the patient with this plan can be challenging. For frequent headaches or chronic daily headaches, input from a neurologist should be sought and a trial of prophylactic therapy (e.g. propranolol, topiramate) considered.

Table. Analgesic agents, their dosing and precautions*

Analgesic	Route	Dosing (suggest use lean body weight for all agents)	Precautions/contraindications	Practical tips
Paracetamol	PO	15 mg/kg (max 1 g); 4-hourly (max 4 doses per day)	Obesity Liver disease Severe illness Malnourished state Reduce dose if: – chronic dosing in the above conditions – unconjugated bilirubin level is very high in neonate	Check concentration of the elixir's formulation – different flavours marketed for different ages; dissolvable and chewable child-friendly tablets available; consider rounding up the first dose to achieve a 'loading dose', e.g. 20 to 30 mg/kg if using as single agent and there is a likely delay to the next administration
	IV	15 mg/kg (max 1 g); 6-hourly in infants and older children (reduced dose and frequency in premature babies in hospital)		
	PR	20 mg/kg (max 1 g); 6-hourly		
Nonselective NSAIDs				
Ibuprofen	PO	For analgesia: 10 mg/kg (max 600 to 800 mg for severe pain; 400 mg for moderate); 3 to 4 times daily with meals	Untreated peptic ulceration/ gastro-oesophageal reflux Thrombocytopaenia or thrombocytopathy Active or high risk of bleeding Hypovolaemia Renal impairment NSAID-exacerbated respiratory disease	100 mg/5 mL and 200 mg/5 mL elixirs available over the counter; 200 mg caplets and tablets available over the counter are relatively large; higher doses for analgesia more effective in adults (improving number needed to treat), whereas lower dose of 5 mg/kg dose used for fever
Diclofenac	PO	1 mg/kg (max dose of 75 mg†); 2 to 3 times daily with meals	As above	Enteric-coated small tablets; dissolving 'rapid' 12 mg child-friendly tablets available over the counter
	PR	1 to 2 mg/kg (max dose 100 mg); 2 times per day		Rectal route has good absorption
COX-2 inhibitor (off-label use)				
Celecoxib	PO	2 to 4 mg/kg (max 200 mg); 2 times daily	Renal impairment Hypovolaemia	Capsule contents can be dispersed in water for divided administration; suspension not commercially available

* See full product information for further prescribing details.

† A maximum dose of 50 mg diclofenac (150 mg/day maximum) is suggested in the product information but as the number needed to treat decreases with increased dosing for other nonselective NSAIDs, the author recommends a higher maximum dose of 75 mg and up to 225 mg/day for severe pain.

Abbreviations: COX-2 = cyclo-oxygenase-2; IV = intravenous; PO = oral; PR = rectal.

for abuse. Hospitals and pain specialists are increasingly aware of the community diversion of oxycodone and the fact it has replaced heroin as a drug of addiction, with parallel increase in associated community deaths.

GPs may see increasing numbers of paediatric patients prescribed tramadol on discharge from hospital. This analgesic is 70% effective through noradrenaline and serotonin reuptake inhibition and 30% effective through its M1 metabolite (or O-desmethy-tramadol; formed by CYP2D6) opioid effect. It is currently favoured in patients with neuropathic or opioid-resistant pain or when patients have obstructive sleep apnoea. It is available as a capsule which can be dispersed as a solution. In New Zealand, a 10 mg/mL elixir is available, but the adult concentrated palliative care drop formulation available in Australia and New Zealand is to be avoided for use in children. This is because confusion between drops and mL leads to a 40-fold dosing error and has resulted in overdose and death in children.[40,41]

