
Paediatric Acute Pain Management Handbook

Waikato Hospital
Department of Anaesthesia

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Disclaimer:

This material is designed as a guide only for the care of paediatric patients at Waikato Hospital. It does not replace decisions tailored to individual patients by the clinicians responsible for their care. No responsibility is taken for factual errors.

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1. INTRODUCTION

The purpose of this handbook is to assist with the education of hospital staff in the commonly available methods of acute pain relief at Waikato Hospital.

It is intended to be a guide which medical and nursing staff can refer to when prescribing and managing pain relief in children.

It is not intended to be exhaustive or to restrict the way individuals practice, but children admitted to hospital may benefit from a more co-ordinated approach to pain management.

Referrals and advice:

The Department of Anaesthesia provides a Paediatric Acute Pain Management Service (PAPS) which is involved in the treatment of all types of acute pain. For in-hours consultation, refer to the 'Amion Rostering' page on the intranet (Look on the Anaesthetics roster for 'Paed Pain'). If this is unsuccessful, phone the Duty Anaesthetist (23322), who will direct you to the Paediatric Anaesthetist covering pain for the week. The Anaesthetist is likely to be working in a theatre, but bearing this in mind they will respond to phone calls as soon as possible. For out-of-hours problems, phone the Anaesthetic Registrar covering Obstetrics (23470) who will consult with the on-call Paediatric Anaesthetist if unable to resolve the problem.

Referrals from within the Department of Anaesthesia:

When referring children to the PAPS, it would be appreciated if the Anaesthetist could please:

- In-hours – phone the Paediatric Anaesthetist covering pain for the week
- Out-of-hours – phone the on-call Paediatric Anaesthetist at a reasonable hour
- Place a patient sticker in the PAPS book (Red A4) found in Level 2 PACU (document the procedure, type of pain relief and ward)
- **Please DO NOT fill out an Adult Pain Referral form**

2. PRINCIPLES OF ANALGESIC ADMINISTRATION IN CHILDREN

There are some major differences between paediatric pain relief and adult pain relief, and this may not be readily appreciated by medical and nursing staff who rotate from adult areas.

Some general principles apply in children:

- Paediatric analgesia needs to be calculated on a mg/kg basis and these dosages need to be rounded off to make volume calculations easy.
- **Children do not like intramuscular (IM) injections and they should not be used unless special circumstances exist.** IM injections are unpredictable, largely ineffective and many children will deny having pain to avoid injections. Intravenous, oral and rectal are the preferred routes of administration.
- Techniques such as opioid infusions, Nurse Controlled Analgesia (NCA), Patient Controlled Analgesia (PCA), epidural infusions, regional infusions and Entonox are freely available and should be used if indicated.
- Following the administration of oral, subcutaneous (or IM) opioids, 60 minutes should elapse before starting opioid infusions, NCA, PCA, or epidurals. **No other opioids or sedatives should be given while using these techniques unless ordered by PAPS.**
- Pain is best treated with continuous methods of analgesic administration (e.g. infusions or PCA). Mild pain can usually be adequately controlled with intermittent bolus dose administration.
- Neonates and some ex-premature infants (up to 60 weeks post-conceptual age) may be sensitive to opioids. If they require opioid analgesics then the method and doses should be discussed with the Consultant involved.
- When faced with unusually high or increasing requirements of pain relief think of alternative causes of pain (e.g. compartment syndrome, pressure necrosis or other surgical complications).
- Hospital approved protocols are available for all the common methods and are included in this handbook.

3. MANAGING PAIN USING SIMPLE AND ORAL ANALGESICS

3.1 Paracetamol

Paracetamol is an analgesic suitable for mild pain or in conjunction with other analgesics for more severe pain. Its mechanism of action is not clear. Paracetamol's main strength is its excellent side effect profile, with serious complications being very rare despite extensive worldwide use over a long period of time.

Liver damage from Paracetamol is a very rare problem despite its widespread use. Risk factors include, prolonged fasting, febrile illness, use of P450 inducing drugs (eg isoniazid) and probably most importantly a unique genetic predisposition. If children are considered at risk, consideration should be given to decreasing the dose of Paracetamol if given for more than 1-2 days. Dosing limits will always be controversial.

Preparations: Tablets (500mg)
Syrup (120mg/5ml and 250mg/5ml)
Suppositories (50, 125, 250, and 500mg)
Intravenous (Perfalgan 1000mg/100ml)

Dosage:

Oral:

Neonates 32 weeks – 44 weeks	10mg/kg 6hrly prn	- max 40mg/kg/day
Neonates 44 weeks – 6 months	15mg/kg 6hrly prn	- max 60mg/kg/day
> 6 months old	15mg/kg 4-6hrly prn	- max 60-90mg/kg/day

- In neonates a single loading dose of 20mg/kg may be given if the neonatologist is in agreement (paracetamol has a large volume of distribution in neonates)
- Anaesthetist may chart 120 mg/kg/day for a short time period in selected patients
- Review Paracetamol dose after 48 hours
- Suggestions for extended use:
 - After 8 days: reduce dose to max 45mg/kg/day
 - After 14 days: reduce dose to max 30mg/kg/day

Rectal:

- Absorption is slow and variable – the oral route should be used when possible
- Max daily dose is same as oral route

Intravenous (Perfalgan):

Neonates 32 weeks – 44 weeks	7.5mg/kg 6hrly prn	- max 30mg/kg/day
Neonates 44 weeks – 3 months	10mg/kg 6hrly prn	- max 40mg/kg/day
> 3 months old	15mg/kg 6hrly prn	- max 60mg/kg/day

- Chart only for 2 days then review
- Convert to oral as soon as possible

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- IV Paracetamol may be considered in patients unable to take or absorb oral Paracetamol. Following major surgery it provides better analgesia and opioid sparing effect than rectal Paracetamol which has slow, poor and very variable absorption

3.2 Diclofenac (Voltaren)

Diclofenac is an NSAID that has a low dose suppository preparation that is licensed for use in children more than 1 year of age. Caution is required in patients with hypovolaemia, renal dysfunction, coagulopathy, GI bleeding, aminoglycosides and in the immediate post-operative period.

Preparation: Tablets (25, 50mg, and 75SRmg)
 Suppository (12.5, 25, 50mg)

Dosage: 0.5-1.0mg/kg 12 hourly prn

3.3 Ibuprofen (Brufen)

Ibuprofen is an NSAID that has a syrup preparation and can be used in children older than 6 months. NSAIDs differ in their nociceptive, anti-inflammatory and side effect profiles. Ibuprofen has been well validated as an analgesic. The usual cautions apply in patients with hypovolaemia, renal dysfunction, coagulopathy, GI bleeding, aminoglycosides and the immediate post-operative period.

Preparation: Syrup (100mg/5ml)
 Tablets (200, 400mg)

Dosage: 5-10mg/kg 6 hourly prn (max 40mg/kg/day)

Ibuprofen is an NSAID that is available as a syrup or tablet. It has been well validated as an analgesic in children. Studies show a safety profile that is at least as good as paracetamol when used in patients as young as 3 months old. Some centres are using Ibuprofen down to 1 month of age, however this cannot be recommended at this time. (There is also limited safety data from studies looking at its use for patent ductus arteriosus closure in premature neonates - 7% of neonates had renal impairment which was completely reversible).

There are some developmental concerns when using Ibuprofen in young babies. Like all NSAIDs, Ibuprofen disrupts prostaglandin production, and prostaglandins are involved in regulation of cerebral and renal blood flow, non-REM sleep and ductus arteriosus closure. In addition, it should be remembered that renal maturity is not reached until 6-12 months. There are also other pharmacokinetic differences in infants which are complex and may affect dosing.

NSAIDs precautions for all children include: hypovolaemia, renal dysfunction, coagulopathy, jaundice, GI bleeding, aminoglycosides and the immediate post-operative period. Most asthmatic children tolerate NSAIDs well, but caution should be exercised in older children with severe asthma and nasal polyp disease, where the rate of severe exacerbation may be as high as 30%.

Preparation: Suspension (100 mg/5 ml)
 Tablets (200 mg, 400 mg)

Dosage:

3-6 months 5mg/kg 8-12 hourly prn (may use 10mg/kg loading dose)
>6 months old 5-10mg/kg 6-8 hourly prn

- Review Ibuprofen dose after 3 days and for consider reducing dose to 5mg/kg

3.4 Parecoxib (Dynastat)

Parecoxib is an NSAID that specifically inhibits the enzyme cyclooxygenase-2 (COX 2). Paediatric trial data is very limited. It is given intravenously, and in adults, it has been shown to be as effective or more effective than the older NSAIDs for treatment of acute pain. It is opioid sparing and associated with less post-operative nausea and vomiting post tonsillectomy. Advantages of parecoxib over other NSAIDs are that it does not impair platelet function, and gastrointestinal ulceration is less likely. In addition, the ability to give the drug intravenously means a more reliable NSAID dose (ie 100% bioavailability in children with an IV cannula in place), compared with traditional perioperative rectal NSAID, or where oral dosing is inappropriate. Parecoxib is not licensed for use in children. However, it may on occasion be a useful analgesic in the paediatric setting. It should only be charted by PAPS.

The adverse effects of intravenous Parecoxib in adult clinical trials are similar to those for NSAIDs, with serious adverse effects such as acute renal failure, Stevens-Johnson syndrome, and hypersensitivity reactions including anaphylaxis and angioedema occurring at low incidence. The usual cautions apply in patients with hypovolaemia, renal dysfunction, coagulopathy and GI bleeding.

Contraindications:

- Sulphur allergy
- Severe hepatic impairment
- Concurrent use of another NSAID

Cautions:

- Allergic like reactions with NSAIDs/ aspirin
 - According to adult data, COX-2 inhibitors are considered safe in *most* of these patients, but a small percentage have cross-sensitivity, so an oral challenge under medical supervision is advisable
 - Considered safe in paediatric patients with NSAID exacerbated respiratory disease

Preparations: Intravenous (Dynastat)

Dosage: 2 yrs and older (no studies looking at safety in younger age to date)
1 mg/kg (max 40mg) once daily IV

- Chart only for 2 days then review
- Convert to oral as soon as possible

3.3 Celecoxib

Celecoxib is a COX 2 inhibitor – it is an NSAID that selectively inhibits the enzyme cyclooxygenase-2 (COX 2). Being a selective inhibitor it has the same advantages as Parecoxib, except that Celecoxib is an oral drug. Paediatric trial data is very limited.

Contraindications: See Parecoxib above

Cautions: See Parecoxib above

Preparation: Capsule (100mg, 200mg)
Solution (10mg/ml – disperse 100mg capsule in 10ml water)

Dosage: 12 months and older
4 mg/kg (max 200mg per dose) BD prn

3.5 Tramadol

Tramadol is used for treatment of moderate to severe pain. Its action is by both opioid and non-opioid monoaminergic mechanisms (serotonergic, noradrenergic), and it may also have some local anaesthetic action on peripheral nerves. It may be given orally and IV, although both PR and IM preparations have also been used. Advantages over opioids such as Morphine may include less sedation, less respiratory depression and less constipation. Tramadol may not be as suitable as opioids for more severe pain.

In New Zealand Tramadol is currently licensed for use in children aged 2 years and older. However, it has been used internationally for many years in children as young as newborn.

The risks and benefits of Tramadol use in early life are not straightforward – there are a number of important considerations. Both Tramadol and its M1 metabolite (formed by CYP2D6 liver enzyme) are active and provide analgesia via different pathways. Tramadol parent drug causes sedation (but does not cause respiratory depression), however the M1 metabolite has is a μ opioid agonist (200 x more receptor affinity than Tramadol itself) and may cause both sedation and respiratory depression.

