Champlain Maternal Newborn Regional Program
Programme régional des soins à la mère et au nouveau-né de Champlain

NEWBORN PAIN MANAGEMENT: A PRACTICAL APPROACH

Self–Learning Module

Developed by the Ottawa Neonatal Pain Interest Group

2015

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Disclaimer:

This self-learning module is intended for health care providers caring for term and preterm newborns and must be used in conjunction with institutional policies and procedures.

Goal

The goal of this booklet is to provide bedside health professionals practical information about identification, prevention and management of pain in the newborn. The guidelines provided were adapted from previous work and publications by national and international neonatal pain interest and advocacy groups from Canada (Canadian Paediatric Society Fetus and Newborn committee), the United States (American Academy of Pediatrics), Australia (Royal Australian College of Physicians), Italy (Pain Study Group of the Italian Society of Neonatology), Great Britain, Ireland (Association of Paediatric Anaesthetists)(1-4) and other international organizations and groups (Evidence Based Group for Neonatal Pain).

Introduction

Newborns, both term and preterm, experience pain and have the right to receive safe, efficient and effective pain relief (5). Compared with the adult, the newborn displays a hypersensitivity to sensory stimuli and as such, is more prone to pain and its consequences. Newborns cannot verbalize their pain and thus depend on others to recognize, assess and manage their pain.

In 1987, authors Anand and Hickey described the potential mechanisms by which neonates could perceive pain and clearly dispelled the long-held medical myth that neonates were unable to experience pain (6). Since then, extensive studies conducted worldwide have documented the newborn's physiological, behavioural, and biochemical responses to painful procedures (7,8).

All newborns undergo at least one painful procedure during their first few days of life (newborn screening and sometimes heel lancing for bilirubin). An infant admitted in the Neonatal Intensive Care Unit (NICU) or Special Care Nursery (SCN) undergoes an average of 14 painful procedures a day (9).The impact of pain and distress may have short (physiological

and behavioural) and long-term consequences (increased or decreased behavioural responses to pain) (10). Yet, pain in neonates has been under-recognized, under- treated and frequently not evaluated or reassessed (9). Despite the vast body of literature supporting the recommendations for assessment and management of neonatal pain, practice remains inadequate and inconsistent.

Pain in neonates, particularly those admitted to a special-care or intensive care unit, can be divided into two types:

1. **Acute procedural pain:** the result of a specific painful procedure or event; it is self-limited.
2. **Chronic or persistent pain:** a state that persists after tissue healing, usually beyond three (3) months (10).

FACTS: Prevention and Management of Pain in Neonates

1. Neural pathways are sufficiently developed to allow transmission of painful stimuli in both very preterm and term neonates.
2. Pain in neonates is often unrecognized and undertreated. Neonates do feel pain, and it should be addressed during medical care.
3. If a procedure is painful in adults, it should be considered painful in neonates, even if they are preterm.
4. Compared with older age groups, neonates may experience a greater sensitivity to pain and are more susceptible to the long-term effects of painful stimulation.
5. Adequate treatment of pain may be associated with decreased clinical complications and decreased mortality.
6. The appropriate use of environmental, behavioural and pharmacological interventions can prevent, reduce or eliminate neonatal pain in many clinical situations.
7. Sedation does not provide pain relief and may mask the neonate's response to pain.
8. A lack of behavioural responses (such as crying and movement) does not necessarily indicate a lack of pain.
9. In keeping with family-centered care principles, health care providers need to engage the mother/parents in the decision-making process regarding pain management options. This may include the scheduling of non-urgent interventions around a time that allows parents to participate in providing pain-reducing measures (e.g. breastfeeding and skin-to-skin care) appropriate for the interventions.