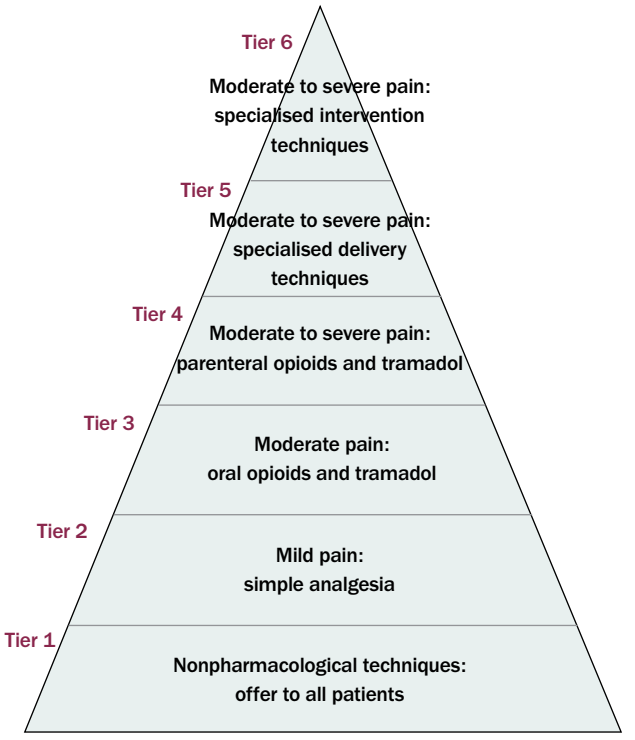
Novel devices and administration routes used prehospital and in emergency departments

Fentanyl is commonly delivered intranasally by metered aerosolised devices in paediatric (and adult) trauma patients by ambulance officers and in emergency departments.[42] This is convenient when no intravenous access is available. The device must be directed at 45° to coat the turbinates while avoiding horizontal delivery which will cause run off into the pharynx, where it is swallowed with resultant reduced bioavailability and efficacy.

Table. Analgesic agents, their dosing and precautions* continued

Analgesic	Route	Dosing (suggest use lean body weight for all agents)	Precautions/contraindications	Practical tips
Opioids				
Codeine	PO	0.5 to 1 mg/kg (max 30 to 60 mg); 4-hourly	Avoid if alternative opioids readily available; recent warnings against use in paediatric tonsillectomy/ adenoidectomy	If using in at-risk group, give first dose under medical supervision and during daylight hours; check combination products for overlap
Oxycodone	PO	0.1 to 0.2 mg/kg (max 5 to 10 mg); 4-hourly	Similar adverse effects (see below) across the opioid class; patients differ in their sensitivity to individual agents	Elixir; 1 mg/mL – convenient dosing advice 1 mL per 10 kg
	IV	Dependent on pain severity and if other analgesics given and had time to achieve effect: 20 µg/kg for unclear severity (titrating 5-minutely), 50 µg/kg for moderate and 100 µg/kg for severe pain; further dosing will depend on availability of nonopioid agents, effect achieved and anticipated dispatch		See titration recommendation for morphine below; further dosing will depend on availability of nonopioid agents, effect achieved and anticipated dispatch
Morphine	PO	0.25 to 0.5 mg/kg (max 15 to 30 mg); 4-hourly	Nausea and vomiting (30 to 40%) Constipation (100%) Sedation (dose dependent) – care in head injury Respiratory depression (dose dependent) Use opioid-sparing agents in preference in obstructive sleep apnoea/sleep-disordered breathing/opioid induced ventilatory impairment or give reduced dose	Check elixir concentration: 1, 2 and 10 mg/mL
	IV	Dependent on pain severity and if other analgesics given and had time to achieve effect: 20 µg/kg for unclear severity (titrating 5 minutely), 50 µg/kg for moderate and 100 µg/kg for severe pain; further dosing will depend on availability of nonopioid agents, effect achieved and anticipated dispatch		Consider titration rather than single dose; e.g. place 0.1 mg/kg in normal saline to a total of 10 mL and give 1 to 2 mL IV aliquots every five minutes; further dosing will depend on availability of nonopioid agents, effect achieved and anticipated dispatch
Fentanyl	IN	1.5 µg/kg (max 200 µg) using metered aerosolised device (or 1 mL syringe and drop administration) [standard concentration 50 µg/mL – some ambulances stock higher concentrations] Can redose at 10 minutes with 0.75 to 1.5 µg/kg		Angled 45° delivery of metered aerosolised device best as coats turbinates with spray; avoid horizontal delivery of volume where run off into pharynx is then swallowed with reduced bioavailability and effect
	IV	Dose depends on severity of pain (as per other IV opioids); 0.2 to 0.5 to 1 µg/kg	More rapid onset than morphine and oxycodone	Can titrate (like morphine IV suggestion above) with 1 µg/kg in 10 mL
Tramadol (mixed action [5HT–NA reuptake and mu opioid])	IV/PO	1 to 2 mg/kg (max 50 to 100 mg); 6-hourly	Nausea and vomiting Caution in seizure disorder or predisposition Modify doses or avoid when patient receiving other 5HT reuptake inhibiting agents (tricyclic antidepressants, selective serotonin reuptake inhibitors, monoamine oxidase inhibitors)	To reduce bolus emetogenic effect, give IV slowly over 15 to 20 minutes; disperse capsule in water for divided administration; elixir formulation not available in Australia; avoid concentrated drop prescription due to potential 40-fold dosing error (state 'not for drops' on prescription to avoid pharmacy dispensing this formulation)

* See full product information for further prescribing details.
Abbreviations: 5HT = 5-hydroxytryptamine; IN = intranasal; IV = intravenous; NA = noradrenaline; PO = oral; PR = rectal.