At term, the newborn's CYP2D6 activity is still immature and the ability to convert Tramadol to M1 is 50% compared to adult levels. The newborn's ability to renally excrete M1 is also reduced, and is 70% compared to adults. However, as a result of the slow maturation of CYP2D6, the plasma concentrations of M1 are low until infants are 3 months old – at this point in time the immature renal elimination becomes relevant and higher M1 levels may occur. Renal excretion and M1 clearance reaches 90% adult levels by age 1 year.

In addition, it must be remembered that the descending pain tracts in the neonate may not be functionally mature, hence the serotonergic/ noradrenergic advantages of the drug over conventional opioids may not apply, with μ agonism predominating.

In 2017 in the United States, the FDA started restricting the use of both Tramadol and codeine in children, after identifying cases involving serious breathing problems and death. Among other groups, their restrictions and warnings have included: children with obesity, sleep disordered breathing, and other breathing problems, post-tonsillectomy and breast feeding mothers.

In response to this, SPANZA (the Society of Paediatric Anaesthesia of New Zealand and

Australia) put out two statements in 2017 regarding Tramadol use. Genetic variation in CYP2D6 exists and ultra-rapid metabolisers may be more at risk in certain situations, although this is less certain with Tramadol than with Codeine. Readers are directed to these statements in the references; their content is acknowledged in the cautions/ dosage recommendations below.

Key points:

Tramadol is safer than opioids in breast feeding mothers
Tramadol doses should be limited for acute pain after tonsillectomy
Children with obstructive sleep apnea who have undergone tonsillectomy should be observed overnight to assess response and sensitivity to opioids

SPANZA Advisory on Tramadol - Use during breast feeding and the neonate
SPANZA Advisory on Tramadol - Warning on tramadol use in children

Caution must be used with certain “at risk” patients:

- Day surgery patients
- Post-tonsillectomy patients
- Patients with obstructive sleep apnoea or obesity or severe lung disease
- Patients with severe hepatic and renal impairment
- Patients susceptible to seizures
- Patients on psychotropic medication (SSRI)

Side effects:

- Nausea and vomiting – around 10% of children
- Dizziness
- Sedation
- Respiratory depression (rare)

Preparation: Tablets (50mg, and 100SRmg)
 Oral solution (10mg/ml)
 Intravenous (50mg/ml)

Drops 100 mg/ml delisted in NZ during 2017 after several unintentional overdoses worldwide

Dosage: 1.5-2mg/kg 6 hourly prn PO
 1-2mg/kg 4-6 hourly prn IV in general population (up to 400 mg daily)
 0.5-1 mg/kg 6-8 hourly prn IV/PO in post tonsillectomy/at risk patients

Note that Tramadol and Ondansetron may decrease each other's efficacy to a mild degree.

3.6 Oral Morphine Preparations

Oral Morphine is widely used and highly effective for acute and chronic severe pain but requires a functional gastrointestinal tract. It has a low bioavailability (30-40%) and thus requires higher doses than parenteral Morphine. All oral opioid prescriptions should be for limited duration. Monitoring of patients is required following doses of oral opioids. (See Section 9 of the Handbook)

Morphine Elixir

Indicated for children unable to swallow tablets.

Preparation: Syrup (1mg/ml only)

Dosage: 0.3mg/kg 4 hourly prn

Morphine Tabs – Immediate Release (Sevredol)

Indicated for children that are comfortable with swallowing tablets.

Preparation: Tablets (10, 20mg)

Dose: 0.1-0.3mg/kg 2-4 hourly prn

Morphine Tabs – Controlled Release (LA Morph)

Indicated for children that are able to swallow tablets that have prolonged severe opioid responsive pain e.g. cancer pain or post-operative pain. **Once swallowed LA Morph is like an infusion that cannot be stopped!**

Preparation: Tablets (10, 30, 60 & 100mg)

Dose: Calculate the amount of parenteral Morphine used in the previous 24 hrs, then chart this orally as a divided dose (BD).

Eg, if the patient used 60mg of IV Morphine in the previous 24hrs then chart LA Morph (controlled release morphine) 30mg BD.

Observations:

Following doses of oral controlled release Morphine, monitoring must continue until 12 hours after last dose administered.

See Section 9 of the Handbook.

Whenever prescribing slow release preparations, it is useful to prescribe an immediate release opioid on a PRN basis for “break-through pain”. This dose is usually equal to 10% of the daily Morphine requirement.

3.7 Oxycodone

Oxycodone is a semi-synthetic opioid, useful for treatment of moderate to severe pain. The analgesic effects of Oxycodone are similar to Morphine, though in adults it is said to have a more rapid onset and longer duration. Both drugs, Morphine and Oxycodone, cause typical opioid side-effects but several reports suggest that hallucinations may be

less frequent with Oxycodone. Oxycodone releases significantly less histamine than Morphine. Oxycodone syrup is not as bitter/ unpleasant tasting as Morphine elixir. Oxycodone has a good oral bioavailability (80%; compared to Morphine 25% and Codeine 50-60%). Oxycodone is eliminated more slowly ($t_{1/2}$ 3 hrs) than Morphine. Metabolism of Oxycodone does not produce significant levels of active metabolites, however clearance of Oxycodone may be reduced in renal and hepatic impairment. In renal failure clearance is reduced, with a resultant increase in half-life ($t_{1/2}$ 3.9 hrs in uraemic patients). In liver failure changes in clearance and half-life are more marked. Oxycodone like Morphine comes in both immediate release (Oxynorm/ Endone) and controlled release (Oxycontin) preparations – **it is important that the two preparations are not confused.**

Oxycodone – Immediate Release (Oxynorm, Endone)

Preparation: Syrup (5mg/5ml)
Tablets (5, 10, 20mg)

Dose: 1-12months 0.05-0.1 mg/kg 4 hourly prn
>12months 0.1-0.25mg/kg 4 hourly prn

Suggested uses:

Inpatients - Oxycodone is a useful analgesic for acute post-operative pain and may be used as an alternative to codeine and for 'stepping down' from intravenous opioids.

Day-stay surgery - Oxycodone may be useful in infants and children who have moderate to severe pain and who are likely to need only one dose of oral opioids (it should not be dispensed for "out of hospital use" following day surgery). Typically:

- Hypospadias repair
- Tonsillectomy

Converting to Oxycodone		
Total mg/ day Oxycodone = Total mg/ day of Previous Opioid x <i>f</i>		
Previous Opioid	Conversion factor (<i>f</i>)	
	Intravenous	Oral
Morphine	2	0.5
Fentanyl	100	NA
Codeine	NA	0.1
Tramadol	0.2	0.2
Methadone	2	1.3

Eg, if the patient used 60mg of IV Morphine in the previous 24hrs then chart Total of 120mg/ day of Oxycodone ie, $60 \times (f = 2) = 120$. This could be charted as Oxycodone (immediate release) 20mg 4 hourly prn, orally.

Oxycodone	Codeine
Parent drug is active – all patients receive analgesia. Metabolised by CYP3A4 and to lesser extent CYP2D6. Unclear how much CYP2D6 polymorphism affects pharmacokinetics.	Prodrug (must be metabolised to morphine in order to provide analgesia) – not all patients are able to this. Metabolised by CYP2D6, which is polymorphic – some patients (5-10% Caucasians) poor/ no activity therefore limited analgesia, while some have increased activity and therefore increased morphine levels.
Duration action 3-4 hrs	Duration action 3-4 hrs
Onset action 45 mins	Onset action 1 hr
Oral bioavailability 70-80% (cf morphine 25%)	Oral bioavailability 50-60%
Lower incidence of hallucinations than other opioids; kappa action may provide good visceral analgesia	Higher incidence of nausea and vomiting than other opioids

3.8 Codeine Phosphate

Codeine is no longer a routine analgesic – numerous health agencies make warnings about its use in children, and it is very rarely used by PAPS.

Codeine is a partial opioid agonist which is most effective when given with Paracetamol. Codeine is a pro-drug with variable metabolism (5-15%) to morphine. Some ultra-rapid metabolisers will achieve higher than average levels of morphine (which has resulted in mortality and morbidity), while at the other extreme 5-10% of Caucasian patients are unable to metabolise codeine to its active form i.e. it will not work.

Preparations: Tablets (30mg)
Syrup (5mg/5ml)

Dosage: 0.5-1.0mg/kg 4 hourly prn

4. MANAGING PAIN USING PARENTERAL ANALGESICS

4.1 Protocol for Intermittent IV Opioids

Introduction:

This technique of analgesia is suitable for minor surgery where there is a need for short term intravenous analgesic therapy. This is prescribed by medical staff. Administration is by medical staff or by nursing staff in PACU or PICU.

Prescription:

This is prescribed on the Inpatient Medication Chart.

Protocol:

Morphine 0.025mg/kg IV every 5 minutes until comfortable.

If the patient is in moderate or severe pain, this dose can be given over 5 minutes directly into the IV port of a running drip and the patient observed closely for the next 15 minutes. Alternatively if the need is less urgent then the dose should be given in the burette to be infused.

For patients unable to tolerate Morphine contact PAPS (Fentanyl or Oxycodone may be used).

Observations:

See Section 9 of the Handbook.

4.2 Protocol for Intravenous Opioid Infusions

Introduction:

Infusions of Morphine or Fentanyl can provide continuous analgesia without the “ups and downs” of intermittent bolus administration. They are suitable for children of any age particularly those who are unsuitable for patient controlled analgesia. Additional prescribed bolus doses may be required to cover additional “incident” pain which occurs during movement or when the patient is subjected to painful procedures. Intravenous infusions need close observation as the patient is always receiving the drug and accumulations may occur.

Prescription:

Opioid infusion orders are prescribed on the PAPS Prescription Form by the Department of Anaesthesia only. Syringe changes are recorded in the Drug Administration Record of the PAPS Prescription Form.

Protocol:

Use CADD Solis pump

Mix drug into 50ml bag of Normal Saline or Dextrose 5%

An anti-reflux valve is necessary with all intravenous Opioid Infusions

Morphine Infusion	INITIAL PROGRAMMING	
Solution	0.5mg/kg into 50mls	(1ml = 10mcg/kg)
Background Infusion	0-4ml/hr	(0-40mcg/kg/hr)

Fentanyl Infusion	INITIAL PROGRAMMING	
Solution	20mcg/kg into 50mls	(1ml = 0.4mcg/kg)
Background Infusion	0-4ml/hr	(0-1.6mcg/kg/hr)

These are the recommended infusion regimes and may be varied at the discretion of the Anaesthetic Staff according to the individual patient's needs.

Children younger than 3 months:

- **Infusion rates and boluses should be halved i.e. 0-2.0ml/hr**

Their metabolic pathways may be very immature, (especially preterm infants) and of major concern is the risk of opioid induced respiratory depression. The method of analgesia must be discussed with senior medical staff.

Managing IV infusions:

Prior to commencing the infusion the patient should be titrated to comfort by a doctor with intravenous boluses of the same opioid. Infusions should be started at 2.0ml/hr (syringe pump) and can then be varied at the discretion of the ward nursing staff according to the degree of analgesia or sedation of the patient (within the prescribed limits).

Bolus doses with opioid infusions:

Morphine: 10-20 mcg/kg (1-2mls of solution) at intervals no less than 10mins
Fentanyl: 0.4 mcg/kg (1ml of solution) at intervals no less than 5mins

Bolus doses can be given in two situations:

- If pain relief is inadequate, a prescribed bolus dose should be administered followed by an increasing infusion rate by 1ml/hr
- To cover anticipated "incident pain" (e.g. pulling out drain, physiotherapy movement, procedures, dressings etc) we suggest that a bolus dose be given 10-15 minutes prior to the anticipated painful procedure

Before bolus doses are given:

- Exclude alternative causes of pain eg, urinary retention, compartment syndrome
- The patient should be awake and coherent

Observations:

See Section 9 of the Handbook.

