MCN for Neonatology

West of Scotland

Neonatal Guideline

Neonatal Pain Guideline

This guideline is applicable to all medical, nursing and midwifery staff caring for neonates and Infants in West of Scotland Neonatal Units.

Purpose

To provide a process for prevention, assessment and management of pain in neonates admitted to the Neonatal Unit. The primary aim is to prevent the potentially damaging effects to the neonatal brain from both the pain experience and the sequelae of medications used to treat pain and agitation.

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1. Definition and Background

Pain is defined as an unpleasant sensory and emotional experience associated with actual and potential tissue damage (IASP, 2003).

Neonates cannot verbally communicate their discomfort, however evidence suggests that neonates do experience pain but lack the adaptive mechanisms that modulate painful stimuli in older children. They express their vulnerability to pain and stress through specific behaviours and with physiological and biochemical responses to pain (Anand et al 2007).

Neonates are frequently exposed to acute, repetitive, and chronic pain within the NICU setting because of procedures, surgeries, and disease processes. Preterm neonates, especially those <30 weeks' gestation, are exposed to 10-15 painful procedures per day at a time when pain is developmentally unexpected. Pain in the neonatal period is often unrecognised and undertreated. In infants born extremely preterm (gestational age ≤29 weeks) greater numbers of painful procedures have been associated with poor early neurodevelopment, altered brain development, delayed postnatal growth and higher cortical activation (Beatriz et al. 2015).

It has also been reported that in toddlers born very preterm (gestational age ≤32 weeks) bio-behavioral pain reactivity-recovery scores have been associated with negative affectivity temperament. Furthermore high numbers of painful experiences in the neonatal period have been associated with a poor quality of cognitive and motor development at 1 year of age and changes in cortical rhythmicity and cortical thickness in children at 7 years of age (Beatriz et al. 2015). Few longitudinal studies have examined the impact of neonatal pain in the long-term development of children born preterm, however neonatal pain-related stress is associated with alterations in both early and in later developmental outcomes (Beatriz et al. 2015).

It is therefore recommended that appropriate methods of assessing pain are applied, such as a validated pain assessment scale NPASS (Neonatal Pain Agitation and Sedation Scale) and appropriate interventions implemented.

Causes of Neonatal Pain and Interventions

There are a wide range of causes of pain to the neonate. It is important that each procedure/event is assessed and appropriate analgesia/support is given.

Summary of Pain Relieving Interventions for Neonatal Procedures

Procedure	Interventions		Comments
	Non-pharmacological	Pharmacological	
NGT/OGT insertion NGT Guideline	Breast milk Sucrose Sucrose Guideline Lubrication of NGT		
Urinary catheter placement	Breast milk Sucrose		
Tape removal Dressing change	Breast milk Sucrose Adhesive remover		
Intramuscular injections Immunisations Immunisation Guideline	Breast milk Sucrose		Paracetamol
ROP /indirect opthalmoscopy	Breast milk Sucrose	Local analgesic eye drops	Prior to exam
Supra pubic aspiration	Breast milk Sucrose		
Heel stick Venepuncture IV cannula Arterial Line	Breast milk Sucrose		
PICC line placement PICC Guideline	Breast milk Sucrose	Morphine Fentanyl	For intubated patients
Lumbar puncture	Breast milk Sucrose		
Chest drain Chest Drain Guideline		Lidocaine Morphine Fentanyl	For intubated patients
Intubation Intubation Guideline		Fentanyl Ketamine	Slow bolus to avoid chest wall rigidity Neonates with hypoplastic left heart syndrome/unstable circulation

Starting doses for each medication are as per the MCN for West of Scotland Guideline, but dosing and weaning should be individualised

2. Effects of Acute, Repetitive and Chronic Pain on the Neonate

Acute pain- Consequences of acute pain which may be experienced by the neonate include; acute increases in heart rate, blood pressure, intracranial pressure and decreases in oxygen saturations. These changes in cerebral blood flow may be associated with an increased risk of IVH and PVL. It has also been suggested that acute pain episodes experienced within the neonatal period may have long-lasting effects on future behavioural pain responses (Taddio et al 1997).

Repetitive pain - Consequences of repetitive or prolonged pain during the neonatal period may result in developmental alterations of the immature nervous system. Preterm infants may have specific learning deficits, poor adaptive behaviour and decreased pain threshold which can alter their response to future episodes to painful or non-painful stimuli. Exposure to repeated painful stimuli early in life is known to have short and long-term adverse sequelae. These sequelae include physiologic instability, altered brain development, and abnormal neurodevelopment (Vinall and Grunau 2014).

