

Prevention and control of pain in children

N. S. Morton

Royal Hospital for Sick Children, Yorkhill NHS Trust, Glasgow G3 8SJ, UK and Department of Anaesthesia, University of Glasgow, Glasgow, UK

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The development of pain pathways and stress responses in the fetus, neonate, infant and child has been elucidated recently and has led to widespread acceptance that for moral, ethical, humanitarian and physiological reasons, pain should be anticipated, and safely and effectively prevented and controlled in all age groups.^{5 6 20 21 27 32 71 77 78 83 86} Simple measures, widely applied, produce the most benefit at the least risk. For more complex techniques, a minimum standard of monitoring should be implemented and regular reassessment of analgesia and adverse effects allow individualized titration of analgesia. Routine perioperative use of local or regional anaesthesia in *all* children, unless there is a specific contraindication, is the foundation of effective postoperative analgesia. A multimodal approach using local and regional anaesthesia, opioids and non-steroidal anti-inflammatory drugs (NSAID)/paracetamol is particularly useful in paediatrics. The emotional component of pain must also be addressed in all aspects of paediatric practice using instinctive comforting measures, provision of child-friendly surroundings and distraction techniques. The child and family should be given the chance to be involved in the control of their pain management. These non-pharmacological techniques should be used to complement safe and effective use of analgesic drugs.

Monitoring standards

For more complex techniques, development of a minimum monitoring standard has encouraged more widespread use of opioid infusion and epidural techniques in children and has helped to allay fears about safety.⁶⁰ Children must be matched carefully to the technique, level of expertise and available facilities for monitoring, with neonates requiring special care because of differences in opioid and local anaesthetic pharmacology in the newborn.^{8 26 45 53 75 80} The currently recommended monitoring standard comprises regular (preferably hourly) assessments of analgesic efficacy, adverse effects and the infusion system.

Assessment

Paediatric pain assessment must be practical to perform and must track both the pain experience of the child and efficacy

of analgesic interventions over time.^{39 60 62 63} Assessment has to be appropriate for: (a) the child's stage of development; (b) severity and chronicity of the illness; (c) surgical or medical procedure; and (d) medical environment. Pain assessment should not be carried out in isolation, on just one occasion or for its own sake. Assessment must be linked to appropriate interventions based on the assessment with the aim of ensuring the child experiences no pain or only mild pain. Pain assessment is most accurate when the child can tell staff about their pain. They need to be given the opportunity, however, and this often does not happen in a busy hospital. For many reasons, children may not ask for pain relief, either because they do not want to disturb staff or because the remedy is unpleasant or induces adverse effects (e.g. i.m. injection of opioid).

It is possible for children as young as 3 yr of age to *self-report* the location and severity of pain using words appropriate to their stage of development. Younger children cannot do so readily. To pick up the symptoms and signs of pain in the younger child, behavioural cues and physiological values are used. These are open to misinterpretation and can be affected by symptoms and events other than pain. It is important that staff are trained to detect the symptoms and signs of pain in different age groups and to take a sufficiently broad view of the child to determine if the observations they are making are caused by pain or by other factors. It is well established that experienced paediatric nurses are better at this than trainees and that parents can be better than nurses.

Neonates (up to 1 month; ex-preterm up to 60 weeks post-conceptual age)

In neonates, behaviour and physiological values are interpreted together to judge if the baby is in distress and needs analgesic intervention. What is often omitted, however, is reassessment of the effectiveness of the intervention in changing the pattern of behavioural and physiological responses. If this does not indicate improvement, then either the intervention may not have been adequate or the responses may not have been caused by pain in the first place.

A variety of assessment tools have been developed and validated for neonates. Observation of facial expression, body position and movement, crying, arterial pressure, heart rate, skin colour, oxygen saturation, ventilatory frequency and sleeplessness are all used.⁴³ However, these can be affected by non-painful stimuli. A more clinically useful assessment is a dynamic one, where improvement in behavioural and physiological changes is sought in response to comforting, analgesia or sedation.^{10 13 20 50 62 63}

The younger, less mature, critically ill, sedated or paralysed baby is unable to show the same pain behaviour as the healthy full-term baby or older infant. Many of the scoring systems do not work in the intubated ventilated neonate. Again, by using a dynamic assessment of the response to nursing interventions such as airway suctioning, a better estimate of the need for sedation and analgesia can be made. It is reasonable to assume that the ventilated neonate senses discomfort from the tracheal tube, ventilatory support and interventions such as suctioning, heel prick blood sampling, insertion of intravascular lines, and insertion and removal of chest drains. Adequate analgesia should be given for these interventions in a pre-emptive manner. Continuous infusions of opioids can give rise to problems of tolerance, cumulation, withdrawal syndromes and possibly immunosuppression. The longer-term effects of continuous exposure of the neonatal central nervous system to opioids is not known²⁷ and a better option may be to consider short-term infusions to cover acutely painful episodes with regular reassessment between infusions of the level of sedation and analgesia required.³⁹ Use of simple techniques such as 'sucrose analgesia' and spring-loaded capillary blood sampling systems is far safer and as effective for painful procedures. With modern tracheal tubes, fixation systems and synchronized or triggered ventilatory modes, discomfort from these aspects of care is far less than with previous less sophisticated systems. Neonates are sensitive to the sedative and respiratory depressant effects of benzodiazepines and opioids with longer elimination times leading to cumulation on repeated dosing. Thus non-ventilated neonates require lower and less frequent doses and intensive monitoring when such agents are used.^{5 6 37 42}

Infants (1 month–1 yr) and toddlers (1–3 yr)

The same problems apply to infants. Metabolic systems are maturing rapidly in the first 3 months of life and renal function is maturing for the first year of life. The sedative and analgesic requirements may peak around the age of 1 yr because of increased metabolic capacity and clearance. With adequate monitoring, conventional doses of analgesics and sedatives can be used safely in infants more than 3 months of age and assessment of their effectiveness and adverse effects using behavioural and physiological responses is acceptable. The response to comforting measures and analgesic interventions should be documented. Remember, however, that exhibited behaviours may be less obvious in the very sick baby, or in one who is ventilated,

paralysed and sedated. In toddlers, exhibited behaviours may be more vigorous with an 'all-or-nothing' type of response. Sometimes the response is more precise (e.g. grabbing at the operation site if it is painful).⁶³