10. Health care professionals have the responsibility to assess, prevent and manage pain in neonates. Severity of pain and the effects of analgesia in the neonate should be assessed and re-assessed.
11. Clinical units providing health care to neonates should implement written guidelines and protocols for the management of neonatal pain.
12. The care environment should be as conducive as possible to the well-being of the newborn and family:
    - Avoiding unnecessary noxious stimuli (acoustic, visual, tactile, vestibular).
    - Minimizing painful or stressful procedures (placement of peripheral, central or arterial lines to reduce repeated I.V. punctures).
    - Non-invasive measurements where possible (e.g. oximeter, end-tidal or transcutaneous $C0_2$ monitoring).
13. Pharmacological therapy is indicated for some procedures and can be used safely.

Common Painful Procedures

Therapeutic	Diagnostic	Surgical
Adhesive tape or suture removal	Arterial puncture or peripheral arterial line	Surgical procedures, e.g. peritoneal drain, cut-down
Bladder catheterization	Eye examination	
Central line insertion/removal	Heel lancing	
Chest tube insertion/removal	Lumbar puncture	
Chest physiotherapy / Postural drainage	Suprapubic bladder tap or bladder catheterization	
Dressing change	Venipuncture	
Gavage tube insertion		
Intramuscular injection		
Mechanical ventilation		
Peripheral venous catheterization		
PICC line insertion		
Tracheal intubation/extubation		

Neonatal Pain Assessment

Facial expressions are the most specific and sensitive indicators of pain, and are included in the majority of neonatal pain assessment scales. The following scales have undergone psychometric evaluation and have shown to be valid, reliable and feasible measures of neonatal pain.

For acute pain (procedural, post-operative):

- Premature Infant Pain Profile (PIPP) (11)
- Neonatal Infant Pain Scale (NIPS) (12)
- Douleur Aigüe du Nouveau-Né (DAN) (13)
- Crying, Requires oxygen, Increased vital signs, Expression, Sleepless (CRIES) (14)
- Neonatal Pain, Agitation and Sedation Score (N-PASS) (15)
- Pain Assessment Tool (PAT) (16)

For chronic pain:

- Neonatal Pain, Agitation and Sedation Score (N-PASS) (15)
- Échelle Douleur Inconfort Nouveau-Né (EDIN) (17)

Health care providers should refer to institutional guidelines. Each institution should select a tool, provide education to its staff and ensure pain is measured consistently, managed optimally and documented appropriately. Discussion about pain assessment scores should be included in rounds and bedside handovers to inform decisions about newborn pain management.

PAIN IS THE 5TH VITAL SIGN!

Non-Pharmacological Approaches to Pain Management

Non-pharmacological strategies - also referred to as physical and psychological strategies - should be used to reduce acute procedural pain and provide comfort. Such strategies are practical and can be easily integrated into care. Most non-pharmacological strategies, used in isolation, do not completely alleviate the effects of the procedural pain, but can be effectively used in conjunction with pharmacological or other non-pharmacological strategies to optimize comfort and minimize distress (18).

Breastfeeding

Whenever possible, breastfeeding medically stable newborns during heel lancing, IM injections or venipuncture, effectively reduces pain (19). However, simply feeding the newborn small volumes of breast milk is ineffective. Supporting mothers to breastfeed during painful procedures requires scheduling of non-urgent procedures in partnership with mothers. For breastfeeding to be effective as a pain management strategy, the infant must achieve an effective latch, with sustained sucking and swallowing for at least 5 minutes prior to the procedure (18, 19). Other important considerations include ensuring the clinicians performing the procedures are comfortable and ergonomically seated at the level of the infant (20).

Skin-to-skin care /Kangaroo Care

Skin-to-skin care (SSC) diminishes pain responses in term and preterm neonates and supports their recovery following completion of painful procedures (21). Most studies evaluate the efficacy of mothers providing SSC, however fathers should also be supported to participate in their infant's pain management. SSC should be maintained for 10-15 minutes prior to the painful procedure to ensure that the parent and the infant are fully relaxed and settled (18, 21). Similar to that of breastfeeding, facilitating SSC for neonates when feasible during non-urgent procedures requires scheduling of non-urgent procedures in partnership with parents

and ensuring the clinicians performing the procedures are comfortable and ergonomically seated at the level of the infant (20).