Chronic pain- Chronic pain has been described as a pathological pain state without apparent biological value that has persisted beyond the normal tissue healing time (Jovey 2002) suggesting that the end of the pain state is not known. Chronic disease conditions such as bronchopulmonary dysplasia (BPD) and some surgical conditions can produce chronic repetitive pain and stress on the neonate. However there are no working definitions or validated assessment scales which can assess an extended period of chronic pain in the neonate and is an area for future study.

Guideline for Prevention of Neonatal Pain

It is important to consider each procedure/event and avoid or limit where possible.

Limitation or avoidance of skin-breaking or other painful procedures

- Review proposed blood investigations daily and limit blood tests to those necessary for clinical care and management of the baby.
- Avoid multiple heel stick/venepunctures by clustering care.
- Consider purposely building in days when no “routine” bloods are done on selected babies.
- Evidence suggests that venepuncture is less painful to the neonate than heel stick, therefore venepuncture should be considered for blood tests in neonates who have no venous access issues. Venepuncture attempts should be limited as per Unit policy (e.g., a maximum of 2-3 attempts per person).
- Suctioning can be painful and should be performed only when necessary.
- Procedures which may cause pain or distress to the baby should not be carried out on the same day e.g. (retinopathy of prematurity exams, immunizations, etc.).
- Care giving activities/procedures should be planned on an individualised basis to allow the infant to fully recover from painful interventions and ensure undisturbed rest.

3. Interventions which may reduce the effects of pain/stress

Limit environmental stressors by reducing noise and light levels.

Interventions may include:

- Close incubator doors gently
- Adjust alarms to an appropriate level
- Appropriate voice levels at the bedside
- Avoid placing telephones/radios/pages close to incubators
- Use incubator covers or drapes to decrease light levels as appropriate for each baby.

a. Cluster nursing care and interventions where appropriate and limit handling of the infant to allow undisturbed rest.

b. Pain and stress may also be alleviated by providing boundaries, swaddling, positioning infants with flexion of extremities, and using pacifiers/encouraging non-nutritive sucking.

c. Parental involvement and interaction should be actively encouraged and should be an integral part of the baby’s care

Interventions may include:

- kangaroo care/skin to skin
- facilitated touch/gentle massage
- breastfeeding when appropriate

For further information on Developmental Care please refer to the WoS Developmental Care Guideline

Central Line Access

In the first few days of life an umbilical arterial catheter (UAC) / umbilical venous catheter (UVC) may be required for blood sampling, blood pressure monitoring and administration of intravenous fluids. This may prevent frequent heel stabs for blood sampling and excessive handling. However, the benefits of central access lines should be carefully balanced with the risks e.g. infection.

4. Guideline for the Assessment of Pain

Identify actual or potential sources of pain / irritability.

- These include indwelling tubes or lines, heel-sticks, surgical procedures, suctioning, peritonitis, other infectious processes, fractures, hunger, peripheral and central lines infusions and noxious environment.
- Pain assessment is performed with each potentially painful clinical intervention to evaluate the efficacy of behavioural, environmental and pharmacological agents.
- Non-pharmacologic measures are implemented first if the infant has no identifiable cause for pain.
- Apply a pain scale assessment with each “hands on” vital sign measurement for all infants with actual or potential sources of pain.

Suggestions for frequency of pain assessment:

- Invasive tubes or lines: 2-4 hourly
- Receiving scheduled or infusion analgesics and/or sedatives: 2-4hrly.
- Analgesic/sedative prn: one hour after dose is given, to assess response.
- Post-operative: hourly for 24-48 hours and then 4 hourly until off medication.
- Treatment is initiated based on assessment which includes an objective pain scale.
- Apply pain/agitation scale with all painful procedures.
- After providing pain management obtain pre-procedure pain assessment.
- Re-assess pain during longer procedures.

5. Guideline for the Assessment of Sedation

- Sedatives do not provide pain relief but some may enhance the effects of opioids.
- Sedatives must not be used in place of analgesics for the management of pain.
- There is no evidence to support that infants can be safely sedated for weeks or months.
- Some sedatives such as benzodiazepines must be used **with caution** and are not recommended in preterm infants. Potential side effects include myoclonic movements and adverse neurological outcome.
- Sedatives may however be considered when ongoing analgesics are necessary.