Children aged 3–7 yr

Most 3-yr-olds can differentiate the presence or absence of pain. They can indicate pain intensity in up to four broad categories, corresponding to nil, mild, moderate and severe. Many can speak well enough to explain if they are feeling pain and to indicate its severity (mild, moderate or severe), but using language and phrases they can understand. They can usually point to the location of the pain. They can understand the concept of 'pieces of hurt' as used with the poker-chip tool. The 'faces' scale can work well, especially if a maximum of four choices is available. Other younger children tend to choose at the extremes of such scales (i.e. an all-or-nothing effect). Older children can also relate to previous painful experiences to indicate their current experience (e.g. from a cut or fall). The same tissue injury in a younger child with no previous painful experiences may be scored as severe while an older child who has had a worse pain before may score the pain as mild. Alternatively, children who have undergone repeated painful procedures may be sensitized and have very low pain thresholds. A more detailed faces progression using photographs arranged vertically (Oucher scale) can be used in this age group and these can be made ethnically appropriate and gender specific. Some younger children may think they have to choose the happiest face and do not relate the faces to their own pain experience. Visual analogue scales can be operated by children from around the age of 5 yr but the classic 100-mm horizontal line is not well understood by younger children. Adding colour gradations is helpful and making the scale vertical, like a thermometer, is better understood.^{10 16 30 54–56 62 63 71 72 79}

Older children and adolescents (7 yr+)

Older children can usually use visual or colour analogue scales and can self-report pain intensity, location and quality.⁶³ For severe or acute pain, which is likely to last or need intervention over several days, the Gauvain–Piquard rating scale, which incorporates an assessment of the emotional or affective component (anxiety, depression) is useful.³⁰

Summary of pain assessment

In neonates, the CRIES score⁴³ is easy to remember and works well in all but the very preterm and sedated, paralysed, ventilated baby. In infants and toddlers, the objective pain scale (OPS)³⁵ is easy to use and the toddler–preschooler postoperative pain scale (TPPPS),⁷⁹ although more complex, has been found to track pain intensity and pain control well. From the age of 3 yr, children can self-report the presence of pain and grade its intensity, although younger

children tend to do this as an all-or-nothing response. Self-reporting with words or visual aids is sensitive enough to track pain control, provided the number of choices is limited to about four words, faces or 'pieces of hurt'. Linear analogues are understood from around 5 yr and colour-graded vertical scales seem to be the most practical. However, verbal self-reporting also works well. From 7 yr, the classical horizontal VAS can work but the vertical colour analogue scale and self-reporting are also reliable. Whichever scoring system is used, assessments should be repeated regularly, appropriate interventions should be prescribed and their effectiveness in reducing the pain score should be documented regularly. Assessments should be carried out during an appropriate movement and at rest. If this is not done, there is a risk of the child lying rigidly still, afraid to move, cough or breathe deeply and being scored as having 'no pain'. Pain-free return to function, ability to cooperate with physiotherapy and move appropriately are the aims of good analgesia management.

Pragmatic scoring systems are used by many pain control services and these comprise four or five categories corresponding to nil, mild, moderate or severe, with an estimate of pain on movement included.^{39 50 51 60} For older children, the child 'self-reports' this information while for younger children, the nurse, parent or doctor carries out the assessment using the same simple scoring system. Scores are repeated hourly and an appropriate intervention to adjust analgesia delivery or to reassess the child more thoroughly is linked to each hourly assessment. This simple system is sensitive enough to allow titration of analgesia with elimination of severe pain, most moderate pain and the majority of mild pain or discomfort. The child is usually pain-free for most of the time at rest and for a large part of the time during mobilization.

Simple measures

Simple measures such as 'sucrose analgesia' are safe and effective for procedural pain, such as heel prick blood sampling in neonates.^{36 69 76} This is a useful manoeuvre as part of the care of ex-premature neonates undergoing surgery covered by regional analgesia alone.

Topical anaesthesia

Topical local anaesthesia of the skin should be routine before all needle procedures in children.²⁹ The eutectic mixture of prilocaine and lidocaine (EMLA cream) is very effective when applied for 60–90 min, while tetracaine gel has a slightly more rapid onset of action (40 min) and produces vasodilatation.⁴⁷ Neither are effective for capillary heel sampling; EMLA constricts capillaries so that sampling is more difficult. These agents can be used at the site of lumbar puncture, bone marrow sampling, skin graft donor sites and to the preputial area before freeing adhesions or after circumcision to provide analgesia and a useful sedative-sparing or anaesthetic-sparing effect. Lidocaine gel can be

used at the site of circumcision to maintain analgesia after caudal or penile blocks wear off and parents can be taught how to apply this for the first 24–36 h after day-case circumcision.⁶⁵ Topical local anaesthesia is very helpful for laceration repair in the accident and emergency department. A bupivacaine plus norepinephrine soak applied to the open wound has recently been found to produce the most effective analgesia.⁷⁴ The wound edges can then be infiltrated with local anaesthetic 'from within' via the anaesthetized area. EMLA has been shown to be effective when used topically on open wounds⁸⁹ although the manufacturers do not recommend this because of the risk of increased systemic uptake. Topical local anaesthetic eyedrops are also available (tetracaine, oxybuprocaine, proxymetacaine) and are useful for providing instant analgesia for removal of small superficial foreign bodies from the eye. Tetracaine eyedrops sting on first application but produce analgesia for up to 2 h. Repeated application is not recommended as punctate corneal keratopathy may result. Oxybuprocaine and proxymetacaine do not sting but have a very short duration of action of 20–30 min. These topical drops have also found a place in the provision of analgesia after squint surgery in children.⁸⁴ Another recently described approach to this latter problem is topical NSAID eyedrops, such as diclofenac or ketorolac, which have analgesic and anti-inflammatory properties when applied to the eye.⁶⁴ They do not have a product licence for paediatric postoperative analgesia but are worthy of further study.