Observations must be recorded on the Paediatric Pain Recording Chart.
Children < 6 months old must have continuous oximetry.

Problems:

See Section 8 of the Handbook or refer to PAPS Prescription Form (Trouble shooting guidelines).

4.3 Protocol for Nurse Controlled Analgesia (NCA)

Introduction:

If a child receiving an opioid infusion is in pain, the only adjustment the nurses may make is to increase the rate of infusion within the prescribed range. Pharmacokinetically what the child needs is a bolus dose, but in order to give this medical staff have to be involved. NCA takes the equipment and principals of PCA and puts the control in the hands of the nurses. NCA allows continuous low dose background infusion and intermittent boluses at specified intervals. The patient is protected from over dose by routine monitoring, a longer lockout interval and the principal of assess-intervene-reassess. There is no place for a parent or guardian to press the button.

NCA is appropriate for the control of pain in infants, pre-verbal children and children that cannot use a PCA. It is useful for moderate to severe pain that has a significant incident/movement component.

Prescription:

NCA orders are prescribed on the PAPS Prescription Form by the Department of Anaesthesia only. Syringe changes are recorded in the Drug Administration Record of the PAPS Prescription Form.

Protocol:

Use CADD Solis pump
Mix drug into 50ml bag of Normal Saline or Dextrose 5%
An anti-reflux valve is necessary with all intravenous NCA

Morphine NCA	INITIAL PROGRAMMING	
Solution	0.5mg/kg into 50mls	(1ml = 10mcg/kg)
Bolus Dose	1-2ml	(10-20mcg/kg)
Lockout	10-30mins	
Background Infusion	0-2ml/hr	(0-20mcg/kg/hr)
Hourly Dose Limit	8ml	(80mcg/kg)

Fentanyl NCA	INITIAL PROGRAMMING	
Solution	20mcg/kg into 50mls	(1ml = 0.4mcg/kg)
Bolus Dose	1-2ml	(0.4-0.8mcg/kg)
Lockout	10-30mins	
Background Infusion	0-2ml/hr	(0-0.8mcg/kg/hr)
Hourly Dose Limit	8ml	(3.2mcg/kg)

In children weighing close to 50 kg it is suggested you use the 'Adolescent protocol' which uses the 'Adult' 100ml premix bags (Morpine 100mg in 100mls, or Fentanyl 1000mcg in 100mls).

Observations:

See Section 9 of the Handbook.

Observations must be recorded on the Paediatric Pain Recording Chart.

Children < 6 months old must have continuous oximetry.

Problems:

See Section 8 of the Handbook or refer to PAPS Prescription Form (Trouble shooting guidelines).

4.4 Protocol for Patient Controlled Analgesia (PCA)

Introduction:

PCA is a technique of managing acute pain which utilises a programmable syringe-pump to allow patients to self-administer their own intravenous opioid analgesics. It can be used by any child who is able to understand the concept of pressing a button when it hurts. Pre-operative education is very worthwhile.

Prescription of PCA:

PCA orders are prescribed on the PAPS Prescription Form by the Department of Anaesthesia only. Syringe changes are recorded in the Drug Administration Record of the PAPS Prescription Form.

Protocol:

Use CADD Solis pump

Mix drug into 50ml bag of Normal Saline or Dextrose 5%

An anti-reflux valve is necessary with all intravenous PCA

Morphine PCA	INITIAL PROGRAMMING	
Solution	0.5mg/kg into 50mls	(1ml = 10mcg/kg)
Bolus Dose	1-2ml	(10-20mcg/kg)
Lockout	5-10mins	
Background Infusion	0-1ml/hr	(0-10mcg/kg/hr)
Hourly Dose Limit	10ml	(100mcg/kg)

Fentanyl PCA	INITIAL PROGRAMMING	
Solution	20mcg/kg into 50mls	(1ml = 0.4mcg/kg)
Bolus Dose	1ml	(0.4mcg/kg)
Lockout	5mins	
Background Infusion	0.5ml/hr	(0.2mcg/kg/hr)
Hourly Dose Limit	10ml	(4mcg/kg)

Morphine is usually the first choice – Fentanyl is used for patients who are unable to tolerate Morphine or have renal impairment.

Observations:

See Section 9 of the Handbook.

Observations must be recorded on the Paediatric Pain Recording Chart.

Problems:

See Section 8 of the Handbook or refer to PAPS Prescription Form (Trouble shooting guidelines).

Adolescent PCA:

In children weighing close to 50 kg it is suggested you use the 'Adolescent protocol' which uses the 'Adult' 100ml premix bags (Morphine 100mg in 100mls, or Fentanyl 1000mcg in 100mls).

4.5 Protocol for Subcutaneous Morphine Boluses

Introduction:

This is ideally avoided because of the irritant nature of subcutaneous (SC) Morphine, but it may be useful for post-operative pain of short duration in the older child. A narrow gauge plastic cannula can be left in position usually just below the clavicle, obviating the need for repeated skin puncture. Morphine is the drug of choice because:

- It has longer duration of action than Pethidine
- It is not irritant and hence not as painful as Pethidine
- It is available in a more concentrated solution than Pethidine and hence a smaller volume can be given for the same effect

In the shocked patient the absorption from the SC (and IM) site is erratic and this form of analgesia should not be used. Because it is necessary to prime the line with Morphine prior to the first injection, it is important to use Morphine of the same concentrations for all injections.

Prescription:

This is prescribed on the Inpatient Medication Chart.

Dosage:

Morphine 0.1mg/kg SC 1-2 hourly prn

Equipment:

- 24g BD Saf-T-Intima cannula
- Alcohol swabs
- Small transparent dressing e.g. Opsite, Tegaderm

Insertion of SC cannula: (may already be in situ from theatre)

- Prime the infusion line with Morphine (concentration 10mg/ml)
- Clean the site in the subclavicular region thoroughly with alcohol swab
- Insert the cannula through the skin at shallow angle. It is best to pinch up a fold of skin to do this
- Cover with the transparent dressing
- All patients should have IV access

Injection procedures:

- Check the drug order for the dose of Morphine (0.1 mg/kg or less)
- Draw the appropriate dose of Morphine into a 1ml syringe. **Do not dilute**
- Wipe the bung with an alcohol swab and then inject. The slower the rate of injection the less discomfort the patient experiences (give over 1-2 minutes)
- **Do not flush** the cannula either before or after the injection

Observations:

See Section 9 of the Handbook.

Observations must be recorded on the Paediatric Pain Recording Chart.

Problems:

See Section 8 of the Handbook or refer to PAPS Prescription Form (Trouble shooting guidelines).

5. MANAGING PAIN USING EPIDURALS

Introduction:

Mixtures of diluted local anaesthetic (LA) and opioids infused into the epidural space can provide virtually complete analgesia for selected procedures, especially in patients with compromised or potentially compromised respiratory function. Epidural catheters can be placed either via the thoracic, lumbar, caudal or trans-sacral routes. The catheter is inserted by the Anaesthetist at the time of surgery.

Advantages:

- Almost complete pain relief
- Reduced analgesic requirement
- Less sedation/ opioid side effects
- Suitable for all age groups

Disadvantages:

- Requires epidural catheter
- No patient participation
- Urinary retention and pruritus may increase

Contraindications:

- Head injury/raised ICP
- Coagulopathy
- Local or systemic infection
- Progressive neurological deficit
- Patient/parent refusal

Local anaesthetic pharmacokinetics in children:

Children are more at risk of local anaesthetic toxicity than adults for a number of reasons:

- Reduced intrinsic clearance. Local anaesthetics are metabolized by cytochrome P450 – lignocaine and bupivacaine mainly CYP3A4, and Ropivacaine by CYP1A2. These enzymes are immature in early life – at 1 month of age the clearance of bupivacaine is one-third of that of adults, and 2-thirds at 6 months, and the clearance of Ropivacaine is not mature until 8 years of age.
- Faster vascular absorption. Children have higher cardiac outputs than adults, which results in faster vascular absorption from vascular tissue. This produces higher initial plasma concentrations and decreased durations of action.
- Reduced protein binding. Alpha-1 acid glycoprotein is the major protein that binds LAs – levels are very low at birth and rise throughout the first year of life.

Toxicity Summary

Children < 2 years – higher risk of cardiac toxicity due to higher baseline heart rates

Children < 1 year – even higher risk of systemic toxicity due to decreased protein binding

Children < 6 months – even higher risk of systemic toxicity due to immature liver enzymes

- Risk of high plasma drug conc is increased with infusions or repeated injections
- Risk of high plasma drug conc somewhat lessened following single injection
 - Volumes of distribution of LAs in neonates and infants are larger than adults

Spinal anaesthesia duration is shorter in infants than in adults (most noticeable in preterm infants). Reasons:

- larger volume of cerebrospinal fluid (CSF)
- faster drug uptake from CSF – infants have a greater blood flow to the spinal cord.

Drugs:

Local Anaesthetics:

Bupivacaine (racemic) has historically been the most popular epidural LA. Ropivacaine is a newer LA. It is a single stereoisomer amino amide agent which, in adults, is thought to produce less motor blockade and be less cardiotoxic than standard Bupivacaine

There still remains very little high quality evidence on what doses of local anaesthetic may be safely used in paediatric practice. Dosages recommended by the ESRA and ASRA Joint Committee (2018) are:

0.1-0.3 mg/kg/hr (Bupivacaine or Ropivacaine)

Multicentre studies show a large variation in dosages used by practitioners and the above is a guideline only. As new evidence becomes available this guideline may need to be updated.

Additives:

Other drugs may be used in the epidural infusion to supplement the LA.

Fentanyl:

- Opioid commonly used to supplement epidural LA analgesia
- At high doses sedation and respiratory depression may occur

Clonidine:

- Partial agonist at alpha 2 receptors
- Sedative, analgesic and antihypertensive properties
- Affects conduction in peripheral nociceptive nerves
- Used for supplementing epidurals/ regional blocks and as a premedication
- Side effects include sedation and hypotension

Prescription:

Epidural orders are prescribed on the PAPS Prescription Form by the Department of Anaesthesia only. Bag changes are recorded on the Drug Administration Record of the PAPS Prescription Form.

Epidural Infusions Protocol:

Use CADD Solis pump

Mix drug into 50ml bag

Infusions can be managed within the prescribed rates by certificated Nursing Staff according to patient comfort.

Drugs:

Bupivacaine 0.1% is standard

- Mix 20mls of 0.25% Bupivacaine (50mg) and 100 mcg of Fentanyl (2mls) and 28mls of Normal Saline to total volume of 50mls
- In order to avoid LA toxicity maximum doses must not be exceeded
- Think in mg/kg not ml/kg
- Bupivacaine 0.1% = 1mg/ml

Age	Max Infusion		Duration
< 6 months	0.2mg/kg/hr	0-0.2ml/kg/hr	24-36hrs
> 6 months	0.4mg/kg/hr	0-0.4ml/kg/hr	36-48hrs

Suggested initial setting range 0-0.3 ml/kg/hr for children > 6 months
(Maximum rate not to exceed 15 ml/hr)

Fentanyl:

- May be added to epidural infusions to improve the quality of analgesia
- May cause sedation
- Added to Bupivacaine 0.1% to give concentration of Fentanyl 1-2 mcg/ml
- Suggest reduced to Fentanyl 0-1 mcg/ml in children < 6 months old

Clonidine:

- May be added to epidural infusions to improve the quality of analgesia without increasing the side-effects of epidural opioids (itching, nausea/ vomiting, respiratory depression)
- May be useful in postoperative spasticity (eg, cerebral palsy)
- May cause sedation
- Use preservative free solution (eg, Catapres150 mcg/ml)
- Added to Bupivacaine 0.1% to give concentration of Clonidine 0.5-1 mcg/ml
- This would result in the following doses of Clonidine
 - Conc 0.5 mcg/ml 0.1-0.3ml/kg/hr -> 0.05-0.15mcg/kg/hr
 - Conc 1 mcg/ml 0.1-0.3ml/kg/hr -> 0.1-0.3mcg/kg/hr
- Literature suggests generally aiming for 0.12-0.16 mcg/kg/hr.
- Suggest reduced to Clonidine 0.5 mcg/ml in children < 6 months old

Epidural Boluses Protocol:

There may be occasions when there is inadequate analgesia while using an epidural infusion. A top-up bolus may improve the analgesia and should be considered before resorting to some other form of analgesia.