Tier 1: Physical: heat/ice packs, massage, positioning, slings/pillows
Distraction: music, reading, playing or other
Relaxation: deep breathing, visualisation, progressive muscle relaxation

Tier 2: Paracetamol, nsNSAIDs, COX-2 inhibitors, sweet solutions; single agent or in combination and combined with nonpharmacological (tier 1)

Tier 3: Oral opioids and tramadol immediate release; in combination with simple analgesia (tier 2) and nonpharmacological (tier 1)

Tier 4: Parenteral opioids and tramadol; in combination with simple analgesia (tier 2) and nonpharmacological (tier 1)

Tier 5: Specialised delivery systems including novel techniques and stepdown/step-up, in combination with tier 1 to 4: morphine or other opioid infusions, patient-controlled analgesic device; oral extended-/controlled-release opioids as stepdown or rotation in subacute scenarios (after major surgery/trauma) or step up (for cancer pain management, including transdermal and sublingual route)

Neuropathic pain (typically opioid resistant) or resistant nociceptive somatic or visceral pain: tricyclic antidepressants, gabapentinoids (alpha-2 delta ligands); ideally in combination (for synergistic effect) and combined with tier 1 to 4 if beneficial effect to movement, function and physiotherapy

Procedural/prehospital analgesia: intranasal metered aerosolised device – opioid, ketamine, alpha-2 agonist; inhalational – nitrous oxide, methoxyflurane; combined where appropriate with tier 1 to 4

Tier 6: Specialised intervention techniques/infusions: regional local anaesthetic single injection nerve blocks or catheter techniques; systemic local anaesthetic; systemic ketamine

Figure 2. Tiered management of pain in children.

Ketamine is used more often in emergency departments at anaesthetic/dissociative doses of 1 to 2 mg/kg intravenously/intranasally or 3 to 5 mg/kg intramuscularly in Australia and New Zealand for paediatric procedural sedation, such as for fracture reduction or laceration repair.[12,43] There is return to use prehospital for paediatric trauma[12,44] via oral, intravenous, intramuscular and intranasal route at subanaesthetic (analgesic) doses of 0.1 to 0.5 mg/kg (i.e. the patient is coherent and not disassociated).

Methoxyflurane is still a popular prehospital intervention in children following trauma, extremity injury or other sources of pain. Methoxyflurane administered via an inhaler is used by older children (>3 years) and is effective.[45,46] The child is instructed to hold the inhaler and take a few breaths (initially with the dilutor hole open), thereafter intermittently for further pain relief with the option to close the dilutor hole if stronger analgesia is required. If the child becomes drowsy, the device will be dropped and is effectively 'patient controlled'.

Multimodal therapy and tiered management

Multimodal therapy is a concept wherein several analgesic medications with different modes of action and possibly holistic use of nonpharmacological interventions are combined to improve pain relief and reduce side effects experienced, particularly of those caused by opioids (aiming for opioid-sparing effect).[47] For patients with moderate-to-severe pain, a tiered management approach is appropriate (Figure 2). Sometimes this is challenging in the acute care setting because a clear diagnosis may not have been established. Ideally, the tiers should start with nonpharmacological interventions, moving to or combining with simple pharmacological analgesics and stepping up to opioid or specialised techniques to manage more severe pain.

Conclusion

Practices are still behind the evidence base regarding analgesia, particularly in children whose pain is usually reported by proxy. The GP is to be encouraged to educate parents in pain assessment (subjective and ideally child self-reported) and their administration of analgesic interventions to modify their child's acute pain and then positively impact upon that child's later pain experience. Nonpharmacological interventions should be used in preference to or in concert with pharmacological therapy as the former are without toxic effects. **PMT**

References

A list of references is included in the website version of this article (www.painmanagementtoday.com.au).

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