Instillation

There are other simple and highly effective ways of using topical local anaesthesia. Instilling bupivacaine into small open wounds before closure of the skin edges is effective⁶¹ and applying dilute bupivacaine with or without epinephrine onto the dressing applied to skin graft donor sites is also simple, effective and safe, provided the maximum dose limits are strictly adhered to. The skin graft donor site can be extremely distressing to the child for a period of up to 48 h and we have found that a simple method of maintaining analgesia is to use a foam dressing soaked with 0.25% bupivacaine 2 mg kg⁻¹ (0.8 ml kg⁻¹) applied to the donor surface and to provide a continuous infusion of 0.25% bupivacaine 1–3 ml h⁻¹ via an 18-gauge epidural catheter curled on the outer or inner surface of the foam. This allows percolation of a small dose of local anaesthetic over the entire donor area which we call *dressing perfusion*.⁶³

Wound perfusion with bupivacaine can also be highly effective and we have found the technique particularly useful for iliac crest bone graft donor sites used for alveolar bone grafting in some techniques of cleft palate repair. Again, an 18-gauge epidural catheter is used and a very low infusion rate of 1–3 ml h⁻¹ of 0.25% bupivacaine is all that is required.⁶³

Wound infiltration

Local anaesthetic infiltration with bupivacaine in the anaesthetized child has been shown to be effective for surface

wounds and tunnelling procedures such as are needed for inguinal surgery, insertion of ventriculoperitoneal shunts, central venous lines, and insertion of central venous catheter-reservoir systems, etc. This technique is particularly useful and safe in small infants and often simplifies their postoperative management considerably as wound infiltration together with generous doses of paracetamol and rapid return to oral feeding are often all that are required for minor and some intermediate procedures.⁷¹

Local anaesthetic infiltration via skin that has already been anaesthetized with topical cream or gel is a useful technique in the conscious child for needle or puncturing procedures, such as lumbar puncture, for vascular access for cardiac catheterization or for removal of small surface lesions in older, cooperative children. Infiltration of local anaesthetic is also used widely in accident and emergency departments and general practice for closure of skin lacerations in children.⁵⁶ The technique is important for ensuring success. Infiltrating outwards from areas which are already anaesthetized with topical local anaesthetic is best. Use of small needles of 27–32-gauge, warming the local anaesthetic to body temperature and slow injection are all helpful. Stinging on initial injection can be minimized using 1% lidocaine rather than 2% and by buffering lidocaine with sodium bicarbonate (1 ml of 8.4% sodium bicarbonate solution to 9 ml of 1% lidocaine). Dilute bupivacaine can be used in place of lidocaine and has the advantage of providing longer lasting analgesia.

Nitrous oxide

Inhalation of nitrous oxide is another safe and effective method of providing rapid onset of analgesia for short painful procedures.^{56 63} It is insoluble in blood and therefore is delivered quickly to the brain to produce an analgesic effect equivalent to i.v. morphine. Maximal pain relief is achieved after approximately 2 min of inhalation. Nitrous oxide can be given in oxygen in inspired concentrations up to 70% but this requires a special delivery system and this concentration may lead to loss of verbal contact with the patient. It is more conveniently given in the form of Entonox, from a cylinder which automatically delivers 50% nitrous oxide and 50% oxygen. The cylinder contents are under pressure and a flow of gas to the patient is usually activated on demand by the patient taking a breath via a special valve. Recently the design of these valves has improved to provide a lightweight, child-friendly system with an opening pressure of 1–2 cm H₂O. The child can breathe via a face mask, nasal mask or mouthpiece and the system is best regarded as a form of ‘inhalation patient-controlled analgesia’ with the child holding the mask or mouthpiece and controlling the inhalation. This has an important safety function in maintaining sedation and thus verbal contact. It is not very suitable for children less than 3 yr old and works best in cooperative children aged more than 5 yr.

Entonox can be used for a wide variety of procedures in

paediatrics which require potent analgesia for a short time, for example: suture insertion or removal; dressing removal or changes (including burns); drain or catheter removal; venepuncture or cannulation; lumbar puncture; physiotherapy; and biopsies (skin, muscle, renal, bone marrow). Nitrous oxide is not suitable for all children and there are absolute contraindications to its administration which include: pneumothorax, bowel obstruction, abnormal airway, recent head injury (especially if there is an intracranial air pocket), chronic respiratory disease, uncorrected congenital heart disease, gastro-oesophageal reflux, age less than 3 yr, inability to cooperate or understand the technique or previous problems with Entonox.

Nitrous oxide is highly diffusible and moves more rapidly into an air pocket than nitrogen in the air pocket moves out. The air pocket therefore expands in volume or, if in a confined space (e.g. within the chest or cranial cavities or within the lumen of the bowel), pressure increases. This tension effect is extremely dangerous, risking tension pneumothorax, ischaemia or shift of intracranial contents or bowel distension with risk of perforation. Nitrous oxide produces a degree of sedation and potentiates the sedative effects of other central nervous system depressants and therefore care is required when opioids, benzodiazepines or anti-histamines have also been given. Nitrous oxide can also induce nausea and vomiting, but if it is to be used as the sole sedative and analgesic, the incidence of emesis is very low and therefore fasting is not required. However, if other sedatives or analgesics have been given, the child should be fasted as for a general anaesthetic. Other adverse effects of nitrous oxide are the potential to oxidize vitamin B12 and affect erythropoiesis, and disputed effects on personnel from prolonged or repeated exposure. It is important that administration of nitrous oxide is performed in well ventilated areas and that, where possible, expired gases are scavenged. As with any sedative technique, consent, selection, preparation, monitoring and record keeping should be meticulous, and trained personnel should be in charge of administering and monitoring the child receiving nitrous oxide.^{38 63}

Non-drug techniques

Non-drug methods can be very helpful for transient acutely painful procedures. In particular, distraction techniques such as blowing bubbles, playing with favourite toys, watching videos, music, guided imagery and hypnosis can be used successfully in individual children. The environment should be made as child-friendly as possible and parental involvement encouraged where appropriate.^{15 44 56 71 81}

Single injection techniques

Peripheral nerve blocks

A large number of studies have demonstrated that peripheral nerve blocks, when performed correctly in children, are as

effective as single-shot central blocks and often produce longer lasting analgesia.⁵⁸ This applies to inguinal blocks or penile blocks compared with caudal blocks with plain bupivacaine. The new plexus blocks, such as the fascia iliaca block and anterior approach sciatic block, result in analgesia which far exceeds single-shot caudal block in terms of duration. The skill needed to produce a reliable block with the various peripheral blocks has to be balanced against the technically easy caudal block where there is no doubt that a very high success rate can be achieved very quickly.