Assessment of Sedation

- The assessment of sedation levels should be based on the infant's response to stimuli only when "hands on" care is being given.
- The infant should not be stimulated unnecessarily to assess sedation.
- Sedation does **NOT NEED** to be assessed with every pain assessment.
- Evidence of sedation without administration of sedatives may indicate neurological depression, sepsis or other pathology.
- Assessment of sedation in infants not receiving pharmacological sedation should be carried out on an as required basis.
- Premature infants who have experienced prolonged periods of untreated pain and stress may become lethargic and "shut down" in response.
- Infants who are muscle relaxed cannot be evaluated behaviourally for pain and sedation.
- Medication doses should be reviewed regularly when paralysis is discontinued.
- Physiological changes such as heart rate and blood pressure may be the only indicator of a need for review of medication.

6. Neonatal Pain Agitation and Sedation Scale (N-PASS)

There are a plethora of neonatal pain assessment scales in the literature (Appendix_1). Each Neonatal Unit should select a validated pain assessment scale and become experienced in its use for pain measurement.

Within the West of Scotland MCN the **N-PASS (Neonatal Pain Agitation and Sedation Scale)** is recommended for use. The N-PASS is a validated pain assessment scale developed in North America for the assessment of pain (page 12) and sedation (page 13) in both term, preterm and surgical neonates utilising multidimensional indicators of neonatal pain. It is **crucial** that all staff using the N-PASS are trained in use of the scale in order to ensure appropriate pain assessment.

When using the N-PASS pain and sedation are scored SEPARATELY.

It is recommended that pain levels should be assessed using the N-PASS:

1. **On admission to the Neonatal Unit**
2. **Minimum of once per shift, frequency thereafter dependent on the baby.**
3. **At every vital sign assessment if receiving regular analgesia/sedation.**

More frequent pain assessment indications:

- Indwelling tubes or lines which may cause pain, especially with movement (e.g. chest tubes) → at least every 2-4 hours
- Receiving analgesics and/or sedatives → at least every 2-4 hours
- 30-60 minutes after an analgesic is given for pain behaviors to assess response to medication
- Post-operative → at least every 2 hours for 24-48 hours, then every 4 hours until off medications

N-PASS:
Neonatal Pain, Agitation, & Sedation Scale

Assessment Criteria	Normal	Pain / Agitation	
	0	1	2
Cry Irritability	Appropriate crying Not irritable	Irritable or crying at intervals Consolable	High-pitched or silent-continuous cry Inconsolable
Behaviour State	Appropriate for gestational age	Restless, squirming Awakens frequently	Arching, kicking Constantly awake or Arouses minimally / no movement (not sedated)
Facial Expression	Relaxed Appropriate	Any pain expression intermittent	Any pain expression continual
Extremities Tone	Relaxed hands and feet Normal tone	Intermittent clenched toes, fists or finger splay Body is not tense	Continual clenched toes, fists, or finger splay Body is tense
Vital Signs HR, RR , BP O2Sat	Within baseline or normal for gestational age	↑ 10-20% from baseline SaO_2 76-85% with stimulation – quick ↑	↑ > 20% from baseline $SaO_2 \leq 75\%$ with stimulation – slow ↑ Out of sync with vent

Premature Neonates: + 1 if <30 weeks gestation / corrected age

Assessment of Pain/Agitation

- Pain assessment is the fifth vital sign – assessment for pain should be included in every vital sign assessment
- Pain is scored from 0 → +2 for each behavioral and physiological criteria, then summed
  - Points are added to the premature infant's pain score based on their gestational age to compensate for their limited ability to behaviorally or physiologically communicate pain
  - Total pain score is documented as a positive number (0 → +10)
- Treatment/interventions are indicated for scores > 3
  - Interventions for known pain/painful stimuli are indicated before the score reaches 3
- The goal of pain treatment/intervention is a score ≤ 3
- More frequent pain assessment indications:
  - Indwelling tubes or lines which may cause pain, especially with movement (e.g. chest tubes) → at least every 2-4 hours
  - Receiving analgesics and/or sedatives → at least every 2-4 hours
  - 30-60 minutes after an analgesic is given for pain behaviors to assess response to medication

Post-operative → at least every 2 hours for 24-48 hours, then every 4 hours until off

Muscle Relaxed

- It is impossible to behaviorally evaluate a paralyzed infant for pain
- Increases in heart rate and blood pressure may be the only indicator of a need for more analgesia
- Analgesics should be administered continuously by drip or around-the-clock dosing
- Higher, more frequent doses may be required if the infant is post-op, has a chest tube, or other pathology (such as NEC) that would normally cause pain.