Music

There is insufficient evidence to support music as a pain reduction strategy in newborns (22;23); however, it may be used to support developmental care. The music should be carefully chosen and its use time limited (~15 minutes per intervention) to prevent the risk of sensory overload.

Non-nutritive sucking (NNS)

NNS supports regulation of preterm and newborn infants and reduces acute procedural pain compared to no treatment (24). NNS in combination with sucrose is more efficacious for reducing procedural pain than when used in isolation (25).

Swaddling/Facilitated Tucking

Evidence supports the use of swaddling/facilitated tucking in preterm infants as a strategy to reduce procedural pain although there is limited evidence of its effectiveness in term newborn infants (24).

Multisensory stimulation

This is also called sensorial saturation. It consists of making eye contact with the infant, massaging the face and back, speaking to the infant gently but firmly, giving oral sucrose, and letting the infant smell the parental natural scent. The idea is to distract the infant from the pain, causing competition between painful and non-painful stimuli (26). Care must be taken not to overstimulate the infant.

The choice of appropriate non-pharmacological approaches will depend on the neonate's condition, ability to suck, maternal/parental presence and availability of other pain relief methods.

Oral Sucrose 24%

Oral sucrose has been shown in large numbers of trials to effectively decrease procedural pain in neonates (25). Sufficient evidence of analgesia also exists for up to one year of age (27). Although the ideal dose is unclear, studies have demonstrated efficacy in doses of 0.1ml to 2.0 ml (25).

Sucrose may be considered for infants meeting the criteria below prior to potentially painful procedures. **For some procedures, sucrose should ideally be used as an *adjunct* in combination with other non- pharmacological and pharmacological approaches in order to give an additive or synergistic effect.** The effect of oral sucrose is potentiated by simultaneously allowing the infant to suck. Generally, small volume doses are required. To ensure a sustained effect, sucrose may be given in small aliquots over the duration of the procedure.

The following recommendations reflect the current policies at The Ottawa Hospital and at the Children's Hospital of Eastern Ontario.

INDICATIONS

Infants who meet the following inclusion criteria are candidates for sucrose:

- Suck and/or swallow reflex present
- Infants greater than or equal to 27 weeks corrected gestation, receiving any amount of oral/enteral feeds
- Infants less than 27 weeks corrected gestation and receiving at least trophic feeds
- Sucrose may be considered in infants who are more than 27 weeks corrected gestational age, NPO and clinically stable

Sucrose should NOT be used in the following infants:

- Known fructose or sucrose intolerance (Fructose1, 6, bisphophatase deficiency, Glycogen Storage Disease Type 1, Hereditary Fructose Intolerance)
- Confirmed Necrotizing Enterocolitis (NEC)
- Unconscious, heavily sedated, those with an absent gag reflex and those who are unable to respond to handling
- Encephalopathic or significantly depressed at birth until neurological recovery
- Pharmaceutically paralyzed (this group should receive IV analgesia)

Sucrose should be used with CAUTION in the following circumstances:

- Intubated infants
- Infants less than 27 weeks corrected gestational age
- Infants with cardiac instability

DOSAGE

Corrected gestational age	Sucrose Dose (mL)	Daily Maximum (mL)
< 28 weeks	0.1 mL	1.2 mL
28 – 31^{6} weeks	0.3 mL	3.6 mL
32 – 35^{6} weeks	0.5 mL	5 mL
$\geq$ 36 weeks	0.5 - 1 mL	6 mL

> 27 weeks NPO, clinically stable:	**Refer to dosing as per gestational age above**	**Maximum as per appropriate gestational age above**

Note: This is only a guide and not based on hard evidence. Please refer to your institutional policies and procedures.

METHOD OF ADMINISTRATION

- By syringe or commercially prepared unidose vials. To be effective sucrose is placed on the anterior tip of the tongue and combined with non-nutritive sucking. Sucking seems to augment the pain relieving effects of each individual intervention (28).
- For best effects, the sucrose dose is provided 1-2 minutes prior to a painful event. To ensure a sustained effect, sucrose may be given in small aliquots throughout the procedure as required.