Prolongation of single injection central blocks

The advantages and disadvantages of addition of opioids to epidural local anaesthetic solutions are well documented in paediatric practice.^{8 9 13 22 39 50 51 55 56 58 61 63 70 71} The use of opioids in the epidural space has the advantage of providing analgesia without the sympathetic or motor block seen when local anaesthetics are used. Morphine is the most frequently used and studied drug in children, although fentanyl and diamorphine are also effective. Lipid solubility affects the dose required, speed of onset, duration of action and degree of complications. If a drug has greater lipid solubility, there is more rapid transfer across the dura to the opioid receptor sites and therefore more rapid onset of analgesia. However, duration of action is also shorter as the drug is removed more quickly from receptor sites. Morphine has a relatively low lipid solubility compared with fentanyl, for example. This means that it may take longer to act but also stays for a greater length of time in the CSF. This has implications with regard to spread of the drug to a site rostral from the point of injection (i.e. drugs are carried by the CSF circulation upwards towards the brain). The analgesic effect of less lipid soluble opioids is less dependent on the dermatomal site of injection. Morphine stays longer in the CSF which means it is more likely to spread cranially and cause unwanted side effects such as respiratory depression. It is important to realize that this may not become manifest until up to 24 h after the initial injection. Rostral spread of a drug also accounts for other side effects, such as nausea, itching and urinary retention. The well documented risk of delayed respiratory depression implies that strict monitoring guidelines need to be instituted before epidural or intrathecal opioids are used in paediatric practice and for this reason many centres use this means of analgesia only in a high-dependency setting. If a more lipid soluble drug such as fentanyl is used, a greater proportion of the dose is absorbed systemically and a dose similar to that given systemically is required. Therefore, fentanyl is often best used in combination with a local anaesthetic drug in an infusion technique and the combination of opioid and local anaesthetic are well known to produce synergistic effects. Clinically, the objectives of co-administering epidural opioids with subanaesthetic concentrations of local anaesthetics are important as reduction in the dose of both drugs is achieved, enhancement of the degree of pain relief

is seen and there is a reduction in the incidence of adverse effects produced by both opioids and/or local anaesthetics.

Analgesia obtained by a single bolus of epidural morphine 30–50 $\mu\text{g kg}^{-1}$ (preservative-free preparation) every 6 h, with the catheter flushed with 0.9% saline 0.5 ml afterwards, is comparable with continuous infusion of fentanyl and local anaesthetic, although with infusion, the incidence of nausea and itching is less. If a child is receiving local anaesthetic only through the epidural catheter, a small dose of fentanyl 0.5–1 $\mu\text{g kg}^{-1}$ given epidurally and flushed with saline may 'smooth' the analgesic effect where the local anaesthetic did not provide complete analgesia. A problem arises where a child has received spinal opioids but does not appear to have adequate pain relief. Ideally, another non-opioid analgesic, such as a non-steroidal anti-inflammatory agent, can be effective, but it may be that parenteral opioids are required. If this is the case, the patient should be monitored intensively until the effects of the spinal opioid are judged to have worn off as there is a high risk of respiratory depression with concurrent administration of opioids by different routes.

Intrathecal opioids are usually given as a single dose. Morphine is given as a single dose of 0.02 $\mu\text{g kg}^{-1}$. Respiratory depression is thought to be a risk for 24 h after the last administration of spinal opioid. Therefore, a child should never receive this method of analgesia as a day case. In addition to respiratory depression, other side effects of opioids have a significant incidence when they are used epidurally or intrathecally. The micturition reflex is inhibited in up to 30% of children. Naloxone 0.5–2 $\mu\text{g kg}^{-1}$ and low-dose naloxone infusion are effective for urinary retention while analgesia is maintained. Catheterization is often needed and many anaesthetists perform this prophylactically in any child receiving epidural or intrathecal opioids. Nausea and vomiting may occur in 40% of children and are treated with antiemetics. Itching occurs in 40–50% and is treated with low-dose naloxone or ondansetron.^{56 63 71}

Clonidine, an alpha-adrenoceptor agonist, in a dose of 1–2 $\mu\text{g kg}^{-1}$, when added to a single caudal epidural injection of bupivacaine in children, results in doubling of the duration of analgesia.^{17 41 48} The NMDA receptor antagonist, ketamine, in its *preservative-free* form at a dose of 0.5 mg kg^{-1} , quadruples the duration of caudal bupivacaine.¹⁷ Although these drugs do not have a licence for use in this way, developments such as these may considerably simplify postoperative pain management for a large number of children and many paediatric anaesthetists are using these techniques on the basis of benefit outweighing risk.

Intermittent vs continuous regional block

There are risks and benefits with the use of continuous infusion techniques in paediatric analgesia practice. All paediatric infusions should be regarded as high risk and must therefore be monitored closely by trained staff. There

is the potential for prescription and dilution errors, programming errors, electronic malfunction of the infusion pump, gravity-free flow, reflux up concurrent infusion lines and malposition or extravasation of the infusion. However, if the system is working correctly, continuous good quality analgesia is more likely than with intermittent dosing; the patient is kept in the 'analgesic corridor' between inadequate analgesia and adverse effects.^{55 63} Intermittent dosing can work well and may be somewhat less intensive in terms of monitoring; it may therefore be safer in general wards or in non-specialist centres.¹² For epidural top-ups, a segmental block can be maintained by small top-up volumes of 0.1–0.3 ml kg⁻¹ of 0.25–0.375% plain bupivacaine provided care is taken to ensure that the catheter tip position is at the level of the middle of the desired segmental distribution. These small volume top-ups often last for 8–12 h in younger children less than 8 yr of age but may only last for 3–4 h in older children. It is safest if these top-ups are administered by a trained anaesthetist who should monitor the effect of the top-up, check vital signs for 15 min to ensure cardiovascular stability and check for development of an excessively widespread or high block.^{26 33 56 58 61 63}

Continuous epidural techniques in children

With infusion epidural analgesia, a constant degree of analgesia can be provided. If the catheter tip is sited at the appropriate dermatomal level, low concentrations and volumes of local anaesthetic can be infused to produce a band of analgesia thus minimizing the risks of toxicity and incidence and degree of motor block. Accumulation of bupivacaine occurs in neonates after infusions lasting 6–12 h because of delayed clearance, and most specialist centres limit the duration of epidural infusions in neonates to 24–36 h.^{7–9 11–13 26 28 33 45 46 52 53 58 67 68 75 85 87}

Use of bupivacaine alone may cause problems in infants despite excellent pain control because of lack of sedation. This may be provided by small amounts of opioid added to the epidural solution, small doses of parenteral opioid or midazolam given i.v. in small intermittent doses or as a low-dose infusion.