- Bolus orders are prescribed by the Department of Anaesthesia only.
 - **The size of the bolus (in mls) may be equal to the hourly rate (in mls).**
 - **The rate of the bolus is to be administered over 10 minutes.**
 - If this does not resolve the pain then a review of the pain management should be sought.
- Following a bolus, observations should be performed quarter hourly for one hour. See Section 9 of the Handbook.

Epidural Catheter Care and Removal:

The catheter should be secured with a combination of Tegaderm/ Opsite and Hypafix/ Slek tape or similar. If a catheter requires redressing the Department of Anaesthesia should be contacted. All children must have IV access.

The tubing from the syringe to the epidural catheter will incorporate an antibacterial filter. There are to be no 3-way taps or injection ports in this line. Antiseptic agents such as Chlorhexidine, Betadine or alcohol are not to come in contact with the epidural catheter or tubing as they are neurotoxic.

Important:

- **Before removing the catheter it is important to check that the patient is not coagulopathic or receiving anticoagulants (eg Heparin, Clexane, Fragmin, Warfarin or Clopidogrel)**
- Removal of the catheter is performed by certificated ward nursing staff
- The adhesive tapes and dressing are removed and the catheter is simply withdrawn
- It is important to confirm that the whole catheter has been removed intact. A Band-aid is optional.

Observations:

See Section 9 of the Handbook.

Observations must be recorded on the Paediatric Pain Recording Chart.

Following bolus administration quarter hourly observations should be done for one hour.

Problems:

See Section 8 of the Handbook or refer to PAPS Prescription Form (Trouble shooting guidelines).

6. MANAGING PAIN USING REGIONAL INFUSIONS

Introduction:

The introduction of ultrasound guided regional anaesthesia has seen an increase in the popularity of paediatric nerve blocks and fascial plane blocks. This is achieved by delivering local anaesthetic around major nerves or in fascial planes. An infusion catheter is usually sited when the patient is anaesthetised, and may be used for postoperative analgesia. These techniques not only help to reduce some of the stress response of surgery, but may also provide excellent analgesia with less systemic effects than may occur with opioid analgesia.

Common types of regional infusions:

Interpleural	catheter in the intrapleural space
Extrapleural	catheter external to the parietal pleura (usually across rib necks)
Paravertebral	catheter in the paravertebral space, next to the vertebral column
Brachial plexus	catheter in the perineural sheath around the brachial plexus
Femoral nerve	catheter in the perineural sheath around the femoral nerve
Sciatic nerve	catheter in the perineural sheath around the sciatic nerve

Paravertebral blocks may be used for surgery entailing unilateral incisions above T12 (eg thoracotomy, renal surgery, cholecystectomy). They may still be suitable in situations where epidurals are contraindicated (↑ICP, coagulopathy etc).

Local anaesthetic pharmacokinetics in children:

Children are more at risk of local anaesthetic toxicity than adults for a number of reasons:

- Reduced intrinsic clearance. Local anaesthetics are metabolized by cytochrome P450 – lignocaine and bupivacaine mainly CYP3A4, and Ropivacaine by CYP1A2. These enzymes are immature in early life – at 1 month of age the clearance of bupivacaine is one-third of that of adults, and 2-thirds at 6 months, and the clearance of Ropivacaine is not mature until 8 years of age.
- Faster vascular absorption. Children have higher cardiac outputs than adults, which results in faster vascular absorption from vascular tissue. This produces higher initial plasma concentrations and decreased durations of action.
- Reduced protein binding. Alpha-1 acid glycoprotein is the major protein that binds LAs – levels are very low at birth and rise throughout the first year of life.

Toxicity Summary

Children < 2 years – higher risk of cardiac toxicity due to higher baseline heart rates

Children < 1 year – even higher risk of systemic toxicity due to decreased protein binding

Children < 6 months – even higher risk of systemic toxicity due to immature liver enzymes

- Risk of high plasma drug conc is increased with infusions or repeated injections
- Risk of high plasma drug conc somewhat lessened following single injection
 - Volumes of distribution of LAs in neonates and infants are larger than adults

Drugs:

Bupivacaine (racemic) has historically been the most popular LA. Ropivacaine is a newer LA. It is a single stereoisomer amino amide agent which, in adults, is thought to produce less motor blockade and be less cardiotoxic than standard Bupivacaine.

There still remains very little high quality evidence on what doses of local anaesthetic may be safely used in paediatric practice. Dosages recommended by the ESRA and ASRA Joint Committee (2018) are:

0.1-0.3 mg/kg/hr (Bupivacaine or Ropivacaine)

Multicentre studies show a large variation in dosages used by practitioners and the above is a guideline only. As new evidence becomes available this guideline may need to be updated.

Prescription:

Regional infusions are prescribed on the PAPS Prescription Form by the Department of Anaesthesia only. Bag changes are recorded on the Drug Administration Record of the PAPS Prescription Form.

Regional Infusion Protocols:

Use CADD Solis pump

Mix drug into 50ml bag

Infusions can be managed within the prescribed rates by certificated ward Nursing Staff according to patient comfort.

Drugs:

Bupivacaine 0.125% is standard

- This is higher concentration than in epidural
- Mix 25mls of 0.25% Bupivacaine and 25mls of Normal Saline to total volume of 50mls
- In order to avoid LA toxicity maximum doses must not be exceeded
- Think in mg/kg not ml/kg
- Bupivacaine 0.125% = 1.25mg/ml

Age	Max Infusion		Duration
< 6 months	0.2mg/kg/hr	0.16ml/kg/hr	24-36hrs
> 6 months	0.4mg/kg/hr	0.32ml/kg/hr	36-48hrs

Suggested initial setting range 0-0.25 ml/kg/hr for children > 6 months
(Maximum rate not to exceed 5 ml/hr)

Infusion Catheter Care and Removal:

The tubing from the syringe to the infusion catheter will incorporate an antibacterial filter. There are to be no 3-way taps or injection ports in this line. Antiseptic agents such as Chlorhexidine, Betadine or alcohol are not to come in contact with the infusion catheter or tubing as they are neurotoxic.

Removal of the catheter is performed by certificated Nursing Staff. The adhesive tapes and dressing are removed and the catheter is simply withdrawn. It is important to confirm that the whole catheter has been removed intact. A Band-aid is optional.

Observations:

See Section 9 of the Handbook.

Observations must be recorded on the Paediatric Pain Recording Chart.

Following bolus administration quarter hourly observations should be done for one hour.

Problems:

See Section 8 of the Handbook or refer to PAPS Prescription Form (Trouble shooting guidelines).

7. MANAGING PAIN USING ENTONOX

Introduction:

Entonox is a 50% mixture of nitrous oxide and oxygen. It is an odourless, colourless gas which can provide potent short-term analgesia for painful procedures. It has a quick onset of action (30-60 seconds) and wears off almost as quickly. It is unsuitable for chronic, long-term administration because of the risk of bone-marrow toxicity.

Apparatus:

Entonox is self-administered via a demand-apparatus.

The apparatus consists of:

- A 4000 litre (size E) OR 1600 litre (size D) cylinder
- A small pressure (contents) gauge
- A reducing valve which reduces the pressure from the cylinder to one suitable for inhalation
- A demand valve which allows gas to flow only when the patient inhales from the face-mask or mouth-piece. For this to occur, the face-mask or mouth-piece must be well sealed and a characteristic sound is heard when the Entonox is being inhaled
- Black tubing leading to the face mask
- An expiratory valve near the face mask vents expired gas to the atmosphere
- New mask/mouthpiece and filter for each patient

Contraindications:

- Children aged <2 years
- Children unwilling or unable to use Entonox
- Intoxication with alcohol or other drugs
- Closed head injury or unconsciousness
- Airway obstruction or airway burns
- Pneumothorax (nitrous oxide diffuses into air filled cavities and expands them)
- Recent Eye/ ENT/ Maxillofacial surgery or injury
- Head injury, raised intracranial pressure or depressed level of consciousness
- Bowel obstruction
- Respiratory distress and hypoxia
- Decompression sickness and air embolism
- Haematologic illness

These contraindications may be relative, in which case, the Duty Anaesthetist should be consulted prior to the use of Entonox.

Side Effects:

- Sedation. If the child becomes sedated the seal around the mask or mouth-piece will be lost and the flow of Entonox will stop if the child has been holding the mask themselves. This mechanism is responsible for the inherent safety of Entonox
- Nausea will occasionally occur
- Bone marrow depression with prolonged use. Ward patients should be limited to no more than 1.5 hours administration per day. Children requiring Entonox for longer than 2 weeks should be prescribed folic acid 15mg orally daily

Administration of Entonox:

Entonox is prescribed on the Inpatient Prescription Sheet for ward patients. **The duration of administration is recorded and signed for with each use.**

For outpatients, Entonox is administered at the discretion of the attending nursing or medical staff but its use is recorded in the Outpatient Notes.

Where practical, the child should be fasted (food and fluids) for 2 hours prior to administration. **Entonox may be administered by any Registered Nurse or Medical Staff who have been trained in the safe administration of Entonox.**

Method of administration:

- Make sure there is a new mask/mouthpiece and filter for each patient.
- Ensure cylinder is upright.
- Turn the key to open the cylinder and check the contents of the cylinder. Change if < 5000 kPa.
- Explain how to use the Entonox and allow the child time to become familiar with the equipment and the noise it makes.
- Instruct the child how to hold the face-mask or mouth-piece to ensure a good fit. The child should self-administer Entonox wherever possible. If the child is unable to do so (eg. burns or fractured arms) then the nurse should provide assistance holding the mask and creating a seal. Verbal contact should be maintained with the patient and the mask should be removed temporarily should over sedation occur.
- Administration should commence several minutes prior to the painful procedure.
- The child continues to breathe normally from the apparatus. The noise indicates satisfactory delivery of Entonox. The expiratory valve should be observed for movement

8. MANAGING ADVERSE EFFECTS & TROUBLESHOOTING

8.1 LA Toxicity

Local anaesthetics (LA) achieve their clinical effect by reversibly blocking voltage-gated sodium channels. Blockade of small fibre afferents is responsible for analgesia while blockade of larger (myelinated) fibres can result in motor blockade. At toxic levels LA may interfere with nerve conduction in the central nervous system (CNS) and heart – again blockade of voltage-gated sodium channels is involved, although recently many alternative sites have also been considered.

LA toxicity can occur following drug overdose, intravascular injection or drug accumulation following infusion. Toxicity is related to the unbound fraction of the drug. Both neonates and acidotic patients are at increased risk of toxicity due to decreased protein binding of the drug. Neonates and infants have lower plasma levels of α_1 acid glycoprotein which is largely responsible for protein binding of the drug, and acidosis causes dissociation of the drug from protein binding.

LA toxicity is rare, but it can have catastrophic consequences. If plasma levels rise slowly the CNS is affected first. Symptoms are initially excitatory – circumoral and tongue paraesthesia, metallic taste, and dizziness, followed by slurred speech, diplopia, tinnitus, confusion, restlessness, muscle twitching and seizures. Higher plasma concentrations result in impaired cardiac conduction, arrhythmia and cardiac arrest. Cardiac arrest due to local anaesthetic toxicity is notoriously refractory to standard resuscitation techniques.