Management of Specific Painful Neonatal Procedures

Environmental, behavioural and non-pharmacological comfort measures are suggested as a first-line approach for minor procedures. Breastfeeding and skin-to-skin care ("kangaroo care") effectively reduce procedural pain (22) and should be facilitated when appropriate and feasible. The combination of measures (i.e. oral sucrose 24% and non-nutritive sucking) can have additive effects.

For planned painful procedures, do not start the procedure until an optimal baseline state of quiet wakefulness is attained (e.g. **do not interrupt sleep** to perform an invasive procedure, plan the procedure far from mealtimes, etc.). Ideally, a team of two people should perform the procedure and provide effective pain management strategies.

Bladder catheterization or suprapubic tap

- Use non-pharmacological interventions (non-nutritive sucking, holding/swaddling)
- Consider oral sucrose 24%

Chest tube insertion

- Use non-pharmacological interventions (e.g. non-nutritive sucking)
- Consider use of oral sucrose 24%
- Consider subcutaneous infiltration of a local anesthetic (such as buffered Lidocaine or Lidocaine 0.5%; higher concentrations may give sensation of burning). Warming the

Lidocaine by keeping the vial in your hands for a few minutes can decrease this burning sensation. (29)

- For infants who are ventilated, provide an opioid dose (such as Fentanyl 1-2 mcg/kg, 2-4 minutes prior) IV bolus prior to the procedure.
- For non-ventilated infants, provide a low dose opioid (such as Fentanyl 0.5-1 mcg/kg, 2-4 minutes prior) IV bolus prior to the procedure.
- An alternative for ventilated and non-ventilated infants is Ketamine 0.5-2 mg/kg prior to the procedure. Ketamine does not lead to respiratory depression (30).

Chest tube removal

Studies agree that chest tube removal causes significant pain (31). No single analgesic strategy has been shown to satisfactorily alleviate this pain and it is likely that the optimum effects will be achieved using a combination of two or more strategies:

- Non-nutritive sucking
- Oral sucrose 24%
- Fentanyl (for infants who are ventilated, 1-2 mcg/kg IV; for non-ventilated infants, 0.5-1 mcg/kg IV 2-4 minutes prior to the procedure) or Ketamine 0.5-2 mg/kg just prior to the procedure

Circumcision

Several approaches have been shown effective in preventing the pain associated with a circumcision:

- Subcutaneous ring block
- Dorsal penile nerve block
- Application of EMLA cream, 1 g to the distal half of the penis 60-90 minutes before the procedure and wrapped in occlusive dressing (32)

Subcutaneous ring block is more effective than other methods (11).

Oral sucrose 24% +/- non-nutritive sucking may be provided for additional pain relief.

After the procedure, oral acetaminophen should be considered for 24-48 hours (10 mg/kg every 4h or 15 mg/kg every 6h).

Endotracheal Intubation

Many variations of premedication combinations exist. A combination of atropine, an analgesic/opioid and a muscle relaxant appears most effective (33). As a general rule that is internationally accepted, tracheal intubation without analgesia and sedation should be reserved only for neonatal resuscitation in the delivery room or for other rare conditions in which the infant does not have venous access and when his or her life is in danger.

Based on evidence, we suggest (34):

- Fentanyl 2-4 mcg/kg
- Atropine 0.02 mg/kg IV
- Succinylcholine 1-2 mg/kg IV

Administer the fentanyl first, slowly (over 2-5 min), then, when ready to intubate, atropine and succinylcholine as a bolus.

Endotracheal suction

- Use non-pharmacological interventions (non-nutritive sucking, holding/swaddling)
- Consider oral sucrose 24%
- Consider opioid dose (such as Fentanyl 1-2 mcg/kg, IV bolus 2-4 minutes prior to procedure

Eye examination for retinopathy of prematurity

The best pain reduction measures are unclear for this procedure. A systematic review of the literature (35) supports the following as best, yet incomplete measures to reduce pain during the eye exam:

- Use non-pharmacological interventions (non-nutritive sucking, holding/swaddling)
- Oral sucrose 24%
- Anesthetic eye drops (ex. Proparacaine HCl 0.5% or Tetracaine) - 1 drop repeated as needed during the exam