Plasma concentrations of bupivacaine during continuous epidural infusions are generally low and significantly below concentrations which give cause for concern. However, peak concentrations in individual patients may sometimes be high. Cumulation of total and free bupivacaine is seen in neonates and cases of local anaesthetic toxicity have been reported. The minimum effective dose must be used and much lower hourly doses should be given to neonates.⁸

Conservative suggestions for doses to be used for epidural infusion in children after a fractionated loading dose of bupivacaine 1–2.5 mg kg⁻¹ is to infuse a maximum of 0.2–0.25 mg kg⁻¹ h⁻¹ in neonates and 0.4–0.5 mg kg⁻¹ h⁻¹ in older children (Table 1). If these infusion rates are unsuccessful then addition of a systemic or epidural opioid may be tried if it is not already included, except in neonates (Table 2). The safety profile of ropivacaine and

Table 1 Examples of epidural local anaesthetic infusion regimens

Age <6 months

Bupivacaine infusion 0.125% plain 0.1–0.2 ml kg⁻¹ h⁻¹ ≡ 0.125–0.25 mg kg⁻¹ h⁻¹. May need top-ups of 0.25% bupivacaine 0.1–0.3 ml kg⁻¹ ≡ 0.25–0.75 mg kg⁻¹ in fractionated doses (maximum total dose (including top-ups) per 4-h period 1.0 mg kg⁻¹)

Age 6 months+

Bupivacaine infusion 0.125% plain 0.2–0.4 ml kg⁻¹ h⁻¹ ≡ 0.25–0.5 mg kg⁻¹ h⁻¹. May need top-ups of 0.25% bupivacaine 0.1–0.3 ml kg⁻¹ ≡ 0.25–0.75 mg kg⁻¹ in fractionated doses (maximum total dose (including top-ups) per 4-h period 2.0 mg kg⁻¹)

Table 2 Examples of epidural opioid and local anaesthetic infusion regimens

Add preservative-free morphine 500 µg (0.5 mg) to 50 ml of 0.125% bupivacaine to give a morphine solution of 10 µg ml⁻¹

Run at 0.1–0.4 ml kg⁻¹ h⁻¹ gives morphine 1–4 µg kg⁻¹ h⁻¹

or

Add fentanyl 100 µg to 50 ml of 0.125% bupivacaine to give a fentanyl solution of 2 µg ml⁻¹

Run at 0.1–0.4 ml kg⁻¹ h⁻¹

Caution: Do not use epidural opioids in neonates

levobupivacaine have yet to be proved in paediatric practice but may provide safer alternatives for continuous infusion epidural analgesia.⁴⁰

Problems with paediatric epidural analgesia

Technical problems with equipment are common when epidural infusion analgesia is used in children and include obstruction of the catheter, disconnection of the bacterial filter and catheter, and leakage of solution through the skin puncture site. These problems can result in early loss of up to 1 in 5 epidural catheters. Improvements in equipment design can reduce this by 75%, including better locking connections between catheter and filter, and use of a short, 50-mm, 18-gauge Tuohy needle with a 23-gauge multiple side hole closed-end catheter.^{39 50 51}

Side effects include urinary retention, leg weakness, tachyphylaxis, epidural haematoma, epidural infection and risk of i.v. and subarachnoid injection. Use of epidural infusion or intermittent top-ups in the postoperative period requires close nursing supervision of the child. Hypotension is rarely a problem, especially in children less than 8 yr of age, but lack of sensation may cause problems if not anticipated. Pressure sores may occur in analgesic skin unless patients are repositioned regularly. After trauma, the technique is generally contraindicated because of the possibility of a compartment syndrome.

Contraindications to epidural analgesia in children are similar to those in adults. Absolute contraindications include local sepsis, systemic sepsis, coagulopathy, operator inexperience and patient or parental refusal. Relative contraindications include spinal anatomical abnormalities and neurological disease.^{8 9 28}

Intermittent vs continuous opioid techniques

I.m. injections are disliked by children but an i.m. or subcutaneous cannula can be sited while the child is

Table 3 'On-demand' analgesia with morphine via a subcutaneous or i.m. cannula

- Draw up an ampoule of morphine sulphate 10 mg ml⁻¹ and dilute to 10 ml with 0.9% saline
- Draw up calculated bolus dose from this 1 mg ml⁻¹ solution
 - <1 month = 25 µg kg⁻¹ = 0.025 ml kg⁻¹ (use 1-ml syringe)
 - 1–3 months = 50 µg kg⁻¹ = 0.05 ml kg⁻¹ (use 1-ml syringe)
 - >3 months = 100 µg kg⁻¹ = 0.1 ml kg⁻¹ (use 1-ml syringe up to 10 kg)
- Dilute with 0.9% saline to 1 ml total volume if <10kg
- Inject via cannula
- Flush cannula with 0.5 ml of 0.9% saline
- Repeat on demand up to every 2 h
- Monitor as for i.v. infusion

anaesthetized and nurse-administered bolus doses can be highly effective provided pain is assessed regularly and the child has good peripheral perfusion at all times.⁸⁸

Intermittent subcutaneous bolus

In appropriately selected cases, the subcutaneous route of administration is useful. A subcutaneous cannula may be sited in the conscious child under topical local anaesthetic cream cover or while the child is anaesthetized. A 24-gauge cannula can be inserted easily into the subcutaneous tissue of the anterior abdominal wall or the deltoid area of the upper outer arm and secured with adhesive tape or a transparent dressing. It is a particularly convenient route of administration in orthopaedics because these children often require parenteral analgesia for up to 72 h but wish to eat and drink and move. Morphine sulphate or diamorphine are most often used by the subcutaneous route. Volume of injection should be small and the first one or two injections via the cannula may sting and cause some redness or itching at the site. If this is severe, check that the cannula has not been inadvertently placed *intradermally* rather than subcutaneously. A slow rate of injection helps to minimize pain on injection.^{57 73}

A subcutaneous bolus can be convenient for nurse-administered rescue analgesia or as part of a 'low-tech' procedure for on-demand analgesia (Table 3). The pharmacokinetics and dynamics are similar to the i.v. route provided peripheral tissue perfusion is stable and adequate.

In paediatric and neonatal intensive care, continuous infusions of opioids and sedatives are often used for long periods and this can lead to tolerance and withdrawal syndromes. Often continuous techniques are mandatory but with improved ventilator design and the trend to more actively supported weaning modes and patient-triggered ventilation patterns, intermittent bolus analgesia titrated against the most painful episodes and interventions can work very well, especially in neonates. This allows use of much lower total daily doses of sedatives and analgesics, and with regular reassessment of comfort and sedation levels, an acceptable degree of titration to minimize distress can be achieved.