8.1.1 Management of Impending LA Toxicity

Suspect local anaesthetic toxicity if:

- Recognised inadvertent overdose
- Symptoms of CNS toxicity
(circumoral paraesthesia, dizziness, disorientation, agitation or tremor)
- Seizure

- Stop LA infusion
- Give Oxygen
- Notify PAPS and Medical Staff – call Arrest Team if required
- Consider Lipid Emulsion (Intralipid 20%) infusion concurrently with management of symptoms

8.1.2 Cardiac Resuscitation in the Event of Suspected LA Toxicity

- Commence APLS according to current protocols
- Call Arrest Team
- Give IV Lipid Emulsion (Intralipid 20%) as soon as practical
 - 1ml/kg over 1 minute
 - Repeat if necessary every 3 minutes (up to 3ml/kg)
 - Follow with an infusion of 0.25ml/kg/min until haemodynamic stability (increase to 0.5ml/kg/min if hypotensive)

8.2 Management of Common Opioid Side-Effects

8.2.1 Management of Overdose

Opioid overdose may be suspected if there are slow shallow respirations and deep sedation or loss of consciousness.

- Stop Opioid infusion
- Give Oxygen, assist ventilation if necessary
- Give Naloxone 2 mcg/kg IV prn 1-2 minutes, if required
 - Stimulation and encouragement to breathe may be all that is required
- Call PAPS and Medical Staff
- 5 minute observations
- **If cardiorespiratory arrest/ minimal respirations/ or unconscious**
 - Give Oxygen, and assist ventilation
 - Give Naloxone 10 mcg/kg IV prn 1-2 minutes
 - Call Arrest team, and commence APLS

8.2.2 Management of Pruritus

This is a very common symptom in infants and children receiving opioid analgesia. Recommendations to attempt to reduce distress:

- Optimize general skin care i.e. change old dressings, adequate skin washing, use skin moisturisers etc
- Try antihistamine
 - Promethazine 0.5mg/kg IV/ IM/ PO 8 hourly prn (max 10-25mg) or
 - Trimeprazine 0.5mg/kg PO 8 hourly prn
- Try Ondansetron 100mcg/kg IV or PO (max 4mg) – if effective, it may be repeated 8 hourly (max 3 doses for pruritus)
- Change opioid i.e. Morphine to Fentanyl
- Try Naloxone
 - Bolus 0.5mcg/kg IV up to 3 doses over 15 minutes
 - Infusion 1mcg/kg/hr if successful
- Stop opioid altogether

8.3 Management of Nausea & Vomiting

Introduction:

Antiemetics may be used prophylactically in theatre if the patient is considered to be significantly at risk of postoperative nausea and vomiting (PONV), or they may be used to treat patients with PONV.

Studies suggest that independent risk factors for PONV in children include:

- History of PONV in patient, sibling, or parent
- Age ≥ 3 years
- Surgery ≥ 30 mins
- Strabismus surgery (others include adenotonsillectomy)

When 0, 1, 2, 3, or 4 factors are present, risk equates to 10%, 10%, 30%, 55%, or 70%

Drugs and doses:

Antiemetic	Dose	Maximum	Frequency	Class
Ondansetron	50-100mcg/kg	Max 4mg	8hrly prn	5 HT3 antagonist
Dexamethasone	150-200mcg/kg	Max 8mg	Once only	Steroid
Droperidol	10-20mcg/kg	Max 500mcg	8hrly prn	Butyrophenone
Cyclizine	0.5-1mg/kg	Max 50mg	6hrly prn	Histamine antagonist
Metoclopramide	150mcg/kg	Max 10mg	8hrly prn	Dopamine antagonist

8.3.1 PONV Prophylaxis

In children at moderate or high risk of PONV, combination therapy with 2 or 3 antiemetics from different classes should be used. Combination therapy may also be appropriate for patients in whom PONV poses a particular morbidity (jaws wired, raised intracranial pressure, gastric/ oesophageal surgery, or day surgery)

Antiemetics are not all equal in their effectiveness.

Numbers needed to treat (NNT) for POV prophylaxis in children:

	Dose	NNT
Ondansetron	50-100 mcg/kg	2-3 (early & late POV)
Dexamethasone	150 mcg/kg	4 (early & late POV)
Droperidol	50-75 mcg/kg	4-5 (early & late POV)
Metoclopramide	150 mcg/kg	Little evidence to show useful

Taken from Gan 2007

Early POV = postoperative vomiting 0-6hrs
Late POV = postoperative vomiting 0-24hrs

Recommendations for PONV Prophylaxis:

- Ondansetron and Dexamethasone
 - First line combination
- Droperidol
 - Potential for extrapyramidal symptoms and high levels of sedation
 - Should probably be reserved for children who have failed other therapies and are being admitted overnight
- Cyclizine
 - May cause sedation, caution if <2 years old
- Metoclopramide
 - Combinations with Metoclopramide are no better than monotherapy

8.3.2 PONV Treatment

When PONV occurs treatment should be given with an antiemetic from a different class than any prophylactic agents already used.

Recommendations for PONV Treatment:

- Ondansetron
 - First line agent if not already given
 - Doses for treatment are lower than doses required for prophylaxis
- May give a repeat dose of an antiemetic if greater than 6 hours since last dose
 - Do not give repeat dose of Dexamethasone
- May consider small dose of Propofol if still in PACU (effect probably brief)

Recommendations for Persistent PONV:

- Exclude correctable causes (eg, unnecessary opioids, ingested blood, abdominal obstruction, hypotension).
- Ensure adequate hydration, analgesia, blood pressure, blood sugar
- Ensure triple therapy (Ondansetron, Dexamethasone, Droperidol)
 - Give Dexamethasone slowly if conscious – may cause discomfort
- Consider:
 - Cyclizine – may cause sedation, caution if <2yrs old
 - Metoclopramide

8.4 Management of Common Epidural Problems

8.4.1 Epidural Disconnection

As soon as an epidural catheter disconnection has been discovered:

- Keep catheter tip clean eg hold with a sterile glove or wrap in sterile gauze
- Clamp catheter tip (or tie a knot next to tip)
- Call PAPS who will manage further
- The PAPS will then review the indication for epidural analgesia
- With a witnessed disconnection the Anaesthetist may decide that it is reasonable to continue with the epidural infusion without removing the existing catheter:
 - Using aseptic technique clean the epidural catheter end with Chlorhexidine/ alcohol 70% (**wait until dry**)
 - Cut approximately 3-4cm off the distal end of the catheter.
 - Reconnect to a new sterile epidural filter and secure carefully
 - Change the epidural infusion set
- With a disconnection that is unwitnessed and thus of an uncertain time frame, the Anaesthetist may:
 - Review the indication for the epidural analgesia – consider the advantages and disadvantages of leaving the existing catheter in situ
 - Consider removing the catheter and:
 - Resiting an epidural in the usual manner with full asepsis
 - Offering an alternative analgesic technique eg PCA / NCA
 - Additional analgesia may be required if the epidural infusion has been disrupted for some time

8.4.2 Inadequate Analgesia

Occasionally epidural analgesia alone may be inadequate.

In this situation it may be worth continuing epidural analgesia but with LA only (ie without additives) and adding IV opioid (ie, NCA or PCA). Before doing this:

- Exclude epidural disconnection and dislodgement
- Consider epidural bolus

These changes may be made by the Department of Anaesthesia only.

8.5 Troubleshooting

Note: Medical staff = House Surgeon, Medical/ Surgical Registrar
PAPS = Paediatric Acute Pain Service

Sedation Score 3 or 4 or Respirations < minimum for age:

Suspect opioid overdose:

- Stop Opioid infusion
- Give Oxygen, assist ventilation if necessary
- Give Naloxone 2 mcg/kg IV prn 1-2 minutes, if required
 - Stimulation and encouragement to breathe may be all that is required
- Call PAPS and Medical Staff
- 5 minute observations
- **If cardiorespiratory arrest/ minimal respirations/ or unconscious**
 - Give Oxygen, and assist ventilation
 - Give Naloxone 10 mcg/kg IV prn 1-2 minutes
 - Call Arrest team, and commence APLS

Trouble breathing and or numbness in fingers, upper limbs:

Suspect epidural block too high:

- Stop epidural
- Call PAPS and Medical Staff
- 5 minute observations

Pain score of 3 or more on two consecutive recordings:

- Call PAPS

Hypotension or heart rate extremes:

- Stop infusion
- Give Oxygen
- Call Medical Staff for opioid infusions/ NCA/ PCA
- Call Medical Staff and PAPS for epidural
- 5 minute observations

Nausea, Vomiting, Pruritus:

- Call Medical Staff
- Refer to Sections 8.2 and 8.3 for drug recommendations and dosages
- Call PAPS if unrelieved

9. MONITORING

9.1 Pain Assessment & Measurement

Children of all age groups experience pain and there are significant physiological and behavioural consequences of inadequately treated pain.

The function of pain assessment is to detect pain, estimate its severity and test the effectiveness of the intervention. It should be routine and one component of the holistic approach to the child. The cause of pain should be sought.

In general, pain assessment instruments in children can be categorised as observational, self-report and physiological. Pain assessment should take place against a background experience of this child's recovery compared to other children at the same stage of recovery.

Pain management should be proactive but when confronted with pain an assessment-intervention-reassessment approach is used. Children can be divided into the preverbal, the cognitively impaired and the verbal.

Preverbal & Cognitively Impaired

This is the most difficult group and they are most at risk of under treatment as they are unable to communicate pain. There are many well validated behavioural and physiological pain score systems (CRIES, CHEOPS) that are used in pain research but are difficult to apply in the ward setting.

We prefer the Instinctive Behavioural Observation approach in this group eg. if experienced staff think the child is in pain we will intervene and then reassess.

Verbal

Children older than 3 years are able to communicate pain. Initially it is an all-or-nothing type of response. Self-reporting with words or visual aids can be used successfully provided the number of choices is limited to around 4 words, faces or 'pieces of hurt'. Visual linear analogues can be used from age 5 years (eg. face pain scale rating). Vertical pain scales are better in children less than 7 years and horizontal pain scales can be used in children older than 7 years. The numerical rating scale (NRS), can usually be comprehended by children older than 10 years.

9.2 Monitoring

Observations are to be recorded on the PAPS Pain Recording Chart.

9.2.1 Opioids

Children taking opioids by any route require the following recordings:

BP	Sedation score
Pulse	Pain assessment
Respiratory rate	Oxygen saturation

Opioid Observation Protocol

- **Before opioid** → Baseline recordings
- **Following opioid** → Every 15 minutes for one hour
- **Then** → Every hour (BP can be done every 2 hours)

For opioid infusions, NCA, PCA and single dose opioids (PO, IV, SC, or IM) recordings may stop 2 hours after discontinuing/ last dose
For controlled release oral opioids recordings may stop 12 hours after last dose
Children < 6 months old must have continuous oximetry if on infusion/ NCA

Pain assessment	
1	No pain
2	A little pain
3	Moderate
4	Very sore
5	Too much pain

Sedation score	
1	Alert
2	Rousable to voice
3	Rousable to light pain
4	Unrousable

9.2.2 Epidurals and Regional Infusions

Epidurals and Regional Infusions require the same monitoring as for opioids with the addition of hourly motor scores.

Motor score	
1	Hip, knee ankle movement
2	Ankle and knee movement
3	Ankle only
4	No movement

All patients with indwelling catheters/ lines (including epidural and regional catheters) must have their temperature documented at least every 4 hours.