N-PASS:
Neonatal Pain, Agitation, & Sedation Scale

Assessment Criteria	Sedation -2	 -1	Normal 0
Crying Irritability	No cry with painful stimuli	Moans or cries minimally with painful stimuli	Appropriate crying Not irritable
Behaviour State	No arousal to any stimuli No spontaneous movement	Arouses minimally to stimuli Little spontaneous movement	Appropriate for gestational age
Facial Expression	Mouth is lax No expression	Minimal expression with stimuli	Relaxed Appropriate
Extremities Tone	No grasp reflex Flaccid tone	Weak grasp reflex ↓ muscle tone	Relaxed hands and feet Normal tone
Vital Signs HR, RR, BP, SaO_2	No variability with stimuli Hypoventilation or apnea	< 10% variability from baseline with stimuli	Within baseline or normal for gestational age

Assessment of Sedation

- Sedation is scored in addition to pain for each behavioral and physiological criteria to assess the infant's response to stimuli
- Sedation **does not need to be assessed/scored with every pain assessment/score**
- Sedation is scored from 0 → -2 for each behavioral and physiological criteria, then summed and noted as a negative score (0 → -10)
    - A score of 0 is given if the infant's response to stimuli is normal for their gestational age
    - Desired levels of sedation vary according to the situation
        - "Deep sedation" → score of -10 to -5 as goal
        - "Light sedation" → score of -5 to -2 as goal
        - Deep sedation is not recommended unless an infant is receiving ventilatory support, related to the high potential for apnea and hypoventilation
    - A negative score without the administration of opioids/ sedatives may indicate:
    - The premature infant's response to prolonged or persistent pain/stress
    - Neurologic depression, sepsis, or other pathology

Muscle Relaxant

- It is impossible to behaviorally evaluate a muscle relaxed infant for pain
- Increases in heart rate and blood pressure may be the only indicator of a need for more analgesia
- Analgesics should be administered continuously by drip or around-the-clock dosing
- Higher, more frequent doses may be required if the infant is post-op, has a chest tube, or other pathology (such as NEC) that would normally cause pain
- Opioid doses should be increased by 10% every 3-5 days as tolerance will occur without
- symptoms of inadequate pain relief

The following information relays the assessment criteria used to score the N-PASS pain assessment scale.

N-PASS Assessment Criteria

Crying / Irritability

-2 → No response to painful stimuli, e.g.:
- No cry with needle sticks
- No reaction to ETT or nares suctioning
- No response to care giving

-1 → Moans, sighs, or cries (audible or silent) minimally to painful stimuli, e.g. needle sticks, ETT or nares suctioning, care giving

0 → Not irritable – appropriate crying
- Cries briefly with normal stimuli
- Easily consoled
- Normal for gestational age

+1 → Infant is irritable/crying at intervals – but can be consoled
- If intubated – intermittent silent cry

+2 → Any of the following:
- Cry is high-pitched
- Infant cries inconsolably
- If intubated – silent continuous cry

Behavior / State

-2 → Does not arouse or react to any stimuli:
- Eyes continually shut or open
- No spontaneous movement

-1 → Little spontaneous movement, arouses briefly and/or minimally to any stimuli:
- Opens eyes briefly
- Reacts to suctioning
- Withdraws to pain

0 → Behavior and state are gestational age appropriate

+1 → Any of the following:
- Restless, squirming
- Awakens frequently/easily with minimal or no stimuli

+2 → Any of the following:
- Kicking
- Arching
- Constantly awake
- No movement or minimal arousal with stimulation (inappropriate for gestational age or clinical situation, i.e. post-operative)

Facial Expression

-2 → Any of the following:
- Mouth is lax
- Drooling
- No facial expression at rest or with stimuli

-1 → Minimal facial expression with stimuli

0 → Face is relaxed at rest but not lax – normal expression with stimuli

+1 → Any pain face expression observed intermittently

+2 → Any pain face expression is continual

Extremities / Tone

-2 → Any of the following:
- No palmar or planter grasp can be elicited
- Flaccid tone

-1 → Any of the following:
- Weak palmar or planter grasp can be elicited
- Decreased tone