Heel Lancing

- Use non-pharmacological interventions:
    - Breastfeeding (ideal) or non-nutritive sucking
    - Skin-to-skin care (ideal) or holding/swaddling
    - Multisensory stimulation
- Consider use of oral sucrose 24%
- Topical analgesics are not effective on the heel of a neonate
- For large samples (>1.5ml of blood), consider the use of venipuncture rather than drawing from the heel. Venipuncture, when performed by a skilled professional, may be less painful (36)
- Warming the heel may lead to more successful bloodletting and lead to more reliable results for capillary blood gases (results closer to arterial values) (37;38). Warming the heel may also reduce pain during the heel lance (39)
- Use an automated lancet, preferably retractable

This approach may not apply to the care of extremely preterm infants.

Intramuscular injections

- Use non-pharmacological interventions:
    - Breastfeeding (ideal) or non-nutritive sucking
    - Skin-to-skin care (ideal) or holding/swaddling
    - Multisensory stimulation
- Consider use of oral sucrose 24%.
- For older infants, consider the application of topical anesthetics*: *EMLA cream* (0.5–1 g) 60–90 min prior to injection or *Ametop gel* (1.0g) 30-45 minutes prior to injection. After application, cover the application site with a clear occlusive dressing until the beginning of the procedure.

- Avoid subcutaneous and intramuscular injections; give medications intravenously whenever possible.

  NOTE: The intramuscular route is the preferred route of administration for Vitamin K. Vitamin K should be given as recommended after birth (40). The birth process produces high levels of endogenous endorphins for several hours after birth and most centres would not use oral sucrose or EMLA in this setting.

EMLA cream* *is only approved for infants ≥ 37 weeks gestation.* ***Ametop gel* *is approved for infants ≥ 1 month although there is experimental data suggesting no harm in younger infants (42, 43).*

Lumbar Puncture

- Use non-pharmacological interventions: non-nutritive sucking, holding the infant during the procedure
- Give oral sucrose 24% in small aliquots during the procedure
- Consider applying *EMLA* (60-90 minutes prior to the procedure) or *Ametop* (30-45 minutes prior to the procedure) to the proposed site.
- Consider subcutaneous infiltration of a local anesthetic (such as buffered Lidocaine or Lidocaine 0.5%).
- If patient is ventilated, consider a dose of Fentanyl 1-2 mcg/kg IV prior to procedure.
- For non-ventilated infants, consider using a low dose opioid (such as Fentanyl 0.5-1 mcg/kg, 2-4 minutes prior) IV bolus prior to the procedure.

Nasogastric/orogastric tube insertion

- Use non-pharmacological interventions: non-nutritive sucking, skin-to-skin care or holding/swaddling, multisensory stimulation
- Give oral sucrose 24%.
- Use appropriate lubrication, ensure the head is in the neutral or sniffing position and insert the tube in a vertical direction at right angles to the face.

Peripherally Inserted Central Catheter (PICC), peripheral arterial line, venous cut down

- Use non-pharmacological interventions: non-nutritive sucking, swaddling, multisensory stimulation
- Consider oral sucrose 24%
- For infants who are ventilated, provide an opioid dose (such as Fentanyl 1-2 mcg/kg, 2-4 minutes prior) IV bolus prior to the procedure.
- For non-ventilated infants, provide a low dose opioid (such as Fentanyl 0.5-1 mcg/kg, 2-4 minutes prior) IV bolus prior to the procedure.
- Consider subcutaneous infiltration of a local anesthetic (such as buffered Lidocaine or Lidocaine 0.5%; higher concentrations may give sensation of burning).

Venipuncture (for bloodwork or IV access) or arterial punctures

- Use non-pharmacological interventions:
    - Breastfeeding (ideal) or non-nutritive sucking
    - Skin-to-skin care (ideal) or holding/swaddling
    - Multisensory stimulation
- Consider oral sucrose 24%
- Consider applying *EMLA* (0.5 – 1 g) 60-90 min or *Ametop* (1 g) 30-45 min prior to procedure, as they have been shown effective to reduce the pain of a venipuncture or arterial puncture.
- For infants who are ventilated, consider using a bolus dose of opioid (such as Fentanyl 1-2 mcg/kg, 2-4 minutes prior) prior to the procedure (41).