9.3 Some Normal Physiological Values for Children 0-16 Years

0 – 3 months	Heart rate	> 110 /min
	Systolic BP	> 65 mmHg
	Respirations	> 25 /min
3 – 6 months	Heart rate	> 100 /min
	Systolic BP	> 75 mmHg
	Respirations	> 20 /min
6 months – 2 years	Heart rate	> 85 /min
	Systolic BP	> 80 mmHg
	Respirations	> 20 /min
2 years – 10 years	Heart rate	> 80 /min
	Systolic BP	> 90 mmHg
	Respirations	> 15 /min
10 years – 16 years	Heart rate	> 60 /min
	Systolic BP	> 100 mmHg
	Respirations	> 12 /min

10. MANAGING PAIN FROM BURNS

Analgesia and sedation for dressing changes:

Dressing changes can be painful and distressing, and consequently may lead to considerable anxiety if managed inadequately. To minimise distress and discomfort it is important for the dressing team to have everything planned and prepared in advance. Preparation will also include appropriate fasting and medication of the child, and importantly, communication and explanation with the child and family about the procedure. The use of distraction techniques involving Play Therapists and family may be helpful. Burns are often painful when exposed, and so it is important to ensure the dressing change does not become protracted - it is important to have enough staff and everything ready, if necessary photos should be taken if surgical staff can not attend in a timely fashion.

Most dressing changes should be appropriately managed without the need for intravenous medication – dressing changes for big or complicated burns, especially in infants or unwell children, may require general anaesthesia, and should be discussed with the Paediatric Anaesthetist or Duty Anaesthetist.

Medication:

Depending on the size of the burn and the age of the child, a combination of the following is often required:

- Paracetamol 15mg/kg orally, give 45mins before procedure
- Morphine 0.3-0.5mg/kg orally, give 45mins before procedure
- Midazolam 0.3mg/kg orally if combined with Morphine, (otherwise 0.5mg/kg with max 15mg), give 30mins before procedure

Other:

- N2O 30-70% Consider for: first dressing/ removal staples/ derroofing blisters/ large debridement/ tricky areas (eg hands). This requires appropriately trained nurse/ doctor and fasting. Not appropriate for children aged <2 years. See Section 7 of the Handbook. (Managing Pain Using Entonox)
- Ketamine 3-5mg/kg orally if combined with drugs above, give 30mins before procedure, (caution if less than 2years old). Charted by Anaesthetist.

Rescue Analgesia/ Sedation:

Option	Indication	Dose	Limitations
N2O	Inadequate analgesia/ sedation	30-70%	Appropriate training & fasting Vomiting (prolonged conc.>50%)
Intranasal Fentanyl	Inadequate analgesia	0.5-1mcg/kg Repeat Q5mins Max 3mcg/kg	Unpleasant, stings Oversedation & nausea/ vomiting (Onset & potency similar to IV)

If a child is distressed and other appropriate measures have been tried it may be necessary to abandon and try again with a different approach or a general anaesthetic. Children should not be undergoing prolonged or distressing dressing changes – if there is any uncertainty discuss with the Paediatric Anaesthetist.

Fasting:

Oral sedation alone	2 hours
N2O sedation alone	2 hours
Combined oral and N2O sedation	4 hours solids/ breast milk 2 hours clear fluids

Monitoring for dressing changes:

Children taking opioids require baseline and regular recording of vital observations every 15mins. See section 9.2.1 of the Handbook. (Monitoring) In addition to this, children requiring sedation with Midazolam, N2O, or Ketamine should also have continuous oximetry and supervision during the dressing change, and until they have woken fully.

Ongoing pain management:

Consider simple analgesics (paracetamol and NSAIDS), although caution is advised with prolonged use, particularly in the presence of poor nutritional status. Reduced daily dosing may be wise, along with surveillance of liver function.

Opioids are frequently required in burns management, and often in high doses. In patients requiring regular opioids, a controlled release preparation is often charted (this will usually be after a few days, at which point the dose can be calculated from the 24 hour usage). As the burns recover, the opioid dose will need to be reduced in a fashion so as to avoid opioid withdrawal.

11. OTHER ANALGESIC MEDICATIONS

11.1 Fentanyl Patches

These are used for patients with chronic or cancer pain, requiring high dosage Fentanyl, that are opioid tolerant. There is marked inter-patient variability in blood concentrations reached. The patch provides the background infusion and incident pain is managed by alternative means, e.g. PCA or oral opioid.

Preparation: Patches (12.5, 25, 50, 75, 100 mcg/hr)

Dose: If the patient is on a Fentanyl PCA, then the patch is selected by calculating the Fentanyl consumption per day and then calculating the average hourly consumption – the patch selected should not exceed this hourly consumption.

Eg, If patient is using 2000 mcg Fentanyl IV per day this equates to average hourly use of $2000 / 24 = 83.3$ mcg/ hr so charting 75 mcg/hr patch would be reasonable.

Alternatively calculate the patients 24 hour oral morphine dose and convert this to the appropriate Fentanyl patch dose using the table below (from Medsafe data).

Oral 24-hour Morphine dose	Fentanyl patch dose
<60 mg	12.5mcg/hour
60 – 134 mg	25
135 – 224 mg	50
225 – 314 mg	75
315 – 404 mg	100
If the patient is taking a medicine other than oral Morphine, then calculate the total daily dose and multiply by the following conversion factors to get the Morphine equivalent dose: oral Oxycodone 2, intravenous Morphine 3, intravenous Fentanyl 0.15	

Eg, If patient is using 2000 mcg Fentanyl IV per day this equates to $2000 \times 0.15 = 300$ mg of oral 24-hour Morphine dose, so (from the table above) charting a Fentanyl 75 mcg/hr patch would be reasonable.

Observations:

The risk of opioid over dose mandates that the patient remain on PCA/ NCA monitoring. The signs of over dosage include sedation, slow weak respirations and pin point pupils.

See Section 9 of the Handbook

Note:

- A new patch is required every 72 hours. It is applied to different areas of hairless, healthy and undamaged skin with thirty seconds of pressure. The onset time to full effect is 12-24 hours. **As the requirement for incident pain intervention falls the patch strength can be weaned.**
- The opioid tolerant patient requires a weaning regime to avoid opioid withdrawal. Off set time is 12-24 hours. Incident pain can be managed without delay following stopping Fentanyl patches.
- Patients should not be discharged home on Fentanyl patches without discussion with PAPs. On the rare occasion that a child is discharged home on Fentanyl patches, then the care givers must be educated on the signs of Fentanyl overdose and on the safe storage of the patches (out of reach of children, preferably in a locked cupboard).

11.2 Gabapentin

Gabapentin is a relatively new anticonvulsant which acts mostly on the $\alpha 2\delta$ subunit of the Ca channel. It has also been shown to be useful in the management of pain.

Chronic pain – FDA approval for:

- Post herpetic neuralgia
- Diabetic neuropathy

Perioperative acute pain – increased use in this setting as an adjunct, particularly in operations associated with a high incidence of chronic pain or with a significant neuropathic component:

- Amputations
- Multilevel orthopaedic surgery
- Spinal surgery (scoliosis)
- Thoracotomy
- High anxiety and significant pain prior to surgery

Other painful conditions

- Burns

Side effects commonly include: sedation, tiredness, dizziness and ataxia.

Currently Gabapentin is not licensed for use in children, but several large centres are using it for specific indications.

Preparation: Capsules (100, 300, 400 and 600 mg)
Oral suspension
-Currently not available in NZ
-Pharmacy can make up an oral suspension
(ideally need half a day notice)

Dose:**Perioperative acute pain** (see indications above)

- Dose: 5-10mg/kg PO TDS starting 2-12 hours preop
- Duration: 3-5 days or until pain settles
- Wean if >1 week use – to avoid acute withdrawal

Chronic pain (children >2 years old)

- Day 1: 10mg/kg/day, as single dose (max 300mg)
- Day 2: 20mg/kg/day, divided BD (max 600mg/day)
- Day 3: 30mg/kg/day, divided dose TDS (max 900mg/day)
- Maintenance: -reassess day 7
-titrate to clinical effect

Important:

- Titrate to clinical effect (upto 40mg/kg/day in divided dose TDS)
- Recommended maximum 2400mg/day (note usual adult dose 900-3600mg/day)
- In outpatient setting titration is usually slower (every 3 days)
- Clinical benefit is usually seen after 1-2 weeks
- Reduce dose in renal dysfunction – monitor more carefully for side effects
- Side effects include: sleepiness, dizziness, confusion, dry mouth, ataxia, abnormal gait and weight gain
- Wean slowly after prolonged use (> 1 week use)

11.3 Amitriptyline

There are few published guidelines on drugs for paediatric neuropathic pain and few are specifically licensed for paediatric use. Amitriptyline is a Tricyclic Antidepressant with membrane stabilising properties that has been used as one of the main pharmacological treatments for paediatric neuropathic pain. It is not recommended for paediatric use in Mims, and should be initially charted by a consultant. A Cochrane review in 2007 confirmed its efficacy in neuropathic pain states. While being best known as an antidepressant it is charted in much lower doses for pain management. Amitriptyline can have marked sedative properties even in low doses.

At Waikato hospital it is generally started in low doses at night to facilitate sleep and minimise daytime sedation. A recent review by Medsafe and the Medicines Adverse Reactions Committee on the safety of antidepressants suggests that all classes of antidepressants appear to carry some degree of risk of QT prolongation and potentially arrhythmia. Patients should be evaluated for the risk factors for QT prolongation before starting Amitriptyline. An ECG should be considered at baseline, steady state, at the time of dose increases, and if another QT prolonging medicine is added.

Preparation: Tablet (10, 25, 50mg)

Dose:

The starting dose is 0.2 mg/kg orally at night, but no more than 10mg. The onset of effect may take 3-5 days, and it is sensible to reassess after one week. If necessary the dose may be titrated to effect by increasing the dose by 0.2mg/kg and waiting 5 days. The dose may be titrated to a maximum of 1mg/kg daily. Maximum dose 50mg (usual adult dose 10-50mg).

11.4 Diazepam

Diazepam may be useful for children troubled with postoperative muscle spasms following multilevel orthopaedic surgery. This surgery involves tenotomies and osteotomies at different levels on one or both limbs. Diazepam may be prescribed on a regular basis, but its effect should be reviewed daily and doses adjusted as required. Caution should be used when charting for children with global developmental delay and particularly children with hypotonia, (these children may be more vulnerable to sedation and respiratory compromise).

Preparation: Syrup (10mg/10ml)

Dose: 0.1mg/kg TDS

11.5 Intranasal Fentanyl

Fentanyl is a short to medium duration opioid commonly used IV for treatment of acute pain and useful for painful procedures of a short duration. Concerns with IV Fentanyl outside of a specialist environment when given as a single large bolus include the potential for respiratory depression and chest wall rigidity. Advantages of Fentanyl via the nasal route include a slower onset of action, longer duration and the fact it does not require IV access for administration. Limited studies to date have shown a good safety profile when used in an appropriate dose. It provides similar analgesia to 0.1mg/kg Morphine IV. Onset of effect is 5min and duration is greater than 30minutes.

Dose:

A suggested initial dose is 1.5mcg/kg. A second dose of 0.5mcg/kg can be given no sooner than 10 minutes later. Maximum dose 100mcg.

Administration:

Calculate and draw up the dose (using Fentanyl 100mcg/2ml concentration)
Use 1ml Tuberculin syringe and MAD (Mucosal Atomiser Device)
Recline patient at 45 degrees. Hold the syringe horizontal and expel the contents into the nostril as a fine mist in one rapid push. Consider dividing doses of more than 1ml between both nostrils

Observations:

See Section 9 of the Handbook.

12. PREOPERATIVE MEDICATIONS

12.1 Topical Local Anaesthetics

The insertion of intravenous cannulas, performance of lumbar punctures and administration of IM injections are potentially very distressing procedures for children. Some of the pain and distress may be reduced by using topical local anaesthetics. The topical LA should be applied under an occlusive dressing and a secondary dressing such as a bandage may help reduce dislodgement/ ingestion of the cream or occlusive dressing.