0 → Relaxed hands and feet – normal palmar or sole grasp elicited – appropriate tone for gestational age

+1 → Intermittent (<30 seconds duration) observation of toes and/or hands as clenched or fingers splayed
- Body is *not* tense

+2 → Any of the following:
- Frequent (≥30 seconds duration) observation of toes and/or hands as clenched, or fingers splayed
- Body is tense/stiff

Vital Signs: HR, BP, RR, & O_2 Saturations

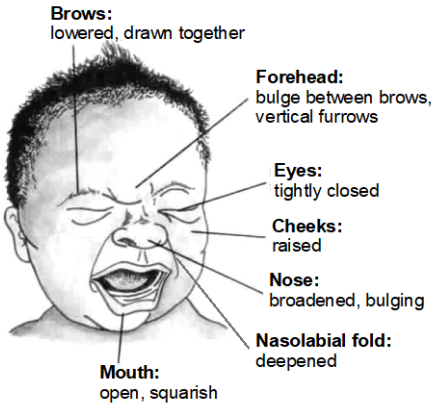
-2 → Any of the following:
- No variability in vital signs with stimuli
- Hypoventilation
- Apnea
- Ventilated infant – no spontaneous respiratory effort

-1 → Vital signs show little variability with stimuli – less than 10% from baseline

0 → Vital signs and/or oxygen saturations are within normal limits with normal variability – or normal for gestational age

+1 → Any of the following:
- HR, RR, and/or BP are 10-20% above baseline
- With care/stimuli infant desaturates minimally to moderately (SaO_2 76-85%) and recovers quickly (within 2 minutes)

+2 → Any of the following:
- HR, RR, and/or BP are > 20% above baseline
- With care/stimuli infant desaturates severely (SaO_2 < 75%) and recovers slowly (> 2 minutes)
- Infant is out of synchrony with the ventilator –fighting the ventilator



Facial expression of physical distress and pain in the infant

10. Management of Pain

1) The best approach to management of neonatal pain is prevention.

- Pain assessment should be ongoing and incorporated into the plan of care for all neonates with potential and actual pain experiences.
- Limit potentially painful procedures and administer appropriate analgesics when pain is anticipated or prior to procedures.

2) Non-pharmacological Interventions

- Breast milk, offer breast feed, swaddling, kangaroo care, facilitated touch, etc. may help alleviate pain and should be used, when appropriate, prior to and during painful procedures (such as blood sampling, PIV or PICC placements).
- Parental involvement has been demonstrated to reduce pain and should be allowed when all involved parties are comfortable.

3) Pharmacological Interventions- Oral and Topical

Oral Analgesics

- **Oral sucrose**

Expressed breast milk or oral sucrose may be used for procedural pain as per the MCN West of Scotland Neonatal Guideline. Oral sucrose is not to be used solely for irritability, or for chronic pain.

- **Oral Paracetamol**

May be used for management of pain in particular post-operative pain relief. Also may be used following vaccinations.

- **Oral Opiates**

Oral morphine may be given for procedural pain. Also may be used as a weaning programme when extended use of IV morphine has been necessary.

Topical or Local Anaesthetics

Local anaesthetics may be applied to the skin before clinical procedures. The cream should be applied to no more than three areas at the same time.

There are two types of local anaesthetic cream: Ametop Gel and EMLA cream.
EMLA cream is licenced for infants over one year of age and therefore **not** frequently used within neonatal units.

- **Ametop Gel**

Ametop Gel contains the anaesthetic tetracaine and is licenced for children **over one month** of age. It is applied 30 to 45 minutes before the procedure and wiped off before the procedure begins, it should not be left on the skin longer. The site remains numb for four to six hours. It increases the size of the blood vessels where it is applied and therefore can cause temporary redness.

Potential Side Effects of the Creams

There can be allergic reactions to the creams, causing itching, swelling or bruising where it is applied. Some changes in skin colour may occur where it is applied however this is normal.

Local anaesthetics should **NOT** be used on:

- wounds, broken skin or eczema
- the ears, nose , eyes, mouth or lips
- genitalia or anus

- **Lidocaine**

Lidocaine may be administered subcutaneously for procedures such as chest drain insertion. Given at least one to two minutes before the procedure.