Note:

Regardless of the acute procedure, pain relief provided at the time of the procedure wears off; therefore **pain must be reassessed and re-addressed as required.**

Neonatal Pain Management - Desktop Reference Guide

Procedure	Suggested means of pain reduction
Bladder catheterization or suprapubic tap	• Non-nutritive sucking • Holding and swaddling • Oral sucrose 24% 1-2 minutes before, and throughout procedure
Chest tube insertion	• Non-nutritive sucking • Oral sucrose 24% • +/- Subcutaneous Lidocaine (0.5% and/ or buffered) • Fentanyl (if ventilated: 1-2 mcg/kg; if not ventilated: 0.5 – 1 mcg /kg) or Ketamine (0.5-2 mg/kg IV)
Chest tube removal	• ≥2 of the following: • Non-nutritive sucking • Oral sucrose 24% • Fentanyl (if ventilated: 1-2 mcg/kg; if not ventilated: 0.5 – 1 mcg /kg) or Ketamine (0.5-2 mg/kg)
Circumcision	• Subcutaneous ring block or dorsal penile nerve block • EMLA 1g 60-90 min prior. • Oral sucrose 24% 1-2 minutes before, and throughout procedure.
Endotracheal intubation	In sequence: 1. Fentanyl 2-4 mcg/kg over 2-5 minutes 2. Atropine 0.02 mg/kg 3. Succinylcholine 1-2 mg/kg
Endotracheal suction	• Swaddling • Oral sucrose 24% • Fentanyl (1-2 mcg/kg IV) or Ketamine 0.5-1 mg/kg
Eye examination for ROP	• Non-nutritive sucking • Holding and swaddling • Oral sucrose 24% 1-2 minutes before, and throughout procedure • Proparacaine HCl 0.5% or Tetracaine, 1 drop repeated as needed during the exam
Heel lancing	• Breastfeeding (or non-nutritive sucking if breastfeeding not possible) • Skin-to-skin care (ideal) or holding and swaddling • Multisensory stimulation • Oral sucrose 24%
I.M. injections ***Not for routine Vitamin K**	• Breastfeeding (or non-nutritive sucking if breastfeeding not possible) • Skin-to-skin care (ideal) or holding and swaddling • Multisensory stimulation • Oral sucrose 24% * +/- EMLA (≥ 37w) (0.5-1 g, 60-90 min prior) or Ametop (≥ 1 month) (1 g 30-45 min prior)

Lumbar puncture	• Non-nutritive sucking • Oral sucrose 24% • +/- EMLA (≥ 37w) (0.5-1 g, 60-90 min prior) or Ametop (≥ 1 month) (1 g 30-45 min prior) • +/- Subcutaneous Lidocaine(0.5% and/ or buffered) • +/- Fentanyl (if ventilated: 1-2 mcg/kg; if not ventilated: 0.5 – 1 mcg /kg)
NG/OG tube insertion	• Non-nutritive sucking • Skin-to-skin care (ideal) or holding and swaddling • Multisensory stimulation • Oral sucrose 24%
PICC, peripheral arterial line or venous cut down	• Non-nutritive sucking • Oral sucrose 24% • Swaddling • Multisensory stimulation • Fentanyl (if ventilated: 1-2 mcg/kg; if not ventilated: 0.5 – 1 mcg /kg) • +/- Subcutaneous Lidocaine(0.5% and/ or buffered)
Venipuncture or arterial puncture IV insertion/removal	Breastfeeding or non-nutritive sucking Skin-to-skin care Multisensory stimulation Oral sucrose 24% Swaddling +/- EMLA (≥ 37w) (0.5-1 g, 60-90 min prior) or Ametop (≥ 1 month) (1 g 30-45 min prior) +/- Fentanyl if ventilated

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