Amethocaine gel (Ametop or Amgel)

4% Amethocaine gel is an ester type LA suitable for topical anaesthesia in infants and children prior to painful procedures. Studies in children show a similar success rate for IV cannulation with Amethocaine or EMLA but lower pain scores with Amethocaine. It provides good topical anaesthesia in 30-45 minutes. Do not leave for longer than 60 minutes. Effective skin anaesthesia lasts 4-6 hrs after removal. Do not apply to broken skin. No systemic side effects have been noted in children. Amethocaine tends to cause erythema secondary to vasodilation. A small number of children may get a marked erythema that resolves after removal.

EMLA cream

EMLA cream is a eutectic mixture of local anaesthetics. This is a mixture of 2.5% Lignocaine and 2.5% Prilocaine. **It requires at least 60 minutes to provide topical anaesthesia.** We recommend caution in children less than 3 months of age because of the possibility of methaemoglobinaemia from the Prilocaine component. In infants use 2g or less and do not leave in place for longer than 2 hours. It tends to cause blanching of the skin secondary to vasoconstriction.

12.2 Premedications

Premedication with sedative drugs is often used in paediatric practice as one of the modalities to reduce preoperative anxiety in children undergoing surgery. The same medications may also be used for unpleasant ward procedures, as long as a few basic safety measures are in place.

Non-pharmacological measures which may contribute to anxiolysis include tablet based interactive distraction (TBID), video distraction, and performance of 'coping promoting behaviour' by physicians and parents. These are beyond the scope of this guideline, but some references are included at the end of this section.

Risk/ benefits:

The following are some conditions where a **careful risk/ benefit** assessment must be made prior to prescribing a premed:

- Anticipated airway difficulty
- Increased risk of aspiration
- Respiratory/ cardiac/ hepatic/ renal impairment

-
- Previous allergy/ adverse reaction to premedication
 - Central/ obstructive sleep apnoea
 - Acute systemic illness e.g. sepsis

Important:

- If in any doubt, discuss your plan with the PAPS Specialist beforehand
- **Some children may only be safely sedated in a theatre environment due to their comorbidities**

Practical Considerations:

- Consider fasting status
- Obtain informed consent from the parent/ guardian
- Chart the premedication dose, route and time to be given
- Inform the nursing staff of the prescription
- Premeds may be mixed with a small volume of clear fluid if required e.g. apple juice, or with cordial or paracetamol suspension
- Sedative drugs should be provided in a safe environment where resuscitation equipment can be readily accessed
- A sedated child should be appropriately monitored at all times, including during transfer from one clinical area to another

Tips:

Oral premeds:

- Midazolam – has a quick and reliable onset and has been the most frequently used. Its bitter taste may be masked by additives, but some children may not tolerate this
- Clonidine – may be useful in these children but note increased onset time required

Intranasal premeds:

- Should be administered with the MAD (mucosal atomiser) device
- May be useful where children have refused oral medications
- Beware the large dead space in the MAD device and requirement to deliver the drug at 45 degrees to coat the turbinates
- **Midazolam** (and to a lesser extent Ketamine) – sore and **not recommended**
- **Dexmedetomidine** – avoid in children with abnormal conduction systems/ on negative chronotropic agents
- **Fentanyl** – has a rapid onset, and wide interpatient variability, and should be given by medical personnel. A further dose of 1.5 mcg/kg may be given after 10 mins if required

Combination regimens:

- May be of benefit – faster onset/ increased efficacy/ attenuation of side effects
- Dose reduction of one or both agents may be appropriate
- **Only after discussion and/ or supervision by the PAPS Specialist** – they have a higher risk of over sedation

Drug	Route	Dose	Onset (mins)	Duration (hours)	Notes	Comments
Midazolam	Oral	0.5-1 mg/kg (max 15 mg)	20-30	1-2	Bitter taste	Paradoxical reactions, esp in children with high impulsivity, hiccups
	Intranasal	0.2 mg/kg	10-15	1-2	Stings	
Temazepam (older children)	Oral	10-30 mg	45-60	3	Tablet	
Ketamine (>2 yrs)	Oral	5-10 mg/kg	10-20	3		Nystagmus, analgesia, N&V, salivation, hallucinations
	Intranasal	3-5 mg/kg	10-15	1-3	Stings	
Clonidine	Oral	4 mcg/kg	60-90	6	Tasteless	Mild bradycardia/hypotension, analgesia, anxiolysis, antiemesis
	Intranasal	2-4 mcg/kg	30-60	6	Painless	
Dexmedetomidine	Intranasal	1-2 mcg/kg			Painless	
Fentanyl	Intranasal	1.5 mcg/kg	2-5	0.5-1	Painless	Respiratory depression, N&V, pruritus

13. MANAGING PAIN FOLLOWING TONSILLECTOMY

Analgesic options following tonsillectomy include:

- Simple analgesics
- Opioids
- Tramadol

Simple analgesics:

Unless contraindicated all children should have regular:

- Paracetamol 15-20mg/kg QID (maximum **75mg/kg/day**)
- Ibuprofen 5-10mg/kg QID (maximum 40mg/kg/day, max dose 1600mg/day)

Opioids:

For those monitored in hospital consider:

- Morphine 0.2mg/kg orally 2hrly PRN
- Oxycodone 0.05-0.1mg/kg orally 3hrly PRN

Note:

- Should **never be used regularly**
- Children with OSA:
 - Use with **extreme caution** and in a reduced dose
 - Have been shown to have 1/3-1/2 the opioid requirements as children without OSA and a much higher rate of post-operative adverse respiratory events
 - Should be monitored overnight in hospital to assess response and sensitivity to opioids

Tramadol:

Alternative analgesia includes tramadol.

- Initial dose: Tramadol 0.5mg/kg 6-8hrly
- Maximum: Tramadol 1mg/kg 6-8hrly (maximum of 400mg/day)

Note:

- Associated with less respiratory depression but not confirmed to be safer than morphine after tonsillectomy
 - Will have an incidence of nausea
 - Recent FDA concerns with the use of Tramadol in children have been largely refuted by SPANZA but as with all potent analgesics a risk benefit analysis should always be evaluated for individual patients before use. SPANZA Recommendations:
 - Children with OSA should be monitored overnight in hospital to assess response and sensitivity to Tramadol
 - Tramadol dose should be reduced following tonsillectomy
- SPANZA Advisory on Tramadol - Warning on tramadol use in children**

General comments:

For further information and precautions on use of the above drugs see Section 3 of the Handbook.

14. MANAGING PAIN FOLLOWING SCOLIOSIS SURGERY

Multi-level spinal surgery is major surgery and is associated with significant postoperative pain, including the potential for neuropathic pain. Patients may have varying levels of pre-operative pain. Presently, at Waikato Hospital, we are performing posterior spinal fusion on patients with idiopathic adolescent scoliosis and, as a general rule, are not including patients with neuromuscular co-morbidities.

14.1 Intraoperative Analgesia

These children usually receive the following analgesia:

- Intrathecal morphine (ITM) **or** intravenous methadone
- Morphine IV (low dose)
- Parecoxib IV
- Paracetamol IV
- Ketamine IV infusion

14.2 Postoperative Analgesia

Routine:

- Paracetamol 15mg/kg PO/ IV 4 hourly (If given IV max 4 doses in a 24 hour period)
- Ibuprofen 10mg/kg (max 400mg) PO 8 hourly
- Morphine PCA
 - Note if intraoperative intrathecal morphine used then:
 - First 24 hours low dose PCA and no basal
 - Increase parameters to normal levels after 24 hours

Adjuvants:

- Gabapentin 5mg/kg PO TDS x 5 days
 - The first dose may be given as part of the premedication
 - Usually prescribed for 5 days
 - Watch out for excessive sedation or dizziness
- Parecoxib 1mg/kg IV daily (max 40mg)
 - Can be given instead of Ibuprofen for the first day or two, especially if patient reluctant to take orally
- Tramadol 1-2mg/kg PO/IV 4 hourly prn
 - Note recent FDA concerns regarding charting in paediatric patients under 12 years and any patients under 18 years with respiratory problems, sleep disordered breathing or obesity (See Section 3.5 of the Handbook)
 - Lowers seizure threshold, and can cause significant nausea and vomiting

Other adjuvant analgesics to consider:

- Clonidine 1-2 mcg/kg IV/ PO 8hourly prn
 - Useful as an anxiolytic and analgesic
 - Sedating but generally not a respiratory depressant
 - Can cause a drop in blood pressure and heart rate

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- Amitriptyline starting at 0.2 mg/kg (max 10mg) PO at night
 - If struggling to sleep and with significant pain
 - Patients should be evaluated for the risk factors for QT prolongation before starting Amitriptyline. An ECG should be considered at baseline, steady state, at the time of dose increases and if another QT prolonging medicine is added
 - Diazepam
 - 0.1mg/kg PO/IV 8 hourly prn
 - Useful for muscle spasms which may be present
 - Anxiolytic
 - Ketamine infusion
 - 0-4 mcg/kg/min – for 24-48 hours postoperatively

General comments:

Care needs to be taken with the multimodal nature of analgesia often used in this setting. Patients do vary in their response, but over-sedation and dizziness can potentially delay mobilization.

15. INITIAL TREATMENT OF CHRONIC PAIN IN CHILDREN

A useful definition of chronic pain is “pain that extends beyond the expected time of healing” and “hence lacks the acute warning function of physiological nociception”.

Mechanisms of pain include acute nociceptive pain (i.e., pain arising from the activation of peripheral nerve endings), neuropathic pain (i.e., resulting from injury to, or dysfunction of, the somatosensory system), and psycho-social-spiritual-emotional pain. Chronic pain commonly involves a combination of these mechanisms.

15.1 Types of Chronic Pain in Children

Primary pain disorders: (formerly functional pain syndrome)

Many different chronic pain syndromes are now considered to be manifestations of an underlying pain vulnerability or pain spectrum condition, rather than being viewed as separate disorders. Considerable evidence, points to a role of shared biological sensitivity, or “pain vulnerability”.

Important features:

- Pain not explained in terms of conventional medical disease (biochemical or structural abnormalities)
- Significant disruption of everyday life (often leads to incapacitation)
- Unimodal medical therapy typically unsuccessful
- Unimodal medical therapy can consume significant time, resources and finances
- Persistent treatment failures can lead to negative implications eg
 - patients perceiving their pain is not organic and therefore not real/ serious
 - stigmatization (i.e. symptoms characterized as fictitious or malingering)

The three most common primary pain disorders in paediatrics are:

- **Primary headaches: tension headaches and migraines**
- **Centrally mediated central abdominal pain syndrome**
- **Musculoskeletal and joint pain**

Chronic-on-acute pain

A significant number of children with recurrent nociceptive pain caused by underlying organic disease (eg, inflammatory bowel disease, sickle cell disease, rheumatoid arthritis or cancer), may develop pain which becomes complicated to treat, and have what is known as “chronic-on-acute” disease. In these children primary pain disorders may also co-exist, or even be triggered by the underlying organic disease, and pain symptoms do not necessarily represent inadequate treatment, flare-up, or recurrence.

15.2 Management

Many children with chronic pain will benefit from an interdisciplinary rehabilitative pain program. This requires appropriate resources including: pain specialists and nurses, psychologists, physiotherapists and occupational therapists and social workers. A lot of

the focus is on restoring function and as this is achieved the pain improves and commonly resolves – this may be summarized as “life gets back to normal” and then “the pain gets better”. To achieve this an interdisciplinary approach is required which involves a combination of: (1) physical therapy (eg, range of movement, strength, balance, graded motor imagery exercises); (2) integrative medicine/active mind-body techniques (eg, self-relaxation, self-regulation, distraction, guided imagery exercises); (3) psychology (coping strategies, targeting anxiety and depression); and (4) normalizing daily routine (school attendance, sports, social life and sleep). Determining which children will benefit from an interdisciplinary approach will require input from the Chronic Pain Team.