IV Pharmacological Interventions:

1) Morphine

- Appropriate in neonates without hypotension
- Should usually be given on a PRN basis in preterm neonates
- May be given pre-emptively in older babies
- Complications include respiratory depression, hypotension, bladder distention/urinary retention, feeding intolerance
- Caution should be exercised in neonates <26 weeks gestational age or those with pre-existing hypotension

- **Opioids for Neonates Receiving Mechanical Ventilation**

Mechanical ventilation is potentially a painful intervention for the neonate. Opioids have historically been used within neonatal intensive care to ease any pain or discomfort experienced. However there is insufficient evidence to indorse the routine use of opioids for neonates requiring mechanical ventilation. It has been reported that opioids are no better or worse for ventilated babies (in terms of future development, duration on ventilation, death, strokes or hospital stay) than other drugs or placebo. It is recommended that opioids should be used selectively, when indicated and guided by clinical judgement and indicators of neonatal pain (Bellu et al 2010).

- **Weaning from Opioid Treatment**

It may be necessary to instigate a weaning programme for those neonates who have had an extended period of time on opioids (Appendix 2). This should be managed in conjunction with appropriate pain assessment.

2) Fentanyl

- May be used in younger neonates and those with hypotension
- Should usually be given on a PRN basis in preterm neonates
- Complications include respiratory depression, chest wall rigidity (especially if given too quickly), mild hypotension
- Used only in babies who are ventilated due to risk of chest wall rigidity.

3) Paracetamol

- May be considered for post-operative patients who are nil by mouth
- May be used in combination with opiates
- Caution in hepatic impairment or neonates with unconjugated hyperbilirubinaemia
- For appropriate dose range please refer to the West of Scotland Neonatal IV Drug Monographs.

4. Sedatives for Treatment of Stress/Anxiety

Benzodiazepines may be given for associated anxiety/stress but are **not appropriate** for the treatment or prevention of pain and not recommended for use in the preterm neonate.

5. Nurse Controlled Analgesia (NCA)

Nurse controlled analgesia (NCA) refers to a modified morphine infusion using technology which permits more flexibility to manage breakthrough pain than a simple continuous infusion. It is used in **limited clinical areas** in the West of Scotland generally in the **immediate post- operative period**. The nurse caring for the patient may press a button to give a bolus dose on the basis of a request for analgesia, pain severity scoring or in anticipation of pain.

Nurse Controlled Analgesia (NCA) is a technique of morphine administration appropriate for some neonates. NCA is delivered through a specifically designed locked pump which allows for programming of a bolus dose to be delivered by nursing staff on the press of the NCA button. Commonly the bolus is 10 – 20 micrograms/kg with a 20-30 minute lockout period. A low rate of background infusion may also be used alongside the bolus, and is set from 4micrograms/kg/hr upwards.

Although this technique potentially allows for larger doses of opiates to be administered, experience shows that the same level of background pain relief is achieved with much reduced total opiate dose. This is because of the dynamic nature of the administration which allows for doses to be given exactly at the moment the patient is experiencing pain or to pre-empt painful/ distressing procedures such as endotracheal suction.

At its most effective, when used in tandem with regular pain scoring NCA will tend to wean itself. For example, as the patient recovers from the pain of surgery their pain scores will improve and the NCA will require fewer presses. Reduction in total opiate load has the potential advantages of reduced respiratory support and more rapid return of GI function post-surgery.

Patient Selection

Patients selected for NCA usually have (or are expected to have) severe acute pain for whom the oral route is not appropriate, such as during the immediate post-operative period. Prior to setting up the infusion the anaesthetist or acute pain service staff will consider the suitability of NCA for each individual patient and the anticipated effectiveness of NCA for the type of surgery / pain.

Absolute contraindications to NCA are:

- Known allergy to opioids (very rare)

Extra caution is advised when using a NCA in patients with certain medical conditions:

- Raised intra-cranial pressure (ICP): Known or suspected raised ICP of any cause represents a relative contraindication to NCA analgesia, although in appropriate circumstances its use in areas with high nurse/patient ratios may still be fitting.
- Severe respiratory disease: NCA should be used with caution in these Patients
- Children with renal impairment or sensitivity to morphine
- No supplementary opioids should be administered while the patient is receiving NCA
- NCA pumps for children must only be programmed by an anaesthetist, member of the Acute Pain Service or appropriately trained health professional.
- All personnel who care for patients receiving NCA must be trained and competent to do so.
- All pumps should be kept locked while in use and a dedicated line should be used. The anti-siphon line should be connected directly to the patients intravenous access or through a 2 way non-return connector
- Parents should be advised in a sensitive manner that they are not permitted to administer a bolus by pressing the button
- Nursing staff should carry out appropriate pain assessment using local pain assessment tool and document hourly.