Table 4 I.v. morphine infusion regimen

Morphine 1 mg kg ⁻¹ in 0.9% saline 50 ml (≡ 0.02 mg kg ⁻¹ ml ⁻¹ , i.e. 20 µg kg ⁻¹ ml ⁻¹); maximum 50 mg in 50 ml
Age
0–1 month: up to 0.004 mg kg ⁻¹ h ⁻¹ , i.e. 4 µg kg ⁻¹ h ⁻¹ ≡ 0.2 ml h ⁻¹
>1–3 months: up to 0.010 mg kg ⁻¹ h ⁻¹ , i.e. 10 µg kg ⁻¹ h ⁻¹ ≡ 0.5 ml h ⁻¹
>3 months: up to 0.020 mg kg ⁻¹ h ⁻¹ , i.e. 20 µg kg ⁻¹ h ⁻¹ ≡ 1 ml h ⁻¹ (may need up to 40 µg kg ⁻¹ h ⁻¹ ≡ 2 ml h ⁻¹)

Continuous opioid techniques in children

Continuous i.v. infusion

The use of continuous infusion of opioid provides a more consistent and constant level of analgesia but each infusion requires titration to the needs of the individual patient. Dose regimens depend on age and whether the child is to undergo ventilation. In children older than 1 month, morphine infusions of 10–30 µg kg⁻¹ h⁻¹ provide adequate analgesia with an acceptable level of side effects (Table 4). Morphine clearance in term infants older than 1 month is comparable with children aged 1–17 yr. In neonates aged 1–7 days, clearance of morphine is one-third that of older infants and elimination half-life is approximately 1.7 times longer; infusion rates should be reduced³⁷ to approximately 5 µg kg⁻¹ h⁻¹. Morphine is the opioid most frequently used and studied but papaveretum and diamorphine have also been used for infusion to good effect in infants aged 1–6 months.

Problems with use of continuous infusions arise from misconceptions about the time it takes to achieve an increase or decrease in blood concentrations. As the half-life of morphine is at least 3 h in the older child and considerably longer in the neonate, altering the rate of infusion will not have a significant effect for several hours, depending on the length of time for which the infusion has been running. This may be as long as *five* half-lives. Thus inadequate analgesia should be treated by a bolus dose. If undesirable side effects are a problem, the infusion should be discontinued until these have resolved before resuming at a lower dose, usually approximately 50% lower than the previous dose.

Patient-controlled analgesia

Patient-controlled analgesia (PCA) has been shown to be safe and effective in children as young as 5 yr and compares favourably with continuous morphine infusion in the older child.^{14 31} Children self-titrate to a level of analgesia which is satisfactory to them and is associated with the minimum severity of adverse effects. PCA allows for variation in opioid requirements between patients and in the same patient over time. Children have control over their own analgesia, which has considerable psychological benefits.^{56 63} It also allows them the chance to anticipate painful procedures, such as physiotherapy. There is a 'built in' safety net as children can only self-administer the drug when their sedation level allows. The PCA pump is programmed to

Table 5 Relative contraindications to patient-controlled analgesia

- Child less than 5 yr of age
- Child with learning difficulties
- Child physically unable to operate demand button
- Increased intracranial pressure
- Depressed conscious level
- Airway obstruction
- Lack of monitoring infrastructure

Table 6 Recommended starting settings for patient-controlled analgesia in children

Recommended drug concentration is morphine 1 mg kg⁻¹ in 0.9% saline 50 ml (=0.02 mg kg⁻¹=20 µg kg⁻¹ml⁻¹); maximum 50 mg in 50 ml
Bolus dose 0.02 mg kg⁻¹, i.e. 20 µg kg⁻¹=1 ml; maximum bolus dose=1 mg
Lockout time 5 min
Background infusion 0.004 mg kg⁻¹ h⁻¹, i.e. 4 µg kg⁻¹ h⁻¹=0.2 ml h⁻¹ (especially in the first 12–24 h)

give a small bolus of opioid from the syringe when the hand-held button is pushed by the child. Any child who understands the basic concept of PCA and can operate the demand button is suitable. Children from 5 yr can operate the device but should be assessed on an individual basis. Children with learning difficulties or those with physical disabilities or injuries to the hands may not be suitable. The hand-operated demand buttons can be adapted to allow activation by pressure pads placed under the elbow, knee or by an air pressure switch operated by blowing into a tube. PCA opioid administration is applicable after most major surgical procedures, in sickle cell disease and in the management of some children with chronic pain. Any situation in which the use of opioid is contraindicated, such as increased intracranial pressure or upper airway abnormality, precludes the use of PCA. Other contraindications are patient unwillingness or lack of ability to use the machine (Table 5).

An initial bolus dose of opioid is usually required before commencement of PCA so that therapeutic levels of analgesia are achieved before starting PCA (Table 6). The child often has had a local or regional block during surgery and PCA is used as continuing pain control.^{23 24 31}

Other routes of PCA administration

The subcutaneous and epidural routes can be used in children. With subcutaneous PCA, feedback from the site of injection may allow the child to learn to time the bolus doses better and use the device more effectively.²⁵

Nurse- or parent-controlled analgesia

The range of patients receiving opioids in an individually controlled manner can be increased if a nurse or parent is allowed to press the demand button within strictly set guidelines. Monitoring for such patients has to be at least as intensive as that for conventional PCA. Most regimens for nurse- or parent-controlled analgesia use a higher level of background infusion (up to 20 µg kg⁻¹ h⁻¹) with a longer lockout time of approximately 30 min.^{39 50 51 56 61 63}

Table 7 Subcutaneous morphine infusion regimen

Morphine 1 mg kg⁻¹ in 0.9% saline 20 ml (≡ 0.05 mg kg⁻¹ ml⁻¹, i.e. 50 µg kg⁻¹ ml⁻¹); maximum 50 mg in 20 ml
 Age
 0–1 month: up to 0.005 mg kg⁻¹ h⁻¹, i.e. 5 µg kg⁻¹ h⁻¹ ≡ 0.1 ml h⁻¹
 >1–3 months: up to 0.010 mg kg⁻¹ h⁻¹, i.e. 10 µg kg⁻¹ h⁻¹ ≡ 0.2 ml h⁻¹
 >3 months: up to 0.020 mg kg⁻¹ h⁻¹, i.e. 20 µg kg⁻¹ h⁻¹ ≡ 0.4 ml h⁻¹ (may need up to 0.6 ml h⁻¹)

Weaning from PCA or nurse-controlled analgesia

This should be individualized and is achieved when pain scores are satisfactory and the number of demands for a bolus decreases. If a background infusion has been used, it is usually best to discontinue this first and then consider increasing the lockout time. It may be appropriate to leave a pump connected even if the child appears not to be using it. Sometimes the psychological benefits may require a little longer weaning time or the continued analgesic requirements may have been misjudged.