15.2.1 Referral to the Pain Service

If the Home Team decide they would like to refer a child with chronic pain to the Pain Service then the following basic principles should be adhered to:

- Ensure the child has been reviewed by the admitting Consultant
- Ensure the team have excluded reversible and treatable conditions
- Ensure a written referral documenting relevant imaging and bloods (including a recent CBC and CRP)
- Over investigation can also be harmful and deflect from confronting the real issues
- Take a thorough pain history including psychological issues
- Use available non-pharmacological treatments

15.2.2 Initial approach and non-drug treatments

It may be useful to start to explain to the child and family the concepts that the pain “is real” but it “has lost its warning function” and that using the affected part of the body does not result in greater harm. It is also helpful that the child and family begin to understand that working towards “life gets back to normal” is important and that this results in “the pain gets better”.

At some point it can be helpful discussing pain transmission and how this can be influenced by down-modulation (which results in decreased pain) or up-modulation (which results in increased pain). This can help explaining that the pain is real and how the interdisciplinary (“non-drug”) treatment modalities work. Down-modulation can be described as “OFF-switch” modulation which involves descending inhibition from the “control center” (the peri-aqueductal grey matter). “OFF-switch” modulation (decreases pain) is triggered by 1) physical therapy/ exercise, and 2) integrative medicine/ distraction. Up-modulation can be described as “ON-switch” modulation (increases pain) which involves activation in the front of the brain (the prefrontal cortex). “ON-switch” modulation is triggered by stress, pessimism, anxiety/ depression, insomnia, and absenteeism (missing school/ sports/ and social contact). “ON-switch” modulation may be reduced by 1) psychological support, and 2) normalizing the activities of daily life.

It is also helpful to understand how fear and catastrophizing can affect pain. Both exacerbate the experience of pain, and both can be experienced by the child and the parents. Catastrophizing involves cognitive and emotional processes which include magnification, rumination, pessimism, and feelings of helplessness. Reducing fear of pain in children is important and is associated with positive functional outcomes in children with primary pain disorders. It has also been shown that parental catastrophizing and expectations strongly influence children’s pain memory.

So even before the Chronic Pain Service has been involved, basic non-drug treatment strategies can be initiated:

- Reassure – the pain is real, using the affected part of the body will not result in greater harm
- Explain – the pain has lost its warning function
- Explain – the pain can be modulated up and down
- Explain – working towards “life gets back to normal” is really important and results in “the pain gets better”
- Initiate some basic interdisciplinary rehabilitation strategies – normalizing daily routine (showering, dressing, eating) and regular sleep
 - Self-relaxation
 - Distraction
 - Targeting anxiety/ catastrophizing
- Involve ward physiotherapist and play therapist

Online resources (for children/ families and staff):

- The “**ACI Pain Management Network**” website in Australia and has some very useful resources
 - Follow the link: [Chronic pain resources for children and families](#)
 - Then see “For Youth: PainBytes” for some very helpful episodes
 - Provides information and education to help children/ families begin to understand what is going on in the nervous system, and how to begin to better manage the pain

15.2.3 Drugs

In the short term, before review by Chronic Pain Service, some pharmacological treatments may have a role, however evidence of strong efficacy is lacking for any agents.

Paracetamol and NSAIDS – Have been shown in many studies to be as efficacious as more “potent” analgesics for reducing pain scores despite not being pursued as much by patients. They have the advantage of a good side effect profile and not exacerbating chronic pain states.

Tramadol – Has a very idiosyncratic profile and may be very effective for some patients. It is often worth trialling.

Opioids – Have little role in primary pain disorders, i.e. those not related to tissue damage. However, they are effective in persistent pain conditions with nociceptive pain caused by tissue damage.

Key points:

- Opioids administered for primary pain disorders have low long long-term efficacy, a poor safety profile, and commonly a worse clinical outcome
- **Opioids should not be administered to paediatric patients with primary pain disorders** – in these patients they are likely to cause more harm than benefit.
These disorders include:
 - Primary headaches: tension headaches and migraines
 - Centrally mediated central abdominal pain syndrome
 - Chronic musculoskeletal and joint pain
 - “Chronic sickle cell pain” (pain that extends beyond the expected time of acute vaso-occlusive crisis)

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- Opioids are important and effective for long-term analgesic management in persistent pain conditions (i.e., long-lasting and/or repetitive nociceptive pain caused by tissue injury), such as:
 - Junctional epidermolysis bullosa
 - Osteogenesis imperfecta
 - Advanced metastasized bone tumours (e.g., Ewing sarcoma)

(Chronic Pain in Children and Adolescents: Diagnosis and Treatment of Primary Pain Disorders in Head, Abdomen, Muscles and Joints. Stefan J Friedrichsdorf et al. *Children* **2016**, 3, 24)

Amitriptyline – May be useful if sleep disturbance and pain. (Children >6 years old). The starting dose is 0.2 mg/kg orally at night, but no more than 10mg. The onset of effect may take 3-5 days, and it is sensible to reassess after one week. Maintenance: -titrate to effect by increasing the dose by 0.2mg/kg and waiting 5 days
-may be titrated to a maximum of 1mg/kg daily (max dose 50mg)
(usual adult dose 10-50mg)

- Patients should be evaluated for the risk factors for QT prolongation before starting
- An ECG should be considered at baseline, steady state, at the time of dose increases and if another QT prolonging medicine is added

If you expect the Paediatric Pain Service to be involved, please discuss this before commencing.

Gabapentin – Maybe useful for neuropathic pain. (Children >2 years old)
Day 1: 10mg/kg/day, as single dose (max 300mg)
Day 2: 20mg/kg/day, divided BD (max 600mg/day)
Day 3: 30mg/kg/day, divided dose TDS (max 900mg/day), until day 7 then reassess
Maintenance: titrate to clinical effect (upto 40mg/kg/day in divided dose TDS)

- Recommended maximum 2400mg/day (note usual adult dose 900-3600mg/day)
- In the outpatient setting titration is usually slower (every 3 days)
- Clinical benefit is usually seen after 1-2 weeks
- Side effects include: sleepiness, dizziness, confusion, dry mouth, ataxia, abnormal gait and weight gain.

If you expect the Paediatric Pain Service to be involved, please discuss this before commencing.

Clonidine – May be useful if anxiety and pain. May cause significant sedation, and may cause reduction in heart rate and blood pressure.
Start at 1-2mcg/kg BD PO.

Melatonin – Has been suggested as being useful in some studies and has the advantages of augmenting sleep and a good side effect profile.

Important Note:

Prior to discharge, a management plan must be made for the ongoing management of these drugs. It must be clear in the discharge letter whether the GP or Outpatient Clinic will be responsible, and when the follow-up will occur.

16. PALLIATIVE CARE, TERMINAL ILLNESS AND END-OF-LIFE

Specialist Paediatric Palliative Care is an extremely limited resource in New Zealand and is currently available only through Starship Hospital.

However, good quality end-of-life care and symptom management can still be achieved through a multidisciplinary approach as required. The lead clinician will be a Paediatrician, who will typically seek Specialist Paediatric Palliative Care advice from Starship Hospital.

However, if required, the Paediatric Pain Service at Waikato is happy to provide advice on the management of pain related issues in this patient group (including outpatients), accepting that we are not Palliative Specialists. This advice is generally in the form of bridging options & may include admission until the primary team can seek a definitive strategy from the Paediatric Palliative Service at Starship Hospital at the earliest possible opportunity.

16.1 Key Aspects of Care

For the child with a life-limiting or life-threatening illness include it is important to remember the following principles:

- Recognising the situation
- Recognising high levels of anxiety are common for the child/ family and professionals
- Appropriate and open communication with the child and family
- Minimising or avoiding interventions that are futile or add limited benefit
- Planning is important, ie an end-of-life care plan
 - Initiated by senior clinician, involves family and child
 - Includes advanced care plan (ceiling of care, place of care/ death, donation)
 - Includes management plan (flexible plan, symptom management goals, psychosocial spiritual support, people and equipment, contacts 24/7)

16.2 Symptom Management

16.2.1 General Approach

As already outlined above, caring for the dying child involves more than just symptom control – emotional, psychological, and spiritual support of the child and the family are essential.

The following may be helpful:

- Don't panic – stop and gather information:
 - Read the notes
 - Talk to the parents – they play a pivotal role in care
 - Talk to the child – they may be old enough to describe their symptoms
- Document and discuss the plan
- Beware of emotional burnout – maintain professional compassion and care

16.2.2 Pain Management

Pain is a feared and common symptom in children receiving end-of-life care. There are many varied causes of pain, and in this group of children the cause of the pain is often multi-factorial. Most of the time the pain is simple to manage. Management is based on a good assessment and understanding of the disease process, good communication and an empiric approach with regular reviews of the response to treatment.

It is also important to remember that management should include 'non-drug' treatment. Without addressing the child's emotional, psychological, and spiritual needs drug treatment alone will not be completely successful.

Remember:

- Effective treatment requires a trusting relationship which requires good communication
- Determine what the pain means to the child and parent – what do they understand
- What children think, feel and do with their pain influences their pain experience
 - Eg, worsening physical function, sleep deprivation, upset parents, and feeling scared may all effect pain
- Myths/ misunderstandings can cause:
 - Increased anxiety
 - Poor compliance
 - Poor reporting eg, if people know I'm in pain I'll have to stay in hospital
- Honest and age-appropriate explanations and options help the child and family

Prescribing:

The oral route is the simplest but may not always be appropriate:

- Pain crisis requiring rapid titration of IV opioids
- Poor absorption: vomiting, disordered GI motility
- Inability to comply: unconscious, severe nausea, poor swallow/ aspiration risk, medication refusal

In this case consider the role of the subcutaneous route. Subcutaneous infusions are frequently and incorrectly viewed as both a painful intervention and an option only when the child is actively dying. Instead they can be utilised over long term periods and minimise both the trauma of repeated cannulation and the risks associated with central access.

Opioids:

There are 3 phases in finding the 'right dose':

- Initiation – charted according to weight/ age (mindful of other charted drugs)
- Titration – remember don't increase daily amount by more than 30-50%
- Maintenance – LA opioids are started once a stable effective daily dose has been found
 - Transdermal fentanyl takes 12-24hours to be effective so it is only used once child is stabilized on morphine or equivalent
 - Chart PRN 'rescue dose' – 1/5th to 1/10th daily dose

Opioid switch and rotation:

- Switch – change in opioid early on because opioid relatively ineffective or trouble with side-effects. Consider when:
 - Analgesia inadequate

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- Dose-limiting side-effects
 - Adequate analgesia but unpleasant side-effects
 - Alternative opioid has specific advantages
(eg change from enteral morphine to transdermal fentanyl)
 - Rotation – change in opioid after a period of benefit because tolerance appears to be developing
 - The new dose is calculated as follows:
 - Calculate oral morphine equivalent
 - Reduce dose of new opioid by 25-30%
(This allows for incomplete cross-tolerance - thus reduces the risk of toxicity)

16.3 Resources

Services:

- Paediatric Medicine – the lead clinician should be a Paediatrician
(One of the Paediatricians at Waikato Hospital will be the assigned the role as ‘link Paediatrician’ for Paediatric Palliative Care in our region)
- Adult Palliative Care – some of the specialists may be comfortable to be consulted

Online resources:

- The “**Together for Short Lives**” website in the UK has some very useful resources
 - Follow the link: [Palliative care resources for professionals](#)
 - Then see “Basic Symptom Control in Paediatric Palliative Care”
 - Pain p108
 - Pain management p110
- The “**Starship Paediatric Palliative Care Network**” website is also very useful
 - Follow the link: [Starship Paediatric Palliative Care Network](#)
 - Then see “Paediatric Palliative Care Clinical Guidelines”:
 - Pain management
 - Various symptom managements
 - Palliative care emergencies