6. Neonatal Regional Techniques

Neonates can present a unique challenge in the management of post-operative pain. Regional techniques are being increasingly used to minimize post-operative pain.

- **Epidura**l

The most commonly used technique is a single dose administration of local anaesthetic agent into the caudal (epidural) space for operations such as inguinal hernia repair. This provides adequate pain relief during the surgery itself, and for up to four hours afterwards.

Another commonly used regional technique involves placement of an epidural catheter in the epidural space in theatre for prolonged pain management. The epidural catheter may have been inserted into the caudal space and advanced to a level in the back that corresponds to the level of surgical incision, or may have been inserted higher up the back at this level. For surgery, where significant pain may be a predicted problem post-operatively, for example laparotomy, a local anaesthetic infusion pump is attached to the catheter to provide ongoing pain relief. Strict monitoring of the patient and pump infusion rates is in accordance with local Acute Pain Team guidelines and protocols. Epidural infusions would normally run for 2 to 3 days post operatively. Observed benefits from this technique are potentially earlier extubation, early return of bowel function, and a reduction in morphine requirement.

More recently single shot spinal anaesthesia, combined with a single shot caudal injection in ex-premature neonates is being performed for surgery below the umbilicus. This is perceived to be beneficial in reducing the risk of post-operative apnoea's in this group of patients by avoiding the need for general anaesthesia, and can result in earlier return to feeding. This technique will result in the neonate not being able to move their legs for about an hour after the local anaesthetic injection. Movement of their legs should be observed to return to normal after this time period.

- **Extrapleural Catheters**

Extrapleural catheters are placed by the surgeons in neonates undergoing cardiac or thoracic surgery. Local anaesthetic infusion pumps will be used in a similar way to epidural pumps to provide ongoing pain relief.

Appendix 1

Neonatal Pain Assessment Scales

Pain Measure	Age	Pain	Indicator	Psychometric Properties
Pain Assessment Tool (PAT) (Hodgkinson et al. 1994)	< 3 years of age unable to verbalise pain	Prolonged (post-operative)	Sleep pattern Posture/tone Colour Expression Respirations Cry Oxygen Saturation Heart Rate Blood Pressure Nurse perception	Content validity Convergent validity (r=0.38) Concurrent validity (r=0.76) Interrater reliability (r=0.85)
Neonatal Pain Agitation and Sedation Scale (N-PASS) (Hummel et al. 2003)	<28 weeks - Term Corrected for prematurity	Prolonged Mechanical ventilation or postoperative	Behavioural state Crying/irritability Facial expression Extremities/tone Vital signs	Preliminary reliability and validity in progress.
Neonatal Infant Pain Scale (NIPS) (Lawrence et al 1993)	Preterm and term	Procedural	Cry Facial expression Breathing patterns Leg movement Arm movement State of arousal	Content validity Concurrent validity (r=0.53-0.83) Interrater reliability (r=0.92-0.97) Internal consistency (0.87-0.95)
Premature Infant Pain Profile (PIPP) Stevens et al. 1996)	Preterm and term	Procedural	Behavioural state Gestational age Heart rate Oxygen saturation Eye squeeze Brow bulge Nasolabial furrow	Content validity Construct validity Interrater reliability (ICC = 0.93-0.96) Intrarater reliability (ICC 0.94-0.98) Internal consistency (alpha = 0.59-0.76)

Appendix_2

SWITCHING FROM IV TO ORAL SEDATION

IV Morphine → oral morphine

1. Calculate the total daily IV morphine dose in micrograms
   I.e. Current dose in microgram/kg/hr X *working weight* X *24*
2. Multiply this figure by 2 (for bioavailability) to give total daily oral dose
3. Divide this into six equal doses and prescribe 4 hourly in micrograms
4. Stop the IV infusion after the second oral dose

Weaning oral morphine

- Wean by 20% of the **original dose** every 24 hours as tolerated
- If not tolerated, step back to previous dose and reattempt the wean 48hours later
- Once 70% of the dose is weaned, begin extending the dosing interval
- Switch to PRN, max 12 hourly, once ready to wean from twice daily

Selected References

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Implementation / Review Dates

Implementation Date 05/09/18 Latest review 22/12/21 Review Date 01/12/24