Continuous subcutaneous infusion

Subcutaneous infusions of morphine can be used to good effect in younger children and those unable to use a PCA machine (Table 7). They are particularly useful in orthopaedic practice where analgesia is required for several days while oral fluid intake and diet is resumed in the early postoperative period.⁵⁷

It is important to recognize that there are certain clinical situations where the use of the subcutaneous route may be unwise or contraindicated. These include the hypovolaemic child or in situations where there may be significant fluid compartment shifts after operation such as during major intra-abdominal surgery or extensive burns. In such situations, a depot of opioid may form at a subcutaneous site of inadequate perfusion so that when perfusion improves, the child is at risk of receiving a substantial bolus dose of the drug with potentially dangerous adverse effects.⁸⁸

Assessment and management of adverse effects

The effectiveness of analgesic techniques may be limited by the incidence and severity of adverse effects. The incidence is more or less the same for equi-analgesic doses of different drugs although individual patients may feel better with one particular drug than another. Opioid-related adverse effects can be minimized by the use of opioid-sparing techniques (local/regional analgesia, NSAID and/or paracetamol) and by careful titration.

Respiratory depression and sedation

Opioids can cause this potentially fatal and much feared complication by depressing central respiratory drive and also causing a partially obstructed upper airway as a result of oversedation. This is compounded by the use of any other drugs causing sedation, including anti-histamines and some antiemetics (e.g. phenothiazines). It is more likely in the very young child or infant, in those with organ failure

Table 8 Management of opioid-induced respiratory depression

-
- Support the airway and give high flow oxygen
 - Assist breathing if hypoventilation severe
 - Discontinue opioid administration
 - Give i.v. naloxone 2–4 $\mu\text{g kg}^{-1}$
 - Repeat naloxone 2–4 $\mu\text{g kg}^{-1}$ up to 10 $\mu\text{g kg}^{-1}$
- (If no venous access give same doses via intraosseous needle or a larger single i.m. dose 10–100 $\mu\text{g kg}^{-1}$)
- Consider naloxone infusion to maintain opioid antagonism at 1–10 $\mu\text{g kg}^{-1} \text{h}^{-1}$
-

caused by accumulation of morphine or active metabolites, in those with an abnormal airway and in those with respiratory or neuromuscular disease. In addition, if a local anaesthetic technique is being used, which becomes more effective at a particular time, an opioid has a relatively greater effect (e.g. when an epidural is topped up with local anaesthetic). Opioids should not be given concurrently by different routes as their sedative and respiratory depressant effects are compounded. Respiratory depression occurs rarely but is the main reason that meticulous attention needs to be paid to monitoring of children receiving these drugs. If a child is noted to be oversedated, to have a consistent pulse oximetry reading of less than 94% or ventilatory frequency less than 20 bpm in an infant or less than 12 bpm in an older child, opioid overdose should be assumed until proved otherwise. All patients receiving opioids in whatever form should have oxygen, suction, face mask, self-inflating bag and the opioid antagonist naloxone immediately available. Initial management consists of ensuring airway patency, administering oxygen and discontinuing any opioid drug being given. If respiratory depression is severe (e.g. the patient is cyanosed and/or bradycardic) naloxone should be given i.v. immediately by the ward nurses (Table 8).

An initial dose of naloxone 2–4 $\mu\text{g kg}^{-1}$ should be given and repeated to a total of 10 $\mu\text{g kg}^{-1}$. Duration of action of naloxone is shorter than most opioids and a continuous infusion of 1–10 $\mu\text{g kg}^{-1} \text{h}^{-1}$ may be required to maintain reversal. If no venous access is available, naloxone can be given via an intraosseous needle in the same doses as for i.v. administration, or i.m. at a higher dose of 10–100 $\mu\text{g kg}^{-1}$. The on-call anaesthetist should be notified and additional respiratory or circulatory support commenced. In severe overdose, especially in a baby, ventilatory support may be required. Any precipitating factors should be sought, such as concomitant use of sedative drugs. Checks should be carried out on the infusion equipment to exclude pump malfunction. When the initial problem has been rectified, opioid administration should be stopped for some time to enable blood concentrations to decrease before recommencing the infusion at a lower rate.^{50 51 56 63 82 85}

Nausea and vomiting

This is thought to be caused by opioid stimulation of the chemoreceptor trigger zone in the medulla of the brain and can be a particular problem in the older child, after upper

abdominal or renal surgery and in those with a past history of postoperative emesis or motion sickness. Moderate or severe pain is also a potent cause of nausea and vomiting, especially if the pain has a visceral origin. Nausea and vomiting are often dose-related and first-line management may be to reduce the dose of drug given. Some antiemetics can cause extrapyramidal signs in children if given frequently (e.g. metoclopramide and prochlorperazine). It is unwise to prescribe these drugs regularly. The 5-HT₃ antagonist ondansetron has been efficacious in several studies and does not produce sedative or extrapyramidal problems. Transdermal hyoscine has also been used to good effect as there is often a component of motion sickness to opioid-induced nausea. Giving a premedicant drug such as trimoprazine in low dose (e.g. 1–2 mg kg^{-1}) appears to reduce the incidence of postoperative nausea and vomiting. Low-dose droperidol is another alternative. Sometimes changing to a different opioid decreases the incidence of nausea and vomiting in a particular patient.^{56 63}

Itching

The cause of pruritus induced by opioids is unclear. It is more common when spinal opioids are used. It is usually generalized but often manifests as an itchy nose. It should be distinguished from localized histamine release at the site of injection. Antihistamine drugs are often tried to decrease symptoms but care needs to be used in case they increase the level of sedation. Chlorpheniramine is most often used at a dose of 0.1 mg kg^{-1} but should not be used in infants. It may be safer to use a small dose of naloxone which does not affect the analgesic properties of the opioid, especially if pruritis is associated with epidural or spinal opioids. A bolus dose of 0.5 $\mu\text{g kg}^{-1}$ can be given and repeated every 15 min up to three times or a low-dose infusion at 1–2 $\mu\text{g kg}^{-1} \text{h}^{-1}$ can be started. Analgesia is not diminished in most cases by these low doses. Ondansetron 0.1 mg kg^{-1} may be effective in reducing pruritus caused by epidural or spinal opioids. These latter two techniques have the safety advantage of avoiding additional sedation.

Urinary retention and gastrointestinal symptoms

The side effects of urinary retention, gut immotility and constipation may also respond to a low dose of naloxone 0.5–2 $\mu\text{g kg}^{-1}$. In small babies, gentle suprapubic pressure allows bladder emptying but it may be necessary to catheterize a patient with troublesome urinary retention as the discomfort from a full bladder may be worse than the original pain. Prophylactic urinary catheterization is recommended by many who use epidural or spinal opioids, for major surgery and where a lumbosacral local anaesthetic block is to be used. Postoperative ileus may be exacerbated by opioids whatever the route of administration but patient groups who are at risk often have contraindications to laxatives or suppositories. The problem can be minimized by using opioid-sparing techniques. Laxatives, suppositories and micro-enemas may be required in severe cases.

Table 9 NSAID doses in children

NSAID	Dose (mg kg ⁻¹)	Maximum daily dose (mg kg ⁻¹ day ⁻¹)
Diclofenac	1	3
Ibuprofen	10	40
Indomethacin	1	3
Ketorolac	0.5	2
Naproxen	7.5	15
Piroxicam	0.4	0.4

Muscle spasms

Skeletal muscle spasm may be seen as chest wall rigidity (particularly when the potent fentanyl analogues are used) or more commonly as adductor muscle spasms in orthopaedic patients receiving parenteral morphine after surgery. This may be caused by cumulation of stimulatory metabolites such as morphine-3-glucuronide. Morphine sparing co-analgesia with NSAID and paracetamol is very helpful and regular low-dose diazepam 0.1 mg kg⁻¹ orally up to 6 hourly is very effective but may cause additional sedation.

Assessment and management of the infusion system

Hourly recordings of residual volume of the infusion syringe should be made and a check of pump position, settings and function made. The integrity of the syringe and extension tubing and its connections should be made hourly, in particular examining for leaks, cracks and loose connections. Docking of the syringe in the pump should also be checked to ensure that the syringe barrel is correctly immobilized and the syringe plunger is correctly gripped and is moving appropriately. The pump should be mounted horizontally no more than 80 cm above the patient's heart level. There should be an anti-free flow (anti-siphonage) valve in place in all infusions and, for concurrent administration of opioids and i.v. fluids through the same cannula, an anti-reflux valve should be incorporated in the infusion line. The infusion site should be checked hourly for leakage, extravasation, inflammation or occlusion.

Multimodal analgesia

NSAID are now used widely for postoperative analgesia in children after minor, intermediate and major surgery, and convenient syrup, suppository and 'melt' formulations are available. Concurrent use of these agents allows use of lower opioid doses and more rapid weaning from opioids. With the expansion of paediatric day-case surgery, NSAID are finding a notable place as adjuncts to good local and regional anaesthesia because of their prolonged duration of analgesia and lack of sedation and respiratory depression (Table 9).

The well recognized contraindications to these drugs must be carefully observed in children; this produces particular problems in paediatrics where the incidence of asthma is increasing. It is probably unwise to use these

Table 10 Paracetamol dosing in children

Orally

Paracetamol 20 mg kg⁻¹ loading dose, then 15 mg kg⁻¹ 4–8 hourly to a maximum of 90 mg kg⁻¹ day⁻¹ (60 mg kg⁻¹ day⁻¹ in neonates)

Rectally

Paracetamol 30–45 mg kg⁻¹ loading dose (20 mg kg⁻¹ in neonates), then 20 mg kg⁻¹ 6–8 hourly to a maximum of 90 mg kg⁻¹ day⁻¹ (60 mg kg⁻¹ day⁻¹ in neonates)

Review use of these doses after 48 h and taper dose after 72 h. Check regularly that dose being administered is not above these limits. Beware hepatotoxicity after repeated doses in the febrile, hypovolaemic, dehydrated child with a viral illness or in the critically ill child.

drugs in young infants as renal maturation is still occurring in the first year of life.

Paracetamol is very convenient and effective in children for mild to moderate pain, and when given as a co-analgesic in adequate dose has an opioid-sparing effect (Table 10). The realization that doses prescribed for postoperative analgesia are often inadequate has prompted a re-evaluation of paracetamol pharmacokinetics. Absorption from the rectal route is slow and it is now realized that higher loading doses up to 40 mg kg⁻¹ are required to achieve therapeutic plasma concentrations of 10–25 µg ml⁻¹, and subsequent rectal doses of approximately 20 mg kg⁻¹ 6 hourly are needed for maintenance. Oral paracetamol premedication is useful in establishing a therapeutic plasma concentration in time for recovery. Total daily doses of paracetamol of approximately 90 mg kg⁻¹ day⁻¹ for up to 72 h can probably be used in healthy children who are relatively resistant to paracetamol hepatotoxicity.^{1–3 49 59} This should be reduced in neonates to 60 mg kg⁻¹ day⁻¹. Paracetamol–codeine combinations can also be very effective. I.v. pro-paracetamol has been investigated in children and is commonly used in some European centres.^{4 34}

Chronic pain

Long-term pain is managed by techniques similar to those used in adult practice but clinics for paediatric patients have been slow to emerge in the UK. Thorough assessment of child and family, use of a pain diary, formulation of a pain management plan, regular reassessment of analgesic efficacy and adverse effects, and review of the coping abilities of child and family are vital for success.^{18 19 30 66} The emotional component of pain must be addressed and specialist psychological and psychiatric involvement sought at an early stage.^{66 81} The principles and practical advice are well summarized in the recent Royal College of Paediatrics and Child Health manual.⁷¹

Conclusions

Most paediatric pain can be prevented and controlled by safe and effective simple measures. Local anaesthesia should be used in every case unless there is a specific reason not to do so. A multimodal approach to analgesia works best. Titration of analgesia based on the results of regular

reassessment of analgesia and adverse effects is safe and effective. Coordination of analgesic management by multidisciplinary pain teams is the best way to advance the cause of ensuring comprehensive provision of safe pain control for all